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THE

NATIONAL DISPENSATORY.

CONTAINING THE

NATURAL HISTORY, CHEMISTRY, PHARMACY,
ACTIONS AND USES OF MEDICINES,

INCLUDING THOSE RECOGNIZED IN THE

PHARMACOPŒIAS OF THE UNITED STATES AND GREAT
BRITAIN.

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WITH ILLUSTRATIONS.

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PREFACE.

In the rapid progress of modern research, few subjects have of late years received greater accessions of facts than the group of sciences connected with materia medica and therapeutics. The new resources thus placed at the command of the pharmaceutist and physician have seemed to the authors to justify an attempt to make, from the advanced stand-point of the present day, a concise but complete statement of all that is of practical importance to both professions—a digest in which that which is old and that which is new shall be so brought together as to give to the reader, within the most moderate practicable compass, all the details in pharmacology, pharmacy, and therapeutics which he is likely to need in his daily avocations. In the almost infinite accumulation of material, this has required a careful and conscientious sifting to discard that which is obsolete, untrustworthy, or comparatively trivial, without impairing the practical completeness of the work. That they have wholly accomplished their object the authors do not venture to claim; but they can say that years of constant labor have been devoted to the task of producing a work to which the inquirer may refer with the certainty of finding everything which experience has stored up as worthy of confidence in the subjects embraced within its scope.

To this end there have been included all crude drugs and chemical and pharmaceutical preparations officinal in the Pharmacopœias of the United States and Great Britain, together with the more important medicines of the French Codex and German Pharmacopœia, which are to some extent prescribed here or which may serve for comparison with similar articles in the English and American standards. Besides these, a large number of drugs which are not recognized by any Pharmacopœia are often kept in the shops because they are prescribed by physicians or used in domestic practice. Some of these give promise of future importance, and in making a selection among this class of remedies it was deemed best not to err on the side of exclusiveness. Not only have many of them been admitted as separate articles, but a large number have found place as *allied drugs* under the heading of more important substances. To these allied drugs reference can readily be made by means of the Index.

The alphabetical order of arrangement has been adopted throughout, as being on the whole the most convenient for reference. In this the non-officinal medicines have been included with the officinal, the latter being distinguished by an affix showing the Pharmacopœia to which they have been admitted. The title of each article is followed by a full synonymy, English, French, and German, together with Latin appellatives and popular names, such as are occasionally used in prescriptions and standard works, or through which articles may be recognized. As all substances thus have their appropriate place in the body of the work, but little is left for the Appendix, in which may be found the leading reagents, tables of weights and measures, comparisons of the scales of different hydrometers, alcoholometers, and thermometers, etc.

In the treatment of the separate articles, detailed botanical descriptions have generally been omitted as being of no practical value, but plants yielding drugs have been briefly characterized as to their general aspect and habitat, while fuller descriptions have been given of those which are native or naturalized, or which seemed to require it from the nature of their product. The treatment which drugs undergo before they reach the hands of the pharmacist also receives attention, because the physical appearance and chemical composition are sometimes influenced thereby. Especial care has been bestowed upon both the external and the structural characteristics of drugs, so that they may be readily identified and distinguished from those which resemble them, and, in aid of this object, a limited number of illustrations has been introduced representing their outward forms as well as their histological appearances revealed by the microscope. Their proximate constituents, when of practical interest, have received special attention, and the effort has been made to decide between the conflicting statements of which these have been the subject. Chemical formulas have been expressed in the new notation, together with the molecular weights of the principal chemicals. Whenever products can be advantageously prepared by the pharmacist, one or more processes have been given and explained as fully as seemed necessary. Attention has been drawn to adulterations and impurities, and the means for detecting them have been pointed out. The officinal processes for pharmaceutical preparations have in most instances been detailed in the language of the Pharmacopœia, followed, when requisite, by explanatory and critical remarks, and practical observations for the guidance of the operator.

With regard to Pharmacodynamics, there is presented, for the first time in a Dispensatory, a succinct account of the physiological action of medicines. The results of experiments are stated as clearly as possible, and occasionally in the theoretical language of the day; but, as a rule, terms have been employed whose meaning is not likely to become obsolete or unintelligible. Whenever it seemed possible an attempt to apply the results of physiological experiments to therapeutical uses has been made; for although the two fields of inquiry may not be so organically connected as to render the former a guide to the latter, it is, nevertheless, true that a scientific explanation of the curative powers of medicines must be sought in the results of their experimental operation upon the animal functions.

In treating of Therapeutics, the most trustworthy results of clinical experience are concisely set forth, without discussing the grounds on which they rest. This method has proved laborious, and has often required a prolonged judicial examination to arrive at a conclusion expressed in a few lines. Its object has been to spare the reader the labor of a personal investigation, which could only be made with facilities which comparatively few possess.

Another feature, novel in a Dispensatory, is the Therapeutical Index. Care has been taken to render it as complete as possible, in order that the inquirer may be enabled to learn by its means all of the more important medicines that have been employed in the treatment of each disease. Such an Index thus becomes to some extent a therapeutical classification of medicines, and it is believed must greatly enhance by its suggestiveness the working value of the book to the practitioner.

On mature consideration it was deemed best not to encumber the text with references to authorities, save in exceptional cases, such as those in which the opinions cited must be estimated by the credit attaching to their originators. Frequently, in the pharmaceutical portion, the year is stated in which the observation or discovery was made, which may serve as a guide to those desiring to undertake further research. For the more recent investigations, the Reports on the Progress of Pharmacy contained in the annual "Proceedings of the American Pharmaceutical Association" and the "Year-Book of Pharmacy" of the British Pharmaceutical Conference afford sufficient opportunities for ascertaining the original sources and consulting abstracts of original papers.

The statistics of importation have been taken from the Reports of the New York Chamber of Commerce, for which they were prepared by Mr. D. C. Robbins, based upon the Tables of the Bureau of Statistics at Washington.

PHILADELPHIA, February, 1879.

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ABSINTHIUM, *U. S.*—WORMWOOD.

Herba s. Summitates absinthii.—Absinthe commune, Grande absinthe, Armoise amère, Fr.; *Wermuth*, G.

The tops and leaves of Artemisia absinthium, *Lin.;* s. Absinthium vulgare, *Lam.* Woodville, Med. Bot. 22; Bentley and Trimen, Med. Plants, 156.

Nat. Ord.—Compositæ Senecionideæ.

Description.—This perennial plant is indigenous to Northern Africa, to the greater portion of Europe, and to the northern part of Asia; it occurs mostly in mountainous regions, and is frequently cultivated for medicinal purposes, both in Europe and in this country, where it has become naturalized in some places. The root produces several stems which are three to four feet high, woody at the base, nearly round, somewhat furrowed, and branching above. The radical leaves attain a length of six to eight inches; the stem-leaves are one to three inches long, petiolate, the upper ones sessile; their outline is roundish-triangular; they are twice or thrice pinnatifid, the segments lanceolate, the terminal one spatulate. The bracts are merely three-cleft or simple and lanceolate. The very numerous nodding heads of yellow flowers are in paniculate racemes, hemispherical in shape, with the involucre imbricate; the receptacle small and hairy, the marginal florets pistillate, and not ligulate, the numerous disk florets perfect and five-toothed, and the ovary obovoid and crowned with a disk, but destitute of pappus. The entire plant, with the exception of the stouter portions of the stem, has a hoary appearance from the numerous appressed white silky hairs, leaving merely the upper surface of the leaves of a dark-green color.

Wormwood should be gathered while flowering, during July or August, the coarse stems being rejected. It has a strong aromatic, not very agreeable odor, and a persistent and intensely bitter taste.

Constituents.—The odor of wormwood is due to a volatile oil, of which from .4 to 1.5 per cent. is obtained from the dry herb. According to Zeller, wormwood grown in a warm climate yields less volatile oil, and cultivation appears to decrease it. Its color varies between dark-green and yellowish-brown, but by careful rectification it may be obtained colorless. Its specific gravity varies between .90 and .973; it dissolves in one part of officinal, and in all proportions of absolute alcohol; has a rotating power to the right in the polariscope, and possesses the pungent aromatic odor and taste of the herb. It consists mainly of *absinthol*, the composition of which is $C_{10}H_{16}O$, which boils at 200° C. (392° F.), and splits with zinc chloride into water and cymene, $C_{10}H_{14}$; it contains also 2 per cent. of terpenes boiling at 150° and above 170° C., and a few per cent. of blue oils boiling at 300° C. and upwards. (C. R. A. Wright, 1874.)

The intensely bitter taste resides in *absinthin*, which may be obtained from the hot infusion of the herb by precipitating it with tannin, washing the precipitate, and decomposing it by oxide of lead; the dry residue is exhausted with alcohol, the solution treated with animal charcoal, evaporated, and dissolved in ether. On evaporating the ether, it is left behind as a colorless mass yielding a white powder. It is fusible; slightly soluble in hot water, freely in alcohol and ether. Its solution in potassa is brown-red; the ammoniacal solution, treated with hydrochloric acid in excess, is rose-red. Composition: $C_{40}H_{58}O_9$, Kromayer ($C_{40}H_{56}O_{12}$, Luck). It was first obtained in 1828 by Caventou, in a still impure condition; Mein prepared it in white prisms (1834). Wormwood contains also some tannin (green, with iron salts), resin, starch, albumen, potassium nitrate and other salts, succinic (Braconnot's absinthic acid, 1815), malic, and acetic acids.

Other Medicinal Species of Artemisia.—A. PONTICA, *Lin.;* Roman wormwood, *E.;* Petite absinthe, *Fr.;* Römischer Beifuss, *G.* Indigenous to Southern Europe and Central Asia. Hoary tomentose, leaves decompound pinnatifid, segments narrow linear; smaller than the preceding; odor strong, more pleasant; taste acrid, aromatic, and bitter; less esteemed than wormwood.

A. ABROTANUM, *Lin.;* Southernwood, Old man, *E.;* Aurone des jardins, *Fr.;* Eberraute, *G.* Western Asia and Southern Europe; cultivated in U. S. Minutely hairy, segments of the pinnatifid leaves capillaceous; odor lemon-like; taste aromatic and bitter.

A. VULGARIS, *Lin.;* Mugwort, *E.;* Couronne de Saint-Jean, Armoise commune, *Fr.;* Beifuss, *G.* Northern Africa, Europe, and Siberia; cultivated and spontaneous in U. S. Stem often purplish; leaves subsessile, green above, white tomentose beneath, pinnatifid, segments linear lanceolate, often incised; odor aromatic, agreeable; taste aromatic, bitter, and somewhat acrid.

A. DRACUNCULUS, *Lin.;* Tarragon, *E.;* Estragon, *Fr.;* Dragunbeifuss, Kaisersalat, *G.* Siberia, Tartary, Southern Europe; cultivated. Plant green and glabrous; radical leaves trifid; stem-leaves narrow lanceolate, entire; odor anise-like; taste aromatic, bitterish. The volatile oil is identical in composition with oil of anise.

Pharmaceutical Preparations.—EXTRACTUM ABSINTHII of the German Pharmacopœia is prepared with diluted alcohol; that of the French Codex with boiling distilled water.

Physiological Action.—*On Animals:* Given to dogs and rabbits the essential oil and the extract of absinth produce a species of intoxication, with insensibility, and, in large doses, epileptiform convulsions. *On Man:* Absinth in medicinal doses acts as a stimulant tonic, but excessive doses occasion disturbance of the cerebral functions, and convulsions. The habitual use of alcohol flavored with absinth gives rise to a peculiar chronic intoxication, in which degradation of the mental and physical powers and a tendency to convulsive epileptiform affections are conspicuous. Absinthin produces similar phenomena.

Medical Uses.—Wormwood may be advantageously employed in *atonic* and especially *flatulent dyspepsia*, and in various conditions of the system in which local disorders are maintained by general debility of the functions, and particularly by that of the digestive apparatus. In this manner partly, and partly also as a direct anthelmintic, it sometimes is used successfully to remove *intestinal worms.* Externally, a decoction of wormwood may be applied as a dressing for unhealthy and indolent *ulcers.* The *dose* of wormwood in substance is from twenty to forty grains. An *infusion* made with an ounce of wormwood in a pint of water may be given in doses of one or two fluidounces.

ACACIA, *U.S.*; ACACIÆ GUMMI, *Br.*—GUM ACACIA.

Gummi arabicum, s. Mimosæ.—Gum arabic, E.; *Gomme arabique*, Fr.; *Arabisches Gummi*, G.

A gummy exudation from Acacia vera and other species of Acacia. Bentley and Trimen, Med. Plants, 94.

Nat. Ord.—Leguminosæ Mimoseæ.

The gum-yielding species of Acacia are shrubs or trees with mostly abruptly bipinnate leaves, and with the stipules often transformed into thorns. The flowers are generally yellow, have numerous stamens, and are aggregated in globular heads or dense oblong spikes.

Origin.—Acacia vera and A. arabica, *Willd.*, which Ehrenberg considered as mere varieties, are now regarded as such, and identical with A. nilotica, *Delile*, and Mimosa arabica, *Roxb.* This middling-sized tree is indigenous, and also cultivated from Egypt south to Abyssinia, and west to Senegambia; also in Arabia and India. Near the Nile it is known by the name of *Sont.*

A. verek, *Guil. et Per.*, s. A. senegal, *Willd.*, occurs from Kordofan, where it is called *Hashab*, west to the river Senegal; it is a small tree attaining the height of 20 feet, and yields the Kordofan gum.

A. tortilis, *Förskäl*, a small or medium-sized tree, called *Seyal* or *Seyaleh*, occurs in Arabia and Upper Egypt.

A. Ehrenbergii *Hayne*, a shrub 10 to 12 feet high, called *Segah*, is found in Arabia and Upper Egypt.

Collection and Commerce.—Gum arabic is probably formed by the metamorphosis of the cell-walls of the parenchyma; some investigators, however, consider it as the product of the transformation of starch, and that this process occurs either regularly, or is increased in consequence of a diseased condition of the plant.

The gum exudes spontaneously, but the discharge is often hastened by incisions. It is yielded most plentifully during the hot summer months, the trees producing it in largest quantity having a sickly appearance. The thick liquid hardens upon the bark, and finally falls to the ground, but is collected by detaching it from the tree with the aid of a wooden axe.

The best gum is collected westward of the White Nile in Kordofan, and enters commerce by being shipped down the Nile to Alexandria; it is the *Kordofan gum*, called *Hashabi* in Egypt. A gum nearly or quite as handsome in appearance, though considered inferior in quality, is collected near the Blue Nile and shipped from Sennaar, either down the Nile or by way of the port of Suakin (Savakin) on the Red Sea; it is the *Sennaar* or *Sennari gum*, which, of late years, has become quite plentiful in our commerce. The kind known in commerce as *Suakin* or *Savakin gum* is collected farther east, not far from the west coast of the Red Sea, and shipped from the port named. The gum collected in Southern Abyssinia and adjoining countries is mostly exported from Berbera, either by way of the East Indies, or through some neighboring ports of Arabia to the Mediterranean. Some gum is collected in India, but the great bulk of the commercial *East Indian gum* is of African origin. Arabia also yields a little gum, but the *Gedda* or *Jidda gum* and the *gum Tor* or *Turic* come originally from the Somali coast of Eastern Africa.

Gum arabic, before it finally enters commerce, is usually assorted in the Mediterranean ports, the clearest and whitest quality being known as *Turkey gum.* It is imported in casks, boxes, bags, and also in skins. The importation of gum arabic into the United States amounts annually to over two million pounds.

Description.—Gum arabic occurs in roundish tears of various sizes, but usually more or less broken, and then constitutes angular fragments, of a glass-like, somewhat iridescent fracture, opaque in consequence of the numerous fissures contained in it, but transparent in thin pieces. The finest quality is colorless, or white in mass, the pieces exhibiting more or less of a yellowish or brownish tint being the inferior varieties.

It has a very faint odor and a mucilaginous insipid taste. It is completely insoluble in strong alcohol, but dissolves in two parts of water, forming a thick transparent mucilage of an acid reaction; this solution is not precipitated by lead acetate; but subacetate of lead and soluble silicates yield white precipitates, and borax and ferric salts gelatinize the solution. Its specific gravity varies between 1.355 and 1.491; when completely dried at 100° C. (212° F.) it is increased to 1.525, with an absolute loss of 13.14 per cent. (Flückiger).

Composition.—Gum arabic or arabin is the calcium compound of *arabic* or *gummic acid*, but contains also magnesium and potassium. This acid may be obtained pure by precipitating with alcohol the mucilage, previously acidulated with muriatic acid, washing the precipitate well with alcohol and repeating the operation several times. While still moist, gummic acid is soluble in water, and from this solution it is not precipitated by alcohol unless hydrochloric acid be added. After drying (meta-gummic acid of Frémy) it merely swells up, but does not dissolve either in cold or boiling water, in which it is rendered soluble again on the addition of alkalies. It is amorphous, and after drying at 100° C. (212° F.) its composition is $C_{12}H_{22}O_{11}$; treated with lime-water and alcohol, the compound $C_{12}H_{20}CaO_{11}+2C_{12}H_{22}O_{11}$ is obtained (Neubauer, 1854). This contains 2.80 per cent. $CaO = 3.80\ CaCO_3$. Löwenthal and Hausmann (1853) obtained 3.17 to 3.30 per cent. of ashes from gum arabic. Solution of gum rotates polarized light to the left; by continued boiling with dilute sulphuric acid sugar is produced; nitric acid oxidizes it to mucic, saccharic, tartaric, and oxalic acids. The inferior qualities of gum contain a little grape sugar, which may be removed by alcohol; thus purified, gum does not reduce alkaline solutions of cupric oxide. 3 grams Kordofan (and Senegal) gum, precipitated from its aqueous solution by an excess (15 grams) of solution of subacetate of lead, yield a scarcely opalescent filtrate, which remains almost clear with ammonia. The filtrate yielded under similar circumstances from Sennaar gum is slowly obtained, is milky, and yields with ammonia a gelatinous precipitate (Schlosser, 1869).

Other Varieties of Gum.—Gum Senegal derives its name from the river Senegal. It is the product of Acacia verek, A. Adansonii, *Guill. et Perr.*, and other species of Acacia growing in Senegambia and adjoining countries of Western Africa. It occurs often in elongated and larger tears than the Egyptian gum, which mostly vary in color between yellow and brownish-red, have few fissures, but occasionally air-cavities in the centre, and otherwise have the appearance and chemical properties of gum arabic. A variety called *gum Galam*, *gomme du bas du fleuve* in France, is lighter in color, and has not the bitterish taste often found in the ordinary kind. Senegal gum enters commerce through France, where it is officinal; it is extensively used in the arts. From five to six million pounds are gathered annually, the principal collection commencing in March. (Féraud, 1873.)

Gum Magador, named after the port in Northwestern Africa, whence most of it is exported from Morocco, also known as *Morocco* and *Barbary gum*, is probably obtained from Ac. gummifera, *Willd.*, and Ac. Seyal, *Delile.* It is in irregular tears of a yellowish-brown to red-brown color, superficially fissured, but breaking with a glass-like fracture.

Cape Gum, imported from the Cape of Good Hope, exudes from Acacia horrida, *Willd.*, occurs in small tears and fragments, and is of a pale yellow to amber color.

Australian Gum, the produce of Acacia decurrens, *Willd.*, A. dealbata, *Link*, and other species, is found in tears, which are frequently quite large, vary in color from yellowish to reddish-brown, have a slightly astringent taste, and break with a glass-like fracture.

Mezquite Gum is obtained from Algarobia (Psoralea) glandulosa, *Tor. & Gr.*, a tree, 20 to 40 feet high, indigenous to Texas, New Mexico, and Mexico; the yield by natural exudation is increased by making incisions; it is collected during the months of July, August, and September. It occurs in tears varying in size and in color from colorless to amber brown, and resembles gum arabic in the fissures, specific gravity, solubility, its behavior to nitric acid, and the amount of ash yielded on incineration, 2.1 to 3 per cent.; but its aqueous solution is not precipitated by subacetate of lead, ferric salts, or borax; acetate of lead, with ammonia subsequently added, yields a gelatinous precipitate. The reactions, however, differ to some extent in different samples, and it is not unlikely that several Mimoseæ may furnish this gum.

Hog-gum; Doctor-gum, comes in translucent or transparent reddish irregular tears, which are but partly soluble in water. It is usually referred to Rhus metopium, *Lin.*, by others to Moronobea coccinea, *Aublet*, both of which yield gummy exudations.

Adulterations and Substitutions.—The inferior kinds of gum described above are frequently substituted for gum arabic in tears. In powder it is liable to the same substitution, and also to adulteration with flour and dextrin. The former is easily detected by adding to the cold mucilage a solution of iodine, when a blue color will be produced; the latter, by Trommer's test, which will separate cuprous oxide at ordinary temperature in an hour or two, or immediately on heating.

Pharmaceutical Uses.—Powdered gum arabic is extensively used in the preparation of emulsions of oleoresins, fixed and volatile oils; also for forming troches and pills; for the latter purpose a solution of gum in glycerin is preferable, particularly if the pills are to be kept for some time. Gum arabic is preferably made into a moderately fine powder (sanded gum), which retains its ready solubility in water; by drying it so that it may be finely powdered, it loses nearly 10 per cent. in weight, does not dissolve rapidly, and reduces alkaline copper solutions (Hager, 1873).

Off. Prep.—Mistura amygdalæ, *U. S.;* Mist. cretæ, *U. S.*, *Br.;* Mist. glycyrrhizæ composita, *U. S.;* Mist. guaiaci, *Br.;* Mucilago acaciæ, *U. S.*, *Br.;* Pulvis amygdalæ compositus, P. tragacanthæ compositus, *Br.;* Trochisci, *Br.*, *U. S.;* Syrupus acaciæ, *U. S.*

Physiological Action and Medical Uses.—Various observations on the use of acacia as food, and experiments upon animals that were kept exclusively upon a diet of this substance, appear to render it probable that it cannot contribute much to real nutrition, that is by providing materials for forming tissue. It is certain that an exclusive diet of gum cannot sustain life. Yet it may possibly retard waste, and thereby prolong life. Such appears to be in part its operation when used by the sick in the form of gum-water. But unquestionably its more demonstrable merit consists in its serving as a protective to inflamed surfaces, as the *throat* when dry during *pharyngitis*, *laryngitis*, etc., when it is usually given in the form of troches or lozenges. In *febrile* affections generally, in *inflammations* of the gastro-intestinal mucous membrane, in *gastritis*, *typhoid fever*, *dysentery*, etc., it is in ordinary use. In all such cases it is a palliative of irritation. Its solution (*mucilago acaciæ*) may be rendered more agreeable and useful by the addition of sugar and various flavoring syrups; or the syrup, which is also officinal, may be used alone. Powdered acacia is sometimes applied to arrest bleeding from leech-bites and other sources of slight *hemorrhage*.

ACETONUM.—ACETON.

Spiritus (s. Æther) pyroaceticus.—Pyroacetic spirit or ether, E.; *Acétone, Ether (Esprit) pyroacétique*, Fr.; *Aceton, Essiggeist, Mesitalkohol*, G.

Formula C_3H_6O. Molecular weight 58.

Formation and Preparation.—Aceton is formed on the dry distillation of acetates, citric acid, and in the presence of lime, from sugar and other carbohydrates. It is obtained pure by the dry distillation of barium acetate (Liebig), but is usually prepared from calcium acetate or from a mixture of 4 parts of crystallized acetate of lead and 1 of burnt lime; the distillate is treated with calcium chloride, and purified by fractional distillation over lime.

Properties.—It is a thin colorless liquid, which when ignited burns with a luminous, non-sooty flame. It has a peculiar ethereal somewhat mint-like odor, and a refreshing, but very pungent and sweetish taste. Its density at 15° C. (59° F.) is .8008; it boils at 56.3° C. (133.3° F.). It is soluble in all proportions in water, alcohol, ether, volatile oils, and most compound ethers, and dissolves camphor, many resins and fats. Most of the salts soluble in alcohol are insoluble in aceton, which separates even from a concentrated aqueous solution of calcium chloride.

Composition.—The empirical formula has been given above. Constitutionally it has been regarded as aldehyd, with 1H replaced by methyl $= C_2H_3(CH_3)O$; also as *bimethylaceton* $CH_3.CH_3.CO$.

Medical Action and Uses.—This preparation was originally employed in chronic *pulmonary affections* to allay cough and diminish expectoration; but it has long since been disused. It is, indeed, asserted to act, not as an anæsthetic, but as a soporific only. It has been recommended as an *anthelmintic*, and in *rheumatism* and *gout*. It may be prescribed in doses of fifteen or twenty drops, dissolved in spirit of nitrous ether.

ACETUM, *U. S.*, *Br.*—VINEGAR.

Acetum crudum; Acetum vini.—Vinaigre, Fr.; *Essig*, G.

ACETUM DESTILLATUM, *U. S.*—DISTILLED VINEGAR.

Vinaigre distillé, Oxéolat simple, Fr.; *Destillirter Essig*, G.

The different pharmacopœias recognize under the above names the dilute acetic acid which is obtained by the acetic fermentation of alcoholic liquids, and the distillate obtained therefrom; the materials from which it is prepared influence its color, and to a considerable extent also its odor and taste.

Production.—Wine, cider, beer, and similar liquids not containing too large an amount of alcohol, when exposed to the atmosphere, turn sour in consequence of the oxidation of alcohol to acetic acid; $C_2H_6O+O_2$ yield $C_2H_4O_2+H_2O$. This acetification is accomplished in casks having a small opening at the top, and requires several weeks or months, or even about two years, to be complete, according to the temperature, which is most suitably kept between 20° and 35° C. (68° and 95° F.). During this process a cryptogamic growth is observed, consisting, according to Pasteur, of *Mycoderma aceti*. The acid liquid thus obtained requires clarification, which is effected either by allowing it time to settle, or by transferring it to other casks containing wood shavings. In this manner, *wine, cider, malt*, and *beer vinegars* are made.

Most generally, however, vinegar is made by the so-called *German* or *quick* *vinegar process*, for which the simple apparatus suggested by Wagenmann is employed. This consists of several straight-sided casks six to nine feet high, having, a few inches above the bottom, a false bottom or perforated diaphragm, upon which is packed a layer 2 to 3 feet in thickness, of fresh beechwood shavings which have been previously steeped in vinegar. Several inches below the top another perforated diaphragm is inserted, or in place of it, the cask is covered with a well-fitting tub having a perforated bottom. The liquid, containing from 6 to 10 per cent. alcohol, being placed upon the upper diaphragm, its flow is regulated by means of wooden pins inserted into the perforations, and it is thus compelled to trickle through the shavings, and thereby to present a large surface to the oxidizing influence of the atmosphere, with which free communication is established by a number of holes bored through the side of the cask immediately above the lower diaphragm, and by several tubes passing through the upper diaphragm and above the surface of the alcoholic liquid. The partly acetified liquid is drawn off from below the lower false bottom by means of a tap or pipe, and transferred to another similarly prepared cask, until the whole of the alcohol has been converted into acetic acid. During all this time the change of air in the room and its temperature must be carefully attended to, as otherwise the oxidation may become too rapid and the heat within the casks too high, so that the alcohol would be oxidized into carbonic acid and water. The process is finished in from three to fifteen days.

Theory of Acetification.—Ethylic alcohol C_2H_6O is first oxidized to aldehyd, acetylaldehyd, or acetylhydride, with the elimination of water: $C_2H_6O + O = H_2O + C_2H_4O$. By the further acquisition of oxygen acetic acid $C_2H_4O_2$ is formed. These oxidations are brought about, according to Pasteur, through the agency of the Mycoderma above referred to, while others ascribe it mainly to the oxidizing influence of the air; according to Mulder the appearance of Mycoderma aceti in vinegar is accompanied by a decrease of the acetic acid.

Properties.—Made by the German process vinegar usually contains some aldehyd and alcohol, which are usually absent if the production has been effected by the slow oxidation in casks. The sensible properties of vinegar are affected to a much larger extent by the material from which it has been obtained. *Malt vinegar* is largely made in Great Britain from beerwort, or from the fermented solution of malt; it is of a more or less deep brown color. *Beer vinegar* made from stale beer has the bitter taste of the hops. *Wine vinegar* is very extensively made in Southern and Western Europe from the lower grades of wines, the aroma of which is, to some extent, preserved; it contains also tartaric acid and tartrates, and if made from a red wine possesses a red color. *Cider vinegar*, which is much employed in the United States, is made from cider, and contains malic acid. *Common vinegar*, made from diluted whiskey, has the flavor of the latter to some extent, and contains the alkaline and earthy salts of the water used in its manufacture.

The color of vinegar varies from yellowish to brown or red; its specific gravity is about 1.008 to 1.018. It has an agreeable acidulous odor, differing from that of diluted acetic acid by the presence of some acetic or other ethers. By exposure to the air it undergoes putrefaction and becomes muddy. It should contain between five and six per cent. of acetic acid. A fluidounce of it should require for neutralization not less than 35 grains of bicarbonate of potassium (*U. S.*), indicating 4½ per cent. 445.4 grains by weight require at least 402 grain measures of the volumetric solution of soda for neutralization, indicating 5.4 per cent. of acid or 4.6 per cent. of acetic anhydrid (*Br.*). 20 parts of vinegar saturate 1 part of anhydrous carbonate of sodium (*P. G.*), indicating 5.66 per cent. of acetic acid. Evaporated to dryness and the residue incinerated, a small amount of ashes, about 0.03 per cent., is left behind.

Distilled Vinegar is made by distilling crude vinegar from a glass retort until seven-eighths (three-fourths, *F. P.*) have passed over. It is colorless, lighter in specific gravity (about 1.004), owing to the removal of extractive and other substances, and 100 grains of it neutralize 7.6 grains of bicarbonate of potassium (*U. S.*), indicating 4.5 per cent. of acetic acid. *Acetum purum s. destillatum* of the German Pharmacopœia is equivalent to the diluted acetic acid, *U. S. P.*

Impurities and Adulterations.—Poisonous metallic salts, like tin, lead, and copper, which may be present as accidental impurities, are detected by the dark coloration or precipitate occurring with hydrosulphuric acid; moreover, copper would be precipitated by keeping a bright iron spatula in the vinegar for a short time; lead, if present, will yield a white precipitate with sulphuric acid, and a yellow one with potassium iodide. Acrid substances, such as capsicum, pepper, pellitory, ginger, etc., which may have been added to impart artificial strength, are recognized by the taste of the vinegar after it has been neutralized with an alkali, or after it has been evaporated in a water-bath to a syrupy consistence.

The most common adulterations are acids, and particularly sulphuric acid. In searching for these it must be remembered that crude (but not distilled) vinegar is likely to contain sulphates, chlorides, and occasionally even nitrates, derived from the water which has been used in its manufacture. *Sulphuric acid* is detected by the white precipitate yielded on boiling with chloride of calcium, which is not precipitated by the small amount of sulphates present. A more delicate test is that of Chevallier, which was recently (1872) again suggested by James T. King: an ounce of vinegar is evaporated to half a drachm, an ounce of alcohol is added, which removes all traces of sulphates; the liquid is now filtered, mixed with an ounce of water, and may be either directly tested with a solution of chloride of barium in diluted alcohol, or the alcohol may be previously evaporated at a moderate temperature. W. C. Young (1877) has proposed to add to 30 cc. of vinegar some barium chloride in excess, estimate the chlorine in one-third of the liquid, and then evaporate the other two-thirds to dryness, incinerate and determine the chlorine in the ashes. The difference between the two results, calculated for the same quantity of vinegar, is due to hydrochloric acid, liberated by an equivalent quantity of free sulphuric acid. *Hydrochloric acid* is recognized by the distillate producing a white turbidity or precipitate with nitrate of silver, which is not removed by nitric acid, but is soluble in ammonia. *Oxalic acid*, if present, occasions with chloride of calcium at once a white precipitate, which is dissolved by nitric acid. *Tartaric acid* is best recognized by concentrating the vinegar in a water-bath, evaporating it to one-fourth or one-sixth of its volume, filtering and adding a concentrated solution of acetate of potassium, when acid potassium tartrate will be precipitated. *Nitric acid* may be detected by evaporating the vinegar in a water-bath to one-third its volume, and digesting it with copper filings, when nitrous acid vapors will be given off, which are recognized by the red color. The presence of *aldehyd* in vinegar is indicated by testing the first portion of the distillate with an excess of potassa solution, when a brown color will be produced.

Distilled vinegar should not be colored by an excess of potassa; it should not on heating destroy the blue tint occasioned by indigo solution (*nitric acid*), not leave any residue on evaporation, and not occasion any precipitates with chloride of barium or nitrate of silver.

Off. Prep.—Emplastrum cerati saponis, *Br.;* Tinctura opii acetata, *U. S.*

Physiological Action.—Vinegar is a mild stimulant and astringent, but distilled vinegar more nearly resembles acetic acid in the energy of its action. The universal employment of vinegar as a condiment, to facilitate the digestion of crude vegetable and fatty animal food, proves that it is useful for these purposes. Its favorable action is supposed to depend upon its power of softening and promoting the solution of animal fibre, and converting cellulose into sugar. The latter explanation may be well founded, but the former does not apply to the utility of the liquid as a condiment for fatty substances. It seems not improbable that, as vinegar powerfully excites the secretion of the salivary glands, it exerts a similar influence on the stomach, augmenting the flow of gastric juice, and thereby increasing the digestive power of the organ. It is probable that, in a similar manner, it moderates thirst, a purpose to which it has always been applied by the laity as well as by physicians. Like other stimulants, if used in excess, it exhausts the susceptibility of the stomach, impairs digestion and nutrition, and may induce a state of marasmus accompanied by degenerative changes in the lungs, and ending in fatal phthisis. Such effects have resulted from the excessive use of vinegar for the purpose of restraining a tendency to obesity. After death, in some cases of this sort, the stomach itself has been found to present the lesions of chronic gastritis. Experience has shown that, as a condiment, vinegar is most suitable for fat and plethoric persons, and in warm weather. It should be very sparingly used by the thin and anæmic, and by those who are subject to diarrhœa. Its tendency to alter the milk of nursing mothers and occasion diarrhœa in their infants should be constantly kept in mind.

Medical Uses.—In common with other acids, acetic acid possesses the property of assuaging thirst, and hence it has always been used for this purpose in *fevers*. It appears also to diminish the frequency of the pulse and the heat of the skin in these affections. Its power of preserving animal and vegetable substances immersed in it, probably led to the notion that it possesses especial virtues in the falsely called putrid fevers, and especially that it prevents contagion. But these notions are groundless. In those affections, however, the use of vinegar as a lotion is useful by the evaporation of the liquid producing a refreshing sense of coolness. Probably, also, its stimulant action upon the skin may promote a salutary diaphoresis. It is an error to suppose, as the ancients did, that vinegar is an antidote to the poisonous effects of *narcotics;* its stimulant action may be advantageous when the poison has been removed from the system, and its direct operation has ceased. In this respect, however, it is greatly inferior to ammonia, coffee, and even alcohol. When given after the ingestion of caustic *alkalies* or earths, or of the carbonates of these substances, it unites with them, and, forming innocuous acetates, arrests their corrosive action. Vinegar and dilute acetic acid have been used beneficially in the treatment of *lead colic*, after the bowels had been moved by purgatives. The stimulant action of strong vinegar or dilute acetic acid is usefully employed by snuffing the fumes of these liquids, to which camphor and various aromatics have been added. This expedient is useful in relieving nervous headache, faintness, drowsiness, commencing coryza, etc., but is less efficient than a similar application of ammonia. Vinegar, distilled or not, is a very useful agent for arresting *hemorrhage*, especially from the nose, stomach, rectum, and uterus. It should, if possible, be applied directly to the source of the bleeding, as in post-partum hemorrhage by expressing vinegar from a sponge introduced into the cavity of the uterus. At the same time compresses saturated with vinegar and water should be applied to the abdomen. Vinegar is popularly employed to prevent *discoloration* of the skin after injuries of the integument, and to retard the redness and swelling, and allay the pain of local inflammations. This method is particularly useful in superficial *burns*, and in preventing *suppuration* in the mamma. A weak solution of vinegar may be used to limit the action of particles of *lime* in the eye.

The *dose* of vinegar is from one to four fluidrachms in from two to four parts of water. An acidulated drink may be made with two fluidounces of vinegar in a quart of water. By enema vinegar may be given to the extent of from one to four fluidounces. A lotion may be made with one part of vinegar and three or four of water. The doses of distilled vinegar do not materially differ from these.

ACETUM CANTHARIDIS, *Br.*—VINEGAR OF CANTHARIDES.

Vinaigre cantharidé, Fr.; *Cantthariden-Essig*, G.

Preparation.—Take of Cantharides in powder two ounces; Glacial Acetic Acid two fluidounces; Acetic Acid eighteen fluidounces, or a sufficiency. Mix thirteen fluidounces of the acetic acid with the glacial acetic acid, and digest the cantharides in this mixture for two hours at a temperature of 93.4° C. (200° F.); then transfer the ingredients after they have cooled to a percolator, and when the liquid ceases to pass pour five ounces of acetic acid over the residuum in the apparatus. As soon as the percolation is complete, subject the contents of the percolator to pressure, filter the product, mix the liquids, and add sufficient acetic acid to make one pint (Imp. meas.). *Br.*

At the elevated temperature directed in this process, the cantharidin, with various extractive matters, is readily dissolved by the acetic acid, and after cooling remains in solution.

Medical Action and Uses.—Vinegar of cantharides is irritating to the skin by means of both of its constituents. Like other strong liquid vesicants, it is especially appropriate where the surface to be blistered is uneven, and of very limited extent, and when it is an object to produce vesication rapidly. It is more painful than other vesicating preparations of cantharides. It should be applied with a brush in several successive coats, and then covered with some simple ointment. Vesication usually occurs within two or three hours. It is very suitable for blistering the skin over the superficial portions of nerves in *neuralgia*, as was first recommended by Cotugno, and more recently systematized by Valleix; and also for blistering in *rheumatism* after the manner of Herbert Davies.

ACETUM LOBELIÆ, *U. S.*—VINEGAR OF LOBELIA.

Vinaigre de Lobélie enflée, Fr.; *Lobelien-Essig*, G.

Preparation.—Take of Lobelia in powder No. 40 four troyounces; Diluted Acetic Acid sufficient. Moisten the powder with two fluidounces of the acid, pack it firmly in a conical glass percolator, and gradually pour upon it diluted acetic acid until the percolate measures two pints.

It may also be prepared by macerating the powder in two pints of diluted acetic acid for seven days, expressing the liquid and filtering through paper. *U. S.*

It is a reddish-brown liquid in which the alkaloid lobelina is supposed to be preserved from alteration by the free acetic acid.

Medical Action and Uses.—The advantages of this preparation appear to be its stability and strength. It is especially indicated in congested states of the *bronchial* mucous membrane, with imperfect secretion, and *spasmodic constriction* of the air-tubes. It may be appropriately associated with preparations of antimony, squill, seneka, or ipecacuanha. The dose for an adult is from thirty minims to a fluidrachm when a merely expectorant operation is desired; but as a nauseant and antispasmodic from one to two fluidrachms should be given at intervals of an hour until its characteristic effects are produced.

ACETUM OPII, *U. S.*—VINEGAR OF OPIUM.

Black Drop, E.—*Vinaigre d'Opium*, Fr.; *Opium-Essig*, G.

Preparation.—Take of Opium dried and in powder No. 40 five troyounces; Nutmeg in powder No. 40 one troyounce; Sugar eight troyounces; Diluted Acetic Acid sufficient. Macerate the opium and nutmeg in a pint of the acid for 24 hours. Put the mixture into a conical glass percolator, and return the liquid which first passes, until the percolate becomes clear. Then pour on diluted acetic acid until 26 fluidounces have been obtained. In this dissolve the sugar, strain, and add sufficient diluted acetic acid to make the whole measure two pints. *U. S.*

This is the strongest of the liquid preparations of opium, one fluidounce containing 75 grains, and one grain of opium being represented by $6\frac{4}{10}$ minims of the vinegar. It is of a deep reddish-brown color.

Medical Action and Uses.—Vinegar of opium is nearly free from the sickening smell and taste which belong to laudanum, and is much less apt to nauseate. This last quality is probably due in part to the nutmeg it contains, and in part to the almost complete absence from it of narcotina, the most irritating to the stomach of the constituents of opium. The latter quality it shares with the deodorized tincture. The dose is from five to ten drops, or minims.

ACETUM SANGUINARIÆ, *U. S.*—VINEGAR OF BLOODROOT.

Vinaigre de Sanguinaire, Fr.; *Blutwurzel-Essig*, G.

Preparation.—Take of Bloodroot in powder No. 40 four troyounces. Diluted Acetic Acid, sufficient. Moisten the powder with two fluidounces of the acid, pack it firmly into a conical glass percolator, and gradually pour upon it diluted acetic acid until the filtered liquid measures two pints.

Vinegar of bloodroot may also be prepared by macerating the powder in two pints of diluted acetic acid for seven days, expressing the liquid and filtering through paper, *U. S.*

Recently prepared, this vinegar is of a deep red color, which becomes lighter on standing, owing to the deposition of coloring matter, which appears to be independent of that due to the sanguinarina salt. (Procter, 1864.)

Medical Action and Uses.—The very limited use of this preparation prevents any definite knowledge of its peculiar virtues. Whatever utility it may have displayed as a gargle in *scarlatinous sorethroat* was probably due to its menstruum. It would be folly to employ it as an emetic, when other more certain emetics are at hand; and there is nothing to show that as an expectorant, which it is reputed to be, its beneficial action outweighs its harsh operation, and its depressing action on the heart and nervous system. Its dose as an emetic is stated to be three or four fluidrachms, and as an alterative and expectorant from fifteen to thirty drops or minims.

ACETUM SCILLÆ, *U. S.*—VINEGAR OF SQUILL.

Vinaigre scillitique, Fr.; *Meerzwiebel-Essig*, *G.*

Preparation.—Take of Squill in powder No. 40 four troyounces. Diluted Acetic Acid, sufficient. Mix the powder with a pint of the acid, and when the liquid has been absorbed, pack the swelled powder carefully into a glass percolator, and gradually pour upon it diluted acetic acid, until the percolate obtained measures two pints.

Vinegar of squill may also be prepared by macerating the squill in two pints of diluted acetic acid for seven days, expressing the liquid, and filtering through paper. *U. S.*

Through an oversight the Pharmacopœia retained the old direction of moistening the powder with *one ounce* of the acid, whereby a solid mass is obtained. Altered as above, the percolation of squill presents no difficulties, and the coarse powder will be practically exhausted, if it has been carefully packed, so that the liquid will penetrate uniformly and pass in drops. The British, French, and German Pharmacopœias direct this preparation to be made by maceration; that of the former being practically identical with, the two last being weaker than, that of *U. S. P.* The formula of the British Pharmacopœia is as follows: Macerate two and one-half ounces of bruised squill in an imperial pint of diluted acetic acid for seven days, strain with expression, add to the strained liquid one and one-half fluidounces of proof spirit, and filter. The German Pharmacopœia macerates one part of squill in one part of alcohol and nine parts of pure vinegar (diluted acetic acid) for three days. The French Codex directs one part of squill to be macerated in twelve parts of white vinegar for eight days.

Off. Prep.—Oxymel scillæ, *Br.;* Syrupus scillæ, *U. S., Br.*

Medical Action and Uses.—Vinegar of squill was anciently employed, and for very diverse purposes, among which it is only necessary to mention the cure of spongy gums, various forms of sorethroat, hoarseness, etc., in all of which it is certain that the vinegar, and not the squill, in the compound was the efficacious ingredient. The diuretic action of squill is probably enhanced by its solution in vinegar, which is the best form in which it can be administered in *dropsy.* Its efficiency is much increased by associating it with acetate of potassium and digitalis, as in the following formula: ℞. Tinct. scillæ f℥ss; tinct. digitalis fʒij; spt. juniperi comp., vin. hispan., āā f℥ij; aquæ f℥viij; potassii acetat. ʒj.—M. S. A tablespoonful, diluted, three times a day. Vinegar of squill should not be used in renal dropsy, but only in dropsy of cardiac origin. Its average dose is about fifteen minims, and it is best administered in an aromatic draught.

ACHILLEA, *U. S.*—YARROW.

Herba s. Summitates Achilleæ s. Millefolii.—*Milfoil,* E.; *Millefeuille, herbe aux charpentiers,* F.; *Schafgarbe, Schafrippe,* G.

Achillea Millefolium, *Lin.* Woodville, Med. Bot. 15; Bentley and Trimen, Med. Plants, 153.

Nat. Ord.—Compositæ Senecionideæ.

Description.—A perennial herb, two to three feet high, occurring in fields and pastures throughout the greater part of the northern temperate zone of America and Europe. The hairy furrowed stem is nearly simple, branching only near the top. The radical leaves are petiolate, nine to twelve inches long; the stem-leaves nearly sessile, two to four inches long, all more or less soft, hairy, dark-green, lanceolate in outline, and twice or thrice deeply pinnatifid; the segments are linear-spatulate, three- to five-cleft, crowded, finely mucronate, and upon the lower side with small oil-glands. The flowers occur in level-topped corymbs; heads numerous with the involucre oblong; scales imbricate, keeled; receptacle flat, chaffy; ray florets pistillate, 4 or 5, short ligulate, white or rose-colored; disk florets several, perfect, tubular, with the margin whitish and the tube greenish; akenes flattened, oblong, without pappus. It has a feeble aromatic odor, reminding us somewhat of chamomile, and a bitterish, rather saline taste.

It should be collected during the months of July and August, while flowering; the coarse stems being rejected.

Constituents.—Yarrow yields by distillation with water about $\frac{1}{10}$ per cent. of a blue or dark-green volatile oil, that of the flowers having a spec. grav. of 0.92, that of the leaves .85 to .92, the latter being butyraceous. The bitter principle *achilleïn* was obtained by Zanon (1846) as a reddish-brown extract-like mass. His *achilleïc acid* is said to be identical with aconitic acid (Hlasiwetz, 1857); according to Von Planta (1870) achillein is an amorphous alkaloid of the composition $C_{20}H_{38}N_2O_{15}$. Yarrow also contains a small quantity of resin, tannin, and gum, and yields 13 to 17 per cent. of ashes, consisting of nitrates, phosphates, and chlorides of potassium and calcium.

Pharmaceutical Preparations.—In Europe an EXTRACTUM MILLEFOLII is employed, which is prepared by digesting the drug with diluted alcohol and evaporating. *P. G.*

Other Species of Achillea.—The following, which are indigenous to Europe, are to some extent employed.

ACH. PTARMICA, *Lin.;* Sneezewort, *E.;* Herbe à éternuer, *Fr.;* Bertramgarbe, *G.* It has been naturalized in some of the New England States. It has lance-linear, finely but sharply serrate leaves, and elongated white ray florets. The root is sternutatory.

ACH. AGERATUM, *Lin.*, has tufted, oblong, serrate, and clammy leaves, and very short ray florets; its odor is strong, but not agreeable; taste bitter.

ACH. NOBILIS, *Lin.*, is softly pubescent, has oval or oblong bi- or tri-pinnatifid leaves, with linear-oblong, toothed lobes; the 5 rayflorets are reflexed; odor and taste stronger than in the common yarrow.

ACH. MOSCHATA, *Lin.;* Iva, *E. G.;* Génépi blanc, *Fr.;* is largely used in Switzerland, has white flowers and smooth pinnatifid leaves with linear entire lobes; it is strongly aromatic and bitter. Von Planta-Reichenau (1870) obtained from it a bluish-green volatile oil, *ivaol*, of a refreshing odor, and bitterish mint-like taste; *ivain*, $C_{24}H_{24}O_3$, soft, yellow, insoluble in water, soluble in alcohol and bitter; *achilleina*, referred to above, is readily soluble in water, with difficulty in absolute alcohol, insoluble in ether, and when boiled with dilute acids yields sugar and *achilletin*, $C_{11}H_{17}NO_4$, which is dark-brown, insoluble in water, and not bitter; *moschatina* $C_{21}H_{27}NO_7$ is insoluble in cold water, and has an aromatic bitter taste.

ACH. ATRATA, *Lin.*, and ACH. NANA, *Lin.*, are used like the other species.

Medical Action and Uses.—Milfoil appears to be a general stimulant, and to possess peculiar relations to the pelvic organs. Like other stimulant tonics it has been found capable of curing certain cases of intermittent fever, and is apt to promote the appetite and digestion in atonic gastric disorders. Its special local action is illustrated by the virtues ascribed to it in *piles* and *amenorrhœa*, for the cure of which it was celebrated even in ancient times. The form of the first of these diseases in which it appears to be most efficient is that in which, along with relaxation of the sphincter ani, there is a discharge of mucus, more or less bloody, during defecation. A similar condition of atony in the reproductive organs of the female is attended sometimes with menorrhagia, and sometimes with imperfect and painful menstruation. A tonic and stimulant regimen is essential to its successful treatment, and as a portion of this, milfoil may sometimes be employed with advantage. By this mode of action, doubtless, milfoil has proved beneficial in *leucorrhœa* and flatulent *colic;* and it may assist in curing relaxed or otherwise inert conditions of the *throat*, when its infusion is used as a gargle, or in cases of *sore nipples*, when it is applied as a lotion. An infusion may be made with half an ounce of milfoil in half a pint of water, and reduced by heat to six ounces. It may be given in tablespoonful doses every hour. The expressed juice has been prescribed in doses of one or two fluidounces three times a day. The volatile oil may be given in doses of twenty drops.

ACIDUM ACETICUM GLACIALE, *Br.*—GLACIAL ACETIC ACID.

Acidum aceticum, P. G.; *Acidum aceticum concentratum, Acetum glaciale.—Acide acétique concentré, Esprit de vinaigre, Vinaigre glacial*, Fr.; *Essigsäure, Eisessig*, G.

Formula $HC_2H_3O_2$. Molecular weight 60.

ACIDUM ACETICUM, *U. S., Br.*—ACETIC ACID.

Acidum aceticum dilutum, P. G.; *Acetum concentratum.—Acide acétique*, Fr.; *Verdünnte Essigsäure*, G.

ACIDUM ACETICUM DILUTUM, *U. S., Br.*—DILUTED ACETIC ACID.

Acetum purum, Acetum destillatum, P. G.—*Acide acétique dilué*, Fr.; *Reiner Essig*, G.

The specific gravity of acetic acid is 1.047 *U. S.*, 1.044 *Br.*, and of diluted acetic acid 1.006.

Preparation.—To obtain acetic acid from vinegar, Stahl proposed, about the year 1700, to expose it to cold and separate the stronger acid from the ice; or to neutralize it with an alkali, evaporate and distil with sulphuric acid. Crystallized acetic acid was observed by the Count de Lauraguais (1759) in the so-called *copper spirit*, the distillate of copper acetate, and Lowitz found that a diluted acetic acid, if repeatedly rectified over powdered charcoal, would yield a product crystallizing at a low temperature, and named it glacial acetic acid. Acetic acid and glacial acetic acid are obtained by the decomposition of an acetate by a stronger acid; for this purpose sodium (or potassium) acetate and sulphuric acid are most generally employed now. The proportions (equal equivalents) adopted already by Stahl, were recently (1873) proven to be correct by Mohr, Buchner, and others, also for the preparation of the glacial acid; in this case, however, the mechanical difficulties of the operation are such as to make it preferable to use a larger quantity, nearly two equivalents of sulphuric acid. The British Pharmacopœia, 1864, directed fully two equivalents; in the last edition, 1867, the process has been omitted.

Preparation of Glacial Acetic Acid.—Carefully heat 13½ parts of pure crystallized acetate of sodium until the water of crystallization has been completely expelled, and the salt has been fused; the residue, weighing nearly 8¼ parts, is coarsely powdered, introduced into a glass retort, intimately mixed with 9 to 9½ parts of concentrated sulphuric acid, and then distilled. It is advisable to warm the retort by placing it in a sand-bath, before the acid is added. The condensation of the acetic acid vapors may be effected either by a Liebig's condenser, or in a receiver connected directly with the retort or by means of an adapter.

The reaction is as follows: $NaC_2H_3O_2+H_2SO_4=NaHSO_4+HC_2H_3O$. Acid sodium sulphate and acetic acid are formed, the latter distilling over, free from empyreuma if the heat has not been suddenly raised too high, and also free from sulphurous and other acids if the sodium acetate had not been contaminated with organic or other impurities. Although theoretically the hydrogen acetate or so-called monohydrated acid should be obtained, the product always contains some water, but crystallizes readily near the freezing-point of water. The hydrogen acetate may be obtained according to Hirsch (1873) by intimately mixing 12 parts of exsiccated sodium acetate with 20 parts of fused acid potassium sulphate, and with a carefully regulated heat, distilling 7 parts.

Properties.—Glacial acetic acid crystallizes near the freezing-point of water (34° F.), and remains crystalline until the temperature rises to above 9° C. (48° F.); it contains, then, about 1 per cent. of water, or not less than 84 per cent. of acetic anhydrid. Hydrogen acetate fuses at 22.5° C. (72.5° F.), Mollerat, has at 16° C. (60.8° F.) a specific gravity of 1.0553, and boils at 119° C. (246.2° F.), Sébille-Auger. At the mean temperature of the air it forms a colorless liquid with a pungent acetous odor. When heated to boiling, the vapor may be ignited and burns with a blue flame. According to the British Pharmacopœia, 60 grains of the acid, mixed with a fluidounce of distilled water, require for neutralization not less than 990 grain-measures of the volumetric solution of soda. The German Pharmacopœia directs the acid to fuse at 16° C. (60.8° F.), and to boil at 118° C. (244.4° F.); ten parts of it should dissolve one part of oil of lemon.

Off. Prep.—Acetum cantharidis; Mistura creasoti, *Br.*

Preparation of Acetic Acid.—Ten parts of crystallized acetate of sodium are mixed in a suitable retort with the cool mixture of 4 parts of sulphuric acid and 2 parts of water, and heated until at 112° C. (333.6° F.) a dry spongy mass remains behind (Mohr, 1873). The distillate is then diluted with distilled water until it has the proper specific gravity. If the addition of water is omitted a larger amount of sulphuric acid will be necessary; the quantity directed here scarcely exceeds the absolutely necessary one equivalent, and the reaction proceeds as follows: $2(NaC_2H_3O_23H_2O)+H_2SO_4=2HC_2H_3O_2+6H_2O+Na_2SO_4$. The residue in the retort is neutral sodium sulphate.

Properties.—Acetic acid has the specific gravity 1.047 *U. S.*, 1.044 *Br.*, 1.040 *P. G.* These figures indicate a percentage of hydrogen acetate amounting to 35 *U. S.*, 32 *Br.*, and 29 *G.* For acetic acid of a somewhat greater strength, the determination of its specific gravity does not afford a reliable criterion, since the acid of maximum strength on being mixed with water increases in its relative weight until the percentage is reduced to 79 or 80, when the maximum density will be reached; an acid of 43 per cent. has the same specific gravity as one of maximum strength, and between 67 and 89 per cent. the gravity of acetic acid shows scarcely any variation. The following table by R. Hoffmann gives the percentage of hydrogen acetate and the specific gravity of acetic acid of different strength at 15° C. (59° F.).

Per ct.	Sp. grav.	Per ct.	Sp. grav.	Per ct.	Sp. grav.	Per ct.	Sp. grav.	Per ct.	Sp. grav.
100	1.0553	80	1.0748	60	1.0685	40	1.0523	20	1.0284
99	1 0580	79	1.0748	59	1.0679	39	1.0513	19	1.0270
98	1.0604	78	1.0748	58	1.0673	38	1.0502	18	1.0256
97	1.0625	77	1.0748	57	1.0666	37	1.0492	17	1.0242
96	1.0644	76	1.0747	56	1.0660	36	1.0481	16	1.0228
95	1.0660	75	1.0746	55	1.0653	35	1.0470	15	1.0214
94	1.0674	74	1.0744	54	1.0646	34	1.0459	14	1.0201
93	1.0686	73	1.0742	53	1.0638	33	1.0447	13	1.0185
92	1.0696	72	1.0740	52	1.0631	32	1.0436	12	1.0171
91	1.0705	71	1.0737	51	1.0623	31	1.0424	11	1.0157
90	1.0713	70	1.0733	50	1.0615	30	1.0412	10	1.0142
89	1.0720	69	1.0729	49	1.0607	29	1.0400	9	1.0127
88	1.0726	68	1.0725	48	1.0598	28	1.0388	8	1.0113
87	1.0731	67	1.0721	47	1.0589	27	1.0375	7	1.0098
86	1.0736	66	1.0717	46	1.0580	26	1.0363	6	1.0083
85	1.0739	65	1.0712	45	1.0571	25	1.0350	5	1.0067
84	1.0742	64	1.0707	44	1.0562	24	1.0337	4	1.0052
83	1.0744	63	1.0702	43	1.0552	23	1.0324	3	1.0037
82	1.0746	62	1.0697	42	1.0543	22	1.0311	2	1.0022
81	1.0747	61	1.0691	41	1.0533	21	1.0298	1	1.0007

The strength of the officinal acid is ascertained by weighing out 100 grains of it, diluting with half an ounce of water, applying a moderate heat, and gradually adding 60 grains of bicarbonate of potassium; after effervescence has ceased, and the carbonic acid has been entirely expelled, the liquid should have a neutral reaction to test-paper. *U. S.* 182 grains of acetic acid of the British Pharmacopœia require for neutralization 1000 grain-measures of the volumetric solution of soda, which is equivalent to 55 grains of bicarbonate of potassium for 100 grains of the acid. The German Pharmacopœia directs that 1000 parts of the acid are to be neutralized by 265 parts of anhydrous carbonate of sodium, indicating a strength of 30 per cent. of monohydrated acid. The use of bicarbonate of potassium, as directed by the United States Pharmacopœia, has the advantage, that three-fifths of its weight in grains necessary for neutralizing 100 grains of the acid indicates directly the strength; the resulting potassium acetate has a faint alkaline reaction, but the error occasioned thereby, being quite insignificant, does not detract from the practical value of the test, more particularly if alkanet-paper be used in place of litmus-paper for determining the neutrality. Absolute accuracy may be had by treating 200 grains of the acid with an excess of dry, pure carbonate of calcium, washing out the resulting calcium acetate, drying and weighing the undissolved carbonate; the loss in grains multiplied with $\frac{3}{5}$ indicates the acid strength. If dry carbonate of barium be employed, instead of the calcium carbonate, the loss in grains is to be divided by 1.6417 to ascertain the percentage of monohydrated acid.

Tests.—Empyreumatic products, if present in considerable proportion, may be detected by the odor after the acid has been largely diluted with water; smaller quantities are indicated by adding a minute quantity of solution of potassium permanganate, the color of which will readily disappear; pure acetic acid, containing less than 50 per cent. of monohydrate, is not affected by this test (Hager, Merck, 1873). Sulphuric and muriatic acids are detected in the diluted acid by the white precipitates occurring with barium chloride and silver nitrate respectively. If sulphurous acid be present, the hydrogen evolved by muriatic acid and zinc in the presence of the acetic acid will be contaminated with sulphuretted hydrogen, which will darken the color of white bibulous paper wetted with solution of subacetate of lead, and suspended in the test-tube or flask. Metallic salts, if present, will produce a coloration or precipitate with hydrosulphuric acid, after previous dilution with distilled water. Acetic acid, being volatile, must not leave any residue on evaporation.

Off. Prep.—Acetum cantharidis, *Br.;* Extr. colchici acetic., Ext. ergotæ fluidum, *U. S.;* Linim. terebinth. aceticum, Liq. ammon. acetatis, Liq. epispasticus, Morph. acetas, Oxymel, Plumbi acetas, *Br.;* Potass. acetas, Zinci acetas, *U. S.*, *Br.*

Preparation of Diluted Acetic Acid.—Take of Acetic Acid one pint; Distilled Water seven pints. Mix them. *U. S.*, *Br.* For the corresponding preparation, acetum purum, the German Pharmacopœia directs the mixture of one part of acetic acid of 30 per cent. with four parts of water.

Properties.—Diluted acetic acid has a specific gravity of 1.006, and 100 grains of it neutralize $7\frac{6}{10}$ grains *U. S.*, $7\frac{2}{10}$ grains *Br.*, $10\frac{1}{10}$ grains *G.*, of potassium bicarbonate, indicating a strength in monohydrated acid corresponding to 4.5 *U. S.*, 4.27 *Br.*, and 6 per cent. *G.* The British Pharmacopœia directs that 440 grains of its diluted acetic acid require for neutralization 313 grain-measures of the volumetric solution of soda, corresponding to 3.63 per cent. of anhydrous acid. The purity of diluted acetic acid is ascertained by the same tests mentioned for the stronger acid.

Off. Prep.—Aceta, Emplast. ammoniaci, Liquor ammon. acet., *U. S.;* Liq. morph. acetat., *Br.;* Syrupus allii, *U. S.*

Medical Action and Uses.—When given to animals in large doses this acid appears to destroy life by arresting the action of the heart. On examination the stomach is found injected, and its mucous membrane softened. In man poisonous doses produce effects of a like nature. Besides extreme abdominal pain, vomiting, and purging, the pulse becomes very small and feeble, and the skin cool. Acetic acid is seldom if ever employed internally, except in the diluted form, which may be used for the same purposes as vinegar, and in the same dose. Strong and glacial acetic acids are applied chiefly as caustics, as for the removal of *warts* and *corns*, and occasionally for *blistering* the skin. The former is a valuable application in the treatment of *favus*, and, if diluted, allays itching in *lichen*, *prurigo*, and *psoriasis*. It was alleged to possess peculiar advantages as a caustic in *cancer* when injected into the substance of the tumor. But the results of this method are unsatisfactory.

ACIDUM ACETICUM PYROLIGNOSUM.—PYROLIGNEOUS ACID.

Acidum pyrolignosum.—Acide acétique du bois, acide pyro-acétique, acide pyroligneux, Fr.; *Holzessig-Säure*, G.

Production.—Vinegar obtained by the destructive distillation of wood and other vegetable substances was known already to Glauber (1648). The identity of the volatile acid obtained in this way with acetic acid was first proven by Fourcroy and Vauquelin (1800), and Thénard showed (1802) that the volatile acid, obtained under similar circumstances from animal substances, is likewise identical with acetic acid.

Preparation.—The destructive distillation of wood is effected in sheet-iron cylinders, either upright or horizontal, which may be charged with billets of wood from the top, and from which the charcoal may be removed through a lateral opening. The cylinder is rapidly heated, the resulting volatile products being passed through wide condensing tubes, cooled by being surrounded with water, into a wooden or iron receiver, from which the condensed products may be drawn off by means of a tap, while the uncondensible gaseous products are carried off through a pipe into the furnace, there to be burned up in place of other fuel. The condensed portion consists of an aqueous stratum, containing, besides acetic acid, methylic alcohol, and aceton, various empyreumatic products; and of an oily layer and more solid tar, consisting of empyreumatic oils and resins, cresylic and phenylic compounds, various hydrocarbons, etc. This tarry portion is used for the preparation of creasote, while the watery layer constitutes *crude pyroligneous* or *wood vinegar*, from which the wood spirit or methylic alcohol is obtained by distillation either before or after treatment with lime. Milk of lime is added in excess, partly for the purpose of forming calcium acetate, partly with the view of removing various tarry products as insoluble calcium compounds. The solution of calcium acetate freed from the precipitate is evaporated to dryness, carefully heated upon an iron plate in thin layers until it chars, then redissolved in water, the solution decomposed by sulphuric acid and then distilled. Owing to the difficulty of regulating the heat so as to avoid the destruction of the calcium acetate, the solution of this salt is usually decomposed by sulphate of sodium, the resulting gypsum removed by settling and filtration, and the filtrate evaporated to dryness. The sodium acetate is more manageable in regard to the regulation of the temperature (about 260° C.=500° F.) necessary to destroy the empyreumatic compounds without affecting the acetate. The latter is purified by dissolving it in a little water, and decanting from the sediment, sulphuric acid is added, the liquid separated from the crystals of sodium sulphate and distilled, when an acetic acid will be obtained more or less pure, in accordance with the care exercised in the process of purification.

A much cleaner pyroligneous vinegar is obtained by subjecting strips of wood for about four hours to the heat of steam under a pressure of from 70 to 100 lbs. (150° to 162° C.=300° to 330° F.), whereby the texture of the wood is but little altered.

If crude pyroligneous vinegar is rectified by distillation as long as a colorless or light-yellowish liquid passes over, *Acetum pyrolignosum rectificatum*, P. G., *purified pyroligneous* or *wood vinegar*, *Vinaigre de bois*, Fr., *Holzessig*, G., is obtained, equal to about three-fourths or four-fifths of the weight of the crude product, and consisting mainly of acetic acid with variable proportions of methylic alcohol, formic acid, methylic acetate, aceton, lignon, aldehyd, mesit, and the more volatile portion of the empyreumatic oils, together with a little creasote.

Properties.—Crude wood vinegar differs from the rectified product mainly in the brown color, which is occasioned by the larger amount of empyreumatic compounds present. Rectified wood vinegar, though at first colorless or yellowish, gradually assumes a dark-brown color when exposed to light and atmosphere, and then requires to be filtered or redistilled. To avoid this, rectified wood vinegar should be kept in full and well-corked bottles, and in a dark place.

The German Pharmacopœia requires both the crude and rectified pyroligneous vinegar to neutralize one-twentieth of its weight of exsiccated carbonate of sodium; it should, therefore, contain 5.66 per cent. of acetic acid.

Medical Action and Uses.—Concentrated crude pyroligneous acid acts as an astringent upon the soft tissues, and diluted has been used as a stimulant and disinfectant for indolent and especially gangrenous *ulcers*, and also in *gangrene of the mouth*, in the treatment of *gonorrhœa*, *leucorrhœa*, *diarrhœa*, etc., and as a dressing for *chilblains*. It is quite superseded by creasote and carbolic acid. The rectified acid has been used for similar purposes, but less efficiently. In excessive doses either acid may produce vomiting, syncope, debility, anæsthesia, and even convulsions.

ACIDUM ARSENIOSUM, *U. S.*, *Br.*—ARSENIOUS ACID.

Acidum arsenicosum (P. G.), *Arsenicum album.*—*Arsenic*, *White arsenic*, *Arsenious anhydrid*, E.; *Acide arsénieux*, *Arsenic blanc*, *Fleurs d'arsenic*, Fr.; *Arsenige Säure*, *Weisser Arsenik*, G.

Formula As_2O_3. Molecular weight 198.

Preparation.—Arsenious acid is obtained in large quantities as a by-product in roasting cobalt, nickel, tin, and even some silver ores, and particularly arsenical iron pyrites; the vapors are conducted through long tubes or chambers, where they are condensed in the form of a white powder, formerly called *flowers of arsenic*. This is not pure, but contains some metallic arsenic, sulphide of arsenic, dirt, etc., from which it is purified by resublimation. For this purpose, the arsenic flour is introduced into cast-iron kettles, surmounted by several communicating iron cylinders, from the top of which a large pipe leads into a chamber where the vapors, which are not condensed in the cylinders, are recovered again as a white powder. The heat, which is applied directly to the kettle, is sufficient to keep the condensing product in the heads in a soft condition, so that on cooling, it congeals into masses. If the heat is raised too high, the greater portion of the acid is carried over into the chamber. That consumed in this country is mostly imported from Europe; during the year ending June 30, 1876, over 506,000 lbs., and in the following year 2,595,000 lbs., were imported into the United States.

Properties.—Arsenious acid occurs in heavy, inodorous masses, which are at first glass-like and transparent, but become superficially white and opaque, the change penetrating gradually to the interior, so that ultimately the entire mass is converted into a porcelain-like mass, the formation of which is dependent upon a molecular change, the amorphous glass-like arsenious acid becoming crystalline. The specific gravity of the vitreous acid is 3.7385, and of the opaque variety 3.699 (Guibourt). Durand and Mitchell determined (1832) the density of the former to be about 3.3. Slowly heated in a glass tube to about 200° C. (392° F.), minute transparent crystals are obtained which, under a magnifying-glass, are recognized as regular octahedra. It is dimorphous, crystallizing also in thin pearly prisms, which are sometimes obtained in the process of roasting arsenical ores. When thrown upon burning charcoal, it is reduced to the metallic state and vaporized, arsenious acid being again produced, and an alliaceous odor emitted. It has a scarcely perceptible, faintly sweetish taste, due to its slow and sparing solubility; the crystalline acid is less soluble than the amorphous, but one is under various circumstances converted into the other. By prolonged contact with cold water, about $\frac{1}{4}$ per cent. of the acid is dissolved, but after boiling for several hours, about 11 per cent. is taken up, the greatest portion crystallizing on cooling, leaving about $2\frac{1}{2}$ per cent. in the solution. Bussy found (1847) that 100 parts of water of 13° C. (55.4° F.) will dissolve 4 parts of amorphous and 1.2 parts of crystalline arsenious acid, the former solution gradually depositing crystals until reduced in strength to the latter. Treated with warm or cold ammonia water, the amorphous acid is converted into the crystalline variety without combining with the ammonia (Guibourt). Arsenious acid is insoluble in ether, quite sparingly soluble in alcohol, but combines with fixed oils when heated, forming a plaster-like mass; several acids increase its solubility in water, particularly muriatic and tartaric acids.

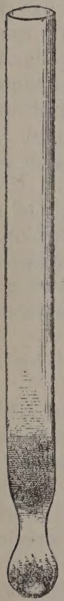
Powdered arsenious acid is often adulterated; hence it should not be employed for medicinal purposes, unless its purity has been previously established. When rubbing the hard masses of vitreous or porcelain-like acid to powder, sufficient alcohol should be sprinkled over it to prevent the dust from rising, and the mouth and nostrils should be protected by a moist sponge. When larger quantities are powdered, it is even advisable to protect the eyes and the bare hands.

Tests.—Arsenious acid is completely volatilized without fusion at a temperature not exceeding 204.5° C. (400° F.). By prolonged boiling with diluted muriatic acid, it dissolves completely without leaving any residue, and 100 grains of it, thus dissolved, yield with hydrosulphuric acid a deposit of tersulphide of arsenic weighing, after washing and drying, 124 grains. *U. S.* Four grains of it, dissolved in boiling water with 8 grains of bicarbonate of sodium, discharge the color of 808 grain-measures of the volumetric solution of iodine. *Br.* The reaction occurring in this test is shown by the equation: $As_2O_3+5H_2O+2I_2=2H_3AsO_4+4HI$; one molecular weight of arsenious acid is oxidized by four atomic weights of iodine, with the formation of two molecules of arsenic and four of hydriodic acid.

Off. Prep.—Liquor arsenicalis (potass. arsenitis), Liq. arsenici chloridi (hydrochloricus), Sod. arsenias. *U. S.*, *Br.*

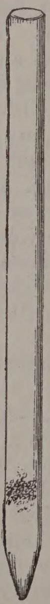
Detection of Arsenic and Arsenious Acid.—A neutral or acidulated solution of arsenic yields with sulphuretted hydrogen a bright yellow precipitate of *sulphide of arsenic*, which is entirely insoluble in dilute acids, but dissolves readily in alkalies, their carbonates and sulphides; if such a solution in sulphydrate of ammonium is acted upon by nitrate of silver in excess, sulphide of silver is precipitated, and the solution contains the arsenic in its original state of oxidation, either as arsenious or arsenic acid, and on the careful neutralization of the ammonia by means of nitric acid, the former is precipitated as yellow arsenite of silver, and the latter as red-brown arseniate of silver, both precipitates being readily soluble in nitric acid and in ammonia. Neutral solutions of arsenious and arsenic acids yield with sulphate of copper precipitates, that of the former being yellowish-green (*Scheele's green*), and of the latter bluish-green in color; both precipitates are freely soluble in nitric acid and in ammonia. It follows, from the behavior just described, that in testing by a soluble silver or copper salt for arsenious or arsenic acid, the solutions of the latter must be very carefully neutralized, or, if acid, are best tested with ammoniacal solutions of copper and silver; but the complete precipitation of arsenic is most conveniently effected from an acidulated solution by means of sulphuretted hydrogen gas; if strongly acid, the liquid should be diluted with water, and it is in all cases advisable, after adding an excess of the gas, to set the mixture aside for some time, if little arsenic is present, even for 24 hours. If not mixed with other metals, the precipitate thus obtained is pretty characteristic, since only two other metals yield under the same circumstances precipitates of sulphides having a similar color, namely, *cadmium* and tin in *stannic* compounds. *Cadmium sulphide* has a bright lemon-yellow color, but is readily distinguished from the corresponding arsenic compound by being completely insoluble in potassa, ammonia, and sulphydrate of ammonium; on the other hand, cadmium sulphide dissolves completely in strong hydrochloric acid, forming cadmium chloride, and giving off sulphuretted hydrogen, while sulphide of arsenic is insoluble in the acid mentioned. *Stannic sulphide* has a dusky-yellow color, and dissolves in potassa, ammonia, and sulphydrate of ammonium, but differs from sulphide of arsenic not only in the shade of color, but also in its complete solubility in strong hydrochloric acid. The three sulphides may likewise be distinguished from each other by their behavior with *cyanide flux*, which is an intimate mixture of one part of cyanide of potassium with three parts of anhydrous sodium carbonate; when heated with this flux in the bulb of a Berzelius reduction tube, sulphide of arsenic yields, in the cooler part of the tube, a sublimate of metallic arsenic having an iron-gray color, and in the upper portion of the ring occasionally a brown color, produced by the intimate mixture of metallic arsenic with some arsenious acid; during the sublimation a garlic-like odor is observed; the sublimate volatilizes on the application of heat, and condenses again in a cooler part of the tube, and if atmospheric air has been admitted, is partly or entirely converted into minute brilliant octahedral crystals of arsenious acid. Sulphide of cadmium, under the same circumstances, yields a red-brown sublimate, consisting of oxide of cadmium, which is not volatilized by heat; and sulphide of tin produces no sublimate; but in the fused mass will be found metallic grains of tin.

Fig. 1.



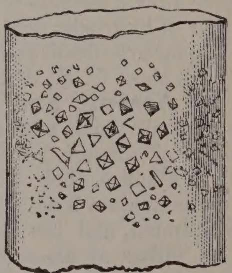
Reduction tube of Berzelius.

Fig. 2.



Reduction tube with sublimate of arsenious acid.

Fig. 3.



Sublimate of arsenious acid magnified.

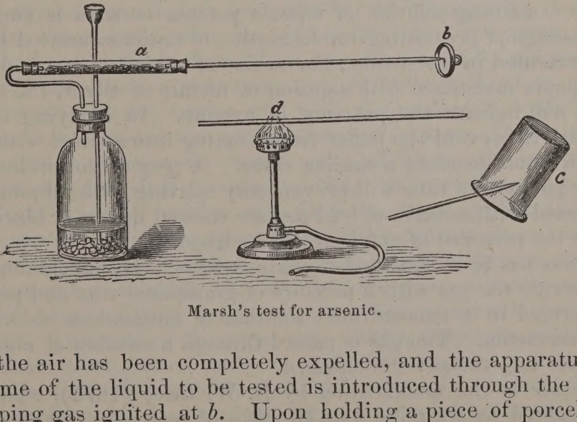
The above tests characterize arsenic if in the form of solution, and if present in more than a very minute quantity. Tests of still greater delicacy will be described below. Arsenious acid, which is usually met with in cases of accidental or criminal poisoning, yields, if heated in a narrow tube, the crystalline sublimate described above; and if mixed with charcoal or cyanide flux, the sublimate will, as in the above case, consist of metallic arsenic, and this, on being sublimed in the presence of air, will yield the same crystals.

In the presence of much organic matter, the detection of arsenic is a more complicated process, involving the separation of most of the organic matter, which Fresenius and Babo have accomplished by heating the mass in a water-bath with muriatic acid, and adding to it chlorate of potassium in small quantities until a thin liquid is produced; if the heat be not raised beyond the temperature of boiling water no chloride of arsenic will be volatilized, but the mixture becomes more liquid in proportion as the solid organic substances are destroyed. The liquid is then filtered, the clear filtrate saturated with sulphuretted hydrogen, and the precipitate, which contains organic matter, treated with strong nitric acid, and subsequently fused with pure nitrate of sodium, whereby the organic compounds are completely destroyed, and the antimony, if present, is converted into insoluble antimoniate of sodium; water will now take up all the arsenic as arseniate of sodium, together with the excess of nitrate of sodium used. The solution, after acidulation with muriatic acid, may then be treated again with sulphuretted hydrogen, or in Marsh's apparatus—in the latter case after evaporation with an excess of sulphuric acid to expel the nitric acid.

The destruction of the organic matter, as described above, may in some cases be omitted, the material being simply boiled with water and the filtrate acidulated with muriatic acid, previous to passing sulphuretted hydrogen through it. A solution suitable for the purpose may likewise be obtained by the process of dialysis, whereby mucous, amylaceous, and albuminous substances are left behind, while the dialyzed liquid contains the arsenious acid, besides organic and inorganic salts. Dr. Penny (1852) suggested the separation of the arsenic from such mixtures by converting it directly into chloride, and distilling this off. To accomplish this, the material should be thoroughly dried, mixed with strong hydrochloric acid, and then heated in a retort placed in a sand-bath. Dr. A. S. Taylor observed that portions of dried liver or stomach gave up every trace of arsenic by one distillation. The distillate may be tested for arsenic by the reagents mentioned above, or in Marsh's apparatus.

Marsh's test depends upon the formation of arseniuretted hydrogen (hydride of arsenic) by the action of nascent hydrogen upon the oxygen compounds of arsenic. Fig. 4 explains itself; hydrogen is generated in a suitable flask and dried by conducting it through a tube, *a*, filled with fragments of calcium chloride. After the air has been completely expelled, and the apparatus filled with hydrogen, some of the liquid to be tested is introduced through the funnel-tube, and the escaping gas ignited at *b*. Upon holding a piece of porcelain into the

Fig. 4.



Marsh's test for arsenic.

flame, a brown-black spot of metallic arsenic will be deposited, which will quickly dissolve on the addition of a little chlorinated lime. Antimony compounds will yield a similar spot, which, however, is not affected by the chlorinated lime. When a dry beaker, *c*, is held over the jet, arsenious acid is deposited upon the inside, and may be recognized by its crystalline form; and, after dissolving it, in a little hot water, a yellow precipitate will be obtained on the addition of some solution of ammonio-nitrate of silver. Antimony similarly treated gives no precipitate. The delivery-tube, which must be of hard glass, may be heated to redness by the flame of a gas-lamp, *d*, when the hydride of arsenic will be decomposed, metallic arsenic being deposited. Antimony gives a similar reaction, and the two metals may be distinguished by heating the deposit in contact with air, when the arsenic will be converted into crystallized arsenious acid; or sulphuretted hydrogen may be passed through the tube, and the deposit gently heated, when the arsenic will be converted into yellow sulphide, and the antimony into orange sulphide. On now passing dry hydrochloric acid through the tube, the sulphide of antimony will disappear, and the sulphide of arsenic remain unaffected.

On passing the hydrogen gas from the delivery-tube through acetate of lead to remove any H_2S, into a solution of nitrate of silver, a black precipitate will be produced both by antimony and arsenic. If the former, the deposit will consist of a compound of antimony and silver; if the latter, metallic silver only is precipitated, while the solution contains the arsenic as arsenious acid mixed with the excess of silver salt, and on cautiously neutralizing with ammonia a yellow precipitate of arsenite of silver is obtained.

Bettendorff's test (1869).—On adding some arsenical solution to a solution of stannous chloride in strong muriatic acid, a gradual, or, on heating, a somewhat rapid reduction to metallic arsenic takes place, the deposit having a brown or black color, according to quantity. Dilution with water and the presence of nitric acid or nitrates interfere with the reaction.

Reinsch's test (1843).—If an arsenical solution is strongly acidulated with hydrochloric acid, and heated to boiling in the presence of a thin slip of bright copper, or, according to A. S. Taylor, preferably of finest copper gauze, the copper will become tarnished by the deposition upon it of metallic arsenic, the film having a bluish or iron-gray color, according to quantity; the presence of nitric acid interferes with the reaction. The copper is washed with water, dried, and heated in a narrow test or reduction-tube, when arsenious acid will be sublimed in the form of octahedral crystals.

Fleitmann's test, like the process of Marsh, with its numerous modifications, depends upon the generation of arseniuretted hydrogen from zinc; instead of an acid, however, a strong solution of caustic potassa or soda is employed which has the advantage of preventing the formation of antimoniuretted hydrogen. If the gas is generated in a test-tube, the orifice of which is covered with a piece of filtering-paper moistened with solution of nitrate of silver, the appearance of a black spot will indicate the presence of arsenic. In applying this test, care must be taken to prevent the paper from coming into contact with the alkaline liquid, which would produce a similar color. A plug of cotton loosely inserted in the upper part of the tube will prevent any spirting of the liquid. A strip of paper moistened with solution of lead acetate colored brown or black by the gas, would prove the presence of sulphuretted hydrogen.

This process has been modified in various ways. Himmelmann (1868) proposed to generate the gas with a mixture of granulated zinc and powdered iron, which is warmed in a concentrated solution of ammonium chloride rendered alkaline by ammonia. The gas is passed through a solution of zinc and ammonium chlorides into the silver solution.

Much simpler is the modification by E. W. Davy (1876), who employs an amalgam prepared by warming 8 or 10 parts of mercury, and dropping upon it gradually in small pieces 1 part of metallic sodium. The amalgam should be used only in a neutral or alkaline liquid, the gas is generated by the action of the sodium upon water, and the presence of arsenic in it is recognized with nitrate of silver, as stated above.

Precautions.—It is scarcely necessary to remark that when testing for arsenic all the reagents must be absolutely free from that metal. The purity of sulphuric and hydrochloric acids is most conveniently ascertained by Bettendorff's or Reinsch's process, and the purity of zinc by that of Fleitmann. The use of copper for the purpose referred to is not, as a rule, interfered with by its containing arsenic, but the presence of the latter may be readily detected, according to Odling (1863), by heating it in a retort with 6 times its weight of ferric chloride and an excess of hydrochloric acid, when chloride of arsenic will distil over, and give the usual reactions of arsenic compounds.

In forensic analysis it is usually required that the arsenic be separated in the metallic state, and that the quantity of the poison be estimated. The former is accomplished by the methods described above; the latter by weighing the metal deposited in the heated delivery-tube of Marsh's apparatus, either upon the glass or upon platinum introduced for the purpose; or by estimating it in the form of pyroarseniate of magnesium.

Physiological Action.—Arsenic is hostile to all forms of vegetable life, whether it acts upon the foliage of plants through the air, or upon their juices by absorption from the soil. It tends to shrivel the leaves and other soft structures if the supply of water is small, or to rot them if the soil and air are humid. It speedily destroys the life of insects and fishes, occasioning convulsive movements in the latter. In birds, however introduced into the system, it produces symptoms of gastro-intestinal irritation, as well as nervous depression exhibited in debility, spasm, or paralysis. In quadrupeds the same evidences of gastro-intestinal irritation and nervous prostration or irritability predominate. But to produce such effects the quantity of the poison introduced at once into the system must be large. After slow poisoning the digestive organs do not usually present the ordinary evidences of inflammation, although they may exhibit an unusual amount of mucous secretion, containing more or less fibrin. The mineral may be detected in all the organs, but chiefly in the liver and spleen, of animals poisoned by its use.

The application of arsenical preparations to the surface of the body is often followed by symptoms of poisoning, particularly if the integument is not whole, as where they are employed in the treatment of cutaneous diseases. But such effects are sometimes observed when the skin is sound, as when an arsenical solution has been used to destroy vermin upon the head and other hairy parts, or when for any purpose it has been allowed to remain long in contact with the skin. In these cases also the gastro-intestinal symptoms predominate, together with thirst, difficult deglutition, pain in the head, and sometimes micturition. Still more severe symptoms are promptly induced by the prolonged contact of arsenic with the vagina and with the surface of wounds and ulcers, including ulcers from cancer treated by arsenical caustics. Poisoning also results from the inhalation of arsenical vapors given off during the combustion of this mineral; from the fine dust produced during its manufacture, and by that of compounds into which it enters. Of these the most prolific in mischief are arsenite of copper, or Scheele's green, and Schweinfurth green, which are extensively used as pigments for paper hangings, artificial flowers, and even dress goods. Other colors used in the arts besides green contain arsenic; it has been found in blue, red, and yellow papers. The symptoms produced in this manner include irritation of the eyes, sore mouth, dyspepsia, neuralgia, spasm, paralysis, cutaneous eruptions, and progressive emaciation.

It is certain that when arsenic is taken habitually, commencing with very small doses, a certain tolerance of its action is induced, so much so, that quantities may at last be consumed which at first would have been actively or fatally poisonous. This remarkable fact has been largely illustrated by the arsenic eaters of Styria, who employ the drug for the purpose of maintaining a ruddy complexion, and enabling them to climb without panting the steep mountain paths of their country. Their acquired tolerance of it is such that some of them have been known to take five or six grains of arsenious acid without the slightest inconvenience. Similar tolerance has been observed in isolated cases elsewhere, and, in certain experiments of Flandin, animals that began with the daily dose of one-sixty-fifth of a grain were able at the end of nine months to take upwards of fifteen grains of arsenious acid in powder mixed with their food, in the course of twenty-four hours, without injury to their appetite or health.

When arsenic is taken in small doses, as from three to five drops of arsenite of potassium, and after meals, it may be used for some time without occasioning any local symptoms; but if the dose be too large it is apt to cause loss of appetite, nausea, abdominal pain, and vomiting or purging. A metallic taste may also be perceived in the mouth, the eyes grow red, and œdema of the eyelids takes place, which, if the medicine is continued, may extend to the whole body. The urine may also become albuminous or even bloody. A longer continuance of the medicine is apt to occasion eruptions of the skin, particularly urticaria, pityriasis, and psoriasis. Sometimes the hair falls out. If the medicine is continued in the same or in greater doses, signs of irritation arise in the œsophagus and stomach, with vomiting and diarrhœa; the nervous system becomes disturbed and the pulse irregular; there are complete loss of appetite, a silvery coating of the tongue, salivation, thirst, tenesmus, and colic; the respiration grows oppressed, the flesh wastes, the limbs are tremulous or paralyzed, and are the seat of severe pains. These phenomena are most frequently observed in workmen employed in the sublimation of arsenical ores; and among them it is not unusual to see numbness and contraction of the extensor muscles of the lower limbs, with torpor of the mind, and a general cachectic, emaciated appearance, with pustules and ulcers of the skin.

The symptoms of acute arsenical poisoning are the following: constriction and heat of the fauces, burning pain in the stomach and bowels, violent retching and vomiting, with spasms of the throat; insatiable thirst, a dry tongue, bloody stools, and strangury; muscular spasms, oppressed breathing, irregular pulse, paleness and coldness of the skin, and general collapse. When death does not result, the cure is generally slow and sometimes imperfect; digestion remains impaired, the muscles are stiff and feeble, and sometimes they are more or less paralyzed, especially those of the lower limbs. After death from acute arsenical poisoning the gastro-intestinal mucous membrane is usually found inflamed and softened, and sometimes covered with a false membrane; but in other cases, those in which nervous prostration has predominated, the gastric lesions may be quite inconsiderable. The violence of the symptoms and the subsequent lesions are apt to be greatly modified by the presence of food in the stomach when the poison is swallowed, and hence the fatal dose varies between remote extremes.

The curative operation of arsenic cannot be explained by the effects of poisonous doses. The explanation must be sought in the nature of those changes in the blood, nervous system, and general nutrition which are observed in chronic poisoning, and especially in the dropsical effusions and the alterations in the skin and its products, which are so commonly observed. They point directly to changes in the blood by which the proportion of its solid elements is diminished, and the facility of elimination of its morbid constituents is increased. That this elimination takes place through the kidneys is not improbable, since the mineral itself is chiefly discharged through those channels. But such phenomena are still to a certain extent morbid, and they are not usually developed by the therapeutical operation of the medicine. Indeed, the occurrence of dropsy in the form of œdema of the eyelids is generally held to be a signal for suspending the use of the medicine; or for diminishing its dose. Within these limits arsenic appears to act as a tonic, improving the digestion and nutrition, restricting the excretion of tissue in the forms of carbonic acid and urea, and lowering the temperature. It would seem, then, that, according to its dose, it may act as a conservative tonic, or as an eliminative agent, and this interpretation would appear to reconcile its apparently opposite effects by referring them to the action of different doses. Thus, comparatively small ones suffice to cure neuralgia and certain cases of intermittent fever, while comparatively larger doses are required by chronic malarial affections and by certain diseases of the skin.

In this sketch of the probable operation of arsenic a subordinate place is given to its direct action upon the nervous system. But there is much reason for thinking that as, physiologically, the supply of blood in the tissues, and the molecular action of these latter, must be under the control of the nervous system, so many of the effects of arsenic may be plausibly ascribed to a primary and direct action upon that system. It is well known that numerous cases of acute skin disease (herpes, urticaria, lichen) arise under the direct influence of mental causes, and are some of them closely related in their distribution to that of the nerves. Again, the symmetrical eruption of the patches in scaly affections appears to demonstrate a nervous influence in the arrangement, for such symmetry from a mere alteration of the blood is less conceivable. Finally, the action of arsenic in curing intermittent fever, like the similar action of quinia, is rendered more intelligible by referring it to the nervous system than in any other manner. Very probably the actions of the medicine upon the blood and upon the nervous system are simultaneous and coöperate with one another.

Medical Uses.—The use of arsenic as a substitute for the cinchona alkaloids in the treatment of periodical *malarial fevers* has been extensively resorted to, and the general result of experience is that it is not comparable to the latter medicines in efficacy. The greater number of cases in which it shows a decidedly curative operation are of the chronic form above referred to; cases in which quinia has generally failed to effect a cure, and in which the malarial cachexia was distinctly marked. In these the cure by arsenic generally coincides with evidences of the constitutional operation of the remedy. In various *skin diseases* arsenic is an invaluable remedy, but is especially so in *lepra*, *psoriasis*, and *chronic eczema*. In a large proportion of cases of these affections it effects a perfect cure; but in none of them can it be regarded in the light of a specific. Some dermatologists advise that the medicine should be given in very small doses at first, and gradually in larger doses, until its constitutional effects are developed; others insist upon commencing at once with a full but moderate dose (five minims), and persisting in its use until the characteristic injection of the eyes or the swelling of the eyelids appears, when the dose should be gradually reduced until these phenomena subside. In either case the medicine should be continued for some time after the eruption has disappeared. The last point is of essential importance. Chronic *eczema* is less amenable than the dry scaly eruptions to the use of this medicine, but nevertheless sometimes will yield to it alone. Syphilitic eruptions of the skin are not curable by arsenic. *Warts*, especially those which appear rapidly in large crops, may generally be cured by arsenic given internally.

This medicine has enjoyed a certain reputation in the treatment of *nodosity of the joints*, both as an internal medicine and under the form of arsenite of sodium in baths. Several distinguished names vouch for its efficacy; but we have made use of it persistently in several cases of the disease without the slightest advantage. In *chorea* it has enjoyed a very high repute, so much so as to have been looked upon by some physicians as a specific; but, on the other hand, some of the best authorities do not even refer to it among the remedies for the disease. Our own impression of its value is very high in those numerous cases in which chorea occurs, as it so often does in delicate children, from overstrain of the mind or from any other exhausting excitement.

The advantages of arsenic in *neuralgia*, especially of the fifth pair and of the intercostal nerves, the forms which most usually depend upon constitutional or acquired debility, have been recognized ever since they were first pointed out by Fowler. It is true that the cases most readily cured by it are those of miasmatic origin; but whether the disease depends upon miasma as a direct effect, or upon its indirect influence on the constitution of the blood, is not clearly determined. Instances are indeed cited of its effecting the cure of traumatic neuralgia, but they are very rare and are open to criticism. Apart from miasmatic neuralgia, there are but few cases of those forms of the disease just named which are not benefited, even if not cured, by arsenic. The mode of its action may be inferred also from the well-known fact that facial and intercostal neuralgias are precisely those in which iron is a very efficient remedy. Another form of the disease, *gastralgia*, very frequently arises under the same states of the system, and is often curable by arsenic; this is the more remarkable, considering how frequently this neuralgia is associated with gastric ulcer, and renders it probable that both affections are cured by the action of arsenic in improving nutrition. This power is conspicuously manifested by it in many cases of pulmonary *phthisis*. Under its influence the bronchial irritation and secretion decline, the hectic abates, the breathing grows calmer, the appetite improves, flesh is gained, and life is prolonged if not permanently secured. It is not in every case that these effects are witnessed, nor is it possible to determine in what cases they may be looked for. But it would seem that arsenic is most efficient when the bronchitic element is strongest and the degenerative process is least active. This judgment is rendered probable by the manifest benefits derived from the medicine in many cases of chronic *bronchitis* affecting the lower lobes of both lungs. To the same tonic and reconstituent power of arsenic must be attributed its utility in many cases of *uterine disorder*, due to an enfeebled constitution or to more local causes; for it is in *amenorrhœa*, *menorrhagia*, *dysmenorrhœa*, and *leucorrhœa* that it has been found efficient, and these affections, although very different symptomatically, may have their root in the same organic debility. The utility of the medicine in many cases of *diabetes* may fairly be attributed to a like operation. They are those in which iron and also strychnia have been found useful, cases in which general debility is attended with a comparatively small secretion of urine, however high its specific gravity may be. Yet there are also cases which have been materially improved under this medicine, although the diuresis was profuse.

The treatment of *cancer* by arsenic has been both internal and external. At one time the administration of iodide of arsenic was held by competent authorities to be capable of diminishing the size of cancerous tumors; but the treatment has now lost whatever credit it once possessed. As a caustic, arsenic was used for the destruction of cancerous tumors even by the ancients, and throughout the course of medical history examples may be found of faith in its propriety and efficacy. But in recent times the practice has chiefly fallen into the hands of quacks. Superficial cancers, and tumors under various names, which tend to occasion ulceration, including *lupus*, continue to be occasionally treated by means of arsenical caustics. They are, however, excessively painful, and if applied over a large surface involve the risk of producing poisonous effects.

The symptoms of *poisoning* produced by arsenic taken into the stomach should be met by thoroughly evacuating that organ by means of ipecacuanha, alum, or the sulphate of zinc or of copper, and the administration of tepid water containing white of egg, flour, or lime-water. If these are unsuccessful, the stomach-pump should be speedily resorted to, after which the hydrated sesquioxide of iron, or the hydrated sulphuret of iron, should be largely administered as a chemical antidote. The saccharated oxide of iron and also magnesia have been recommended with the same object. The tendency of the patient to collapse is to be counteracted by means of hot bottles, bricks, etc., applied to the limbs and back, and by the cautious administration of alcoholic liquors and of opiates by enema.

Administration.—The dose of arsenious acid may be stated to be between one-thirtieth and one-fifteenth of a grain. Like other preparations of the medicine, it should never be given when the stomach is empty, and like them, also, its dose should be gradually increased until the eyes begin to show signs of its operation, or the symptoms of the disease for which it is given are ameliorated.

ACIDUM BENZOICUM, *U. S.*, *Br.*—BENZOIC ACID.

Acidum benzoicum sublimatum, Flores benzoes.—Acide benzoique, Fleurs de benjoin, Fr.; *Benzoesäure, Benzoeblumen*, G.

Formula $HC_7H_5O_2$. Molecular weight 122.

Preparation.—Take of Benzoin in coarse powder twelve troyounces. Spread it evenly over the bottom of an iron dish 8 inches in diameter and 2 inches deep, cover the dish with a piece of filtering-paper, and, by means of paste, attach it closely to the rim. Then, having prepared a conical receiver or cap of thick well-sized paper, of rather larger diameter than the dish, invert it over the latter so as to fit closely around the rim. Next apply heat by means of a sand-bath, or of the iron-plate of a stove, until, without much empyreuma, vapors of benzoic acid cease to rise. Lastly, separate the receiver from time to time, and remove the benzoic acid from it and the paper diaphragm as long as the acid continues to be deposited. By renewing the paper diaphragm after it has become so obstructed as to prevent the passage of vapor, an additional quantity of benzoic acid may be obtained. *U. S.*

The above process and apparatus were first proposed by Mohr. The directions are plain, and, if followed, an excellent product will be obtained, particularly if a few precautions have been adopted. The benzoin should be previously deprived of all adhering moisture by keeping the coarse powder for a few days in a close vessel over burned lime, removing it to the dish only when ready for use; if this moisture be not expelled, it will condense in the cap, and with it a portion of the acid will be absorbed by the paper. Loose filtering-paper should be used for the diaphragm, so that the passage of the vapors be not impeded. The heat should be regulated, to accomplish which it is preferable to place the dish in a sand-bath, which, at the beginning of the operation, should be carefully kept at a temperature of about 145° C. (293° F.), and gradually raised to 200° C. (392° F.). The operation will require about four hours, and if the cap has not been shaken in the mean time, all the sublimed acid may be obtained from the cooled apparatus, and will be ready for use. A portion of the acid remains in the benzoin, which, by the heat employed, has been fused. It may be obtained by breaking the mass again into small pieces, and submitting it to another sublimation, or preferably by the wet process described below.

If during the operation the apparatus should be shaken, a portion of the sublimed acid will be detached from the paper cap, and, falling upon the diaphragm, will be absorbed with the empyreumatic oils, and require to be resublimed. A change of the receiving cap is, therefore, not advisable if the apparatus remains entirely undisturbed until the process is finished. To avoid these difficulties, one or two diaphragms of gauze may be inserted in the receiver a few inches above the subliming vessel, so as to retain any acid which may become accidentally detached. To attain the same end, several modifications of the apparatus described above have been proposed. Mohr covers the subliming vessel with a very shallow sheet-iron funnel, terminating in a tube about one inch long, and about three inches in diameter. The receiving vessel consists of a nearly cubical box, made of pasteboard, and covered upon the inside with glazed paper, a circular hole fitting closely around the tube, being cut in one side. By this arrangement very little acid can fall back into the iron dish.

Hager replaces the shallow funnel by a flat sheet-iron cover, having near the edge a tubulure, through which the termination of the sublimation may be ascertained by removing the stopper and covering the opening for a short time by glass, upon which some benzoic acid, if it still sublimes, will be deposited. The receiving vessel consists of a pasteboard cylinder, terminating conically at one end, so as to fit well around the large circular tubulure, in the centre of the cover. The upper end of the cylinder is closed during the operation with a plate of glass. The insertion of one or two gauze-diaphragms near the conical end is advisable.

C. Rump (1868) recommends a sheet-iron kettle eighteen inches in diameter and twelve inches deep, which has inserted in it, on two opposite sides, tubes six inches in length and diameter, with which large paper-boxes serving as receivers may be connected, into the extreme end of which a short tube is fitted to establish communication with the air. Sublimation is effected from a cast-iron or earthen dish, which is placed in the kettle, and may be charged through an opening in the cover. The temperature is ascertained by means of a thermometer suspended in the vessel, and passing through a tubulure in the cover. Since a portion of the acid is liable to condense on the cover, the latter should be kept hot.

Benzoic acid may also be prepared by boiling two parts of powdered benzoin and one part of lime with from 20 to 25 per cent. of water, filtering while hot, and supersaturating the clear liquid, after some concentration, with muriatic acid. In this process, which is essentially that of Scheele (1775), the benzoic acid, together with a little resin, is rendered more freely soluble in water through the formation of benzoate of calcium. This salt is decomposed in the filtrate by the muriatic acid, with the production of freely soluble chloride of calcium and crystallizing benzoic acid, the latter being contaminated with some resin and coloring matter, from which it may be freed by dissolving it in twenty times its weight of boiling water, adding some animal charcoal, filtering while hot, and crystallizing.

Benzoate of sodium is about fifteen times more soluble in water than the calcium salt, and from it the acid may be prepared with smaller quantities of liquid. Bucholz recommends (1810) the digestion for three hours at a temperature of 40° to 60° C. (104° to 140° F.) of from four to five parts of powdered benzoin with one part of crystallized carbonate of sodium, and eight to ten parts of water. The mixture may afterwards be boiled, filtered, and treated as stated above in Scheele's process. If the digestion is prolonged for a day or two, care being taken not to raise the heat to such a degree that the resin fuses, boiling will not be necessary, and the pulverulent residue may easily be washed with warm water to remove the benzoate. The resin left by this process may be advantageously used in the preparation of fumigating pastilles. The acid obtained is mixed with a larger amount of resin than that obtained by the lime process. However, this can scarcely be considered a disadvantage, since sublimation of the impure acid with a little benzoin will convert it into the condition required by the Pharmacopœias.

Much of the benzoic acid of commerce appears to be made from hippuric acid. The urine of cattle or horses is mixed with an excess of lime, evaporated to one-sixth or one-twelfth its volume, and supersaturated with muriatic acid (Gregory). The impure hippuric acid may be purified by recrystallization after treatment with animal charcoal or with chlorinated lime, or with hydrochloric acid and some chlorate of potassium. By boiling the purified hippuric acid $C_9H_9NO_3$ with crude hydrochloric acid for half an hour, it is split into glycocoll $C_2H_5NO_2$ and benzoic acid $HC_7H_5O_2$. The latter is purified by recrystallization from water, and, after sublimation with some benzoin, resembles the acid obtained by the first process, in appearance, and is chemically identical with it.

From 4000 to 5000 lbs. of benzoic acid are annually imported into this country.

Properties.—Benzoic acid is in white feathery flexible crystalline plates and needles, having an agreeable aromatic odor and a warm acidulous taste. The odor is due to the presence of a small quantity of volatile oil, produced from the benzoin during sublimation. The pure acid is without odor. It fuses at 120.5° C. (249° F.), and boils at 239° C. (462° F.), but volatilizes freely with the vapor of boiling water, and more slowly at a somewhat lower temperature. Its vapors are suffocating and acrid, inciting to coughing. It requires for solution about 24 parts of boiling and 200 parts of cold water, 10 parts of glycerin, 2 parts of cold and 1 part of boiling alcohol, and 25 parts of ether. It is also soluble in fixed and volatile oils. Its solubility in water is increased by several sodium salts. Its chemical composition is represented by the formula $HC_7H_5O_2$. Its salts with the alkalies are freely soluble in water. According to R. Otto (1862), the benzoic acids obtained from different sources (benzoin, oil of bitter almonds, urine, benzalanin, etc.) differ from each other in the degree of their solubility in water. The experiments of Reichenbach and Beilstein (1865), however, indicate the existence of but one variety of benzoic acid.

Tests.—Benzoic acid should completely evaporate from platinum foil. If much charcoal be left behind, the presence of other organic substances would be indicated, of which sugar manifests itself by the odor of caramel, and hippuric acid by the odor of hydrocyanic acid during the application of heat; while mineral substances will be left behind as a fixed residue. Since some varieties of benzoin contain cinnamic acid, this should always be tested for before benzoic acid is prepared. Its presence in the latter is readily ascertained by an oxidizing agent, such as chlorine or bichromate of potassium and sulphuric acid, when the odor of oil of bitter almonds will be perceived. That benzoic acid has been prepared from hippuric acid may be ascertained by tinging its solution in liquor potassæ with permanganate of potassium to a deep violet color, and then boiling for a few minutes. The solution of benzoic acid from benzoin will become green; that from hippuric acid will become yellow or colorless, in consequence of a further reduction resulting from insufficient purification.

Exposed to the light, benzoic acid sublimed from benzoin becomes darker in color, and separates a few oily drops of a brown color.

Off. Prep.—Ammon. benzoas, Tinct. opii camphorata (composita), *U. S.*, *Br.*; Tinct. opii ammoniata, *Br.*

Medical Action and Uses.—Taken internally in doses of twenty grains, and repeated several times a day, benzoic acid irritates the throat, and is said to occasion a diffused sense of warmth over the whole body, and to increase expectoration and perspiration. In the urine it is converted into hippuric acid at the expense of the urea.

It is maintained by authorities of equal weight to be no less advantageous when the urine contains an excess of *uric acid*, than when it is *phosphatic*. Certainly, when the urine is excessively acid, this medicine, in doses of ten or more grains dissolved in a weak solution of carbonate or phosphate of sodium, will materially lessen its acidity. On the other hand, phosphatic urine may be rendered acid by means of twenty grains of benzoic acid given twice a day, and at the same time the accompanying local irritation will subside whenever the phosphatic state of the urine is due to derangements of the bladder. When, however, this state is owing to constitutional causes, the medicine is of no avail. Phosphatic deposits are apt to arise when the urine becomes ammoniacal in the bladder from the action of fermenting mucus, and to form masses in layers upon the lining membrane, or calculous concretions of the ammoniaco-magnesian phosphate. The due administration of benzoic acid maintains the acidity of the urine and prevents the formation of such deposits.

Incontinence of urine without any altered condition of this secretion, and depending probably upon irritability of the lining membrane of the bladder, has been frequently treated by this medicine with success.

Benzoic acid has some repute as a remedy for *jaundice*, but the conditions for its successful use are undetermined. It may be assumed, however, that it can only be employed with a hope of advantage when the jaundice is due to simple obstruction of the ducts by inspissated bile, whatever may be the remaining conditions of the liver.

In *chronic bronchitis* the fumes of benzoic acid have for a long time been inhaled advantageously, and more recently atomized solutions of the compound tincture, whose internal administration is of older date in the treatment of the same affection.

Administration.—The dose of benzoic acid is from ten to forty grains. To promote its solution in water, four parts of phosphate of sodium, or one and a half parts of borate of sodium may be added.

ACIDUM CARBOLICUM, *U. S.*, *Br.*—CARBOLIC ACID.

Acidum phenicum s. phenylicum crystallisatum.—Phenic acid, Phenylic alcohol, Phenol, E.; *Acide phénique, Acide carbolique, Hydrate de phényle*, Fr.; *Carbolsäure, Phenylsäure, Phenylalkohol*, G.

Formula HC_6H_5O. Molecular weight 94.

ACIDUM CARBOLICUM IMPURUM, *U. S.*—IMPURE CARBOLIC ACID.

Acide phénique cru, Fr.; *Rohe Carbolsäure*, G.

Origin.—Carbolic acid occurs in castoreum, in the urine of man and of herbivorous animals, and in the products of the dry distillation of various organic substances, such as resins, bones, wood, and more especially coal. It is from the latter source that it is obtained in the arts.

Preparation.—That portion of coal tar which is known as *dead oil* is subjected to distillation. The portion distilling between 150° and 200° C. (302° and 392° F.) is collected separately. It is agitated with warm concentrated solution of potassa and some solid potassa, when it crystallizes. On being dissolved in water, the empyreumatic oils separate, and are removed from the aqueous solution of the potassium phenylate, which, on being supersaturated with muriatic acid, yields the phenol in the form of an oily liquid. This is repeatedly agitated with water, then digested with chloride of calcium for the purpose of removing the water, and distilled. The portion passing over between 180° and 190° C. (336° and 374° F.) is collected separately, and exposed to a low temperature, when it solidifies into a crystalline mass, from which the mother-liquor is drained off and expressed. It may be again distilled or further purified by combining again with potassa, and repeating the operations described before.

This is the process of Laurent (1844). Another, proposed by H. Müller (1865), differs from the preceding mainly in the following particulars: The potassium or sodium phenylate is diluted with water as long as naphthalin and other empyreumatic products are separated. The liquid is exposed to the air for some days, by which it acquires a dark-brown color. It is filtered from the precipitated oxidation products, and then mixed with one-eighth or one-sixth of the total amount of sulphuric acid, which is necessary for the complete decomposition of the phenylate. Empyreumatic resins are thus separated, and on the addition of a second similar quantity of acid more resinous products and cresylic alcohol are removed, so that the third addition of the acid usually separates almost pure carbolic acid, requiring distillation to obtain it crystallized. It is obvious that if either process be interrupted at different points, carbolic acid varying greatly in degree of purity must be obtained.

Crude phenylic acid may, according to H. Müller, be purified by treating it several times with soda solution sufficient to combine only with a fractional portion of the phenol. The solutions first obtained contain the acid in a purer condition than the last; but, as stated above, they require dilution with water and exposure to the air.

Absolutely pure carbolic acid is obtained by Church (1871) from the nearly pure commercial product by treating it with a quantity of water (about 20 parts) insufficient to dissolve it completely, removing the undissolved portion, and saturating the clear aqueous solution with pure table salt, when the carbolic acid will separate as an oily layer, requiring distillation over some quicklime to obtain it crystallized. The portion passing up to 185° C. (365° F.) has, at ordinary temperatures, merely a very faint aromatic odor.

Pure carbolic acid is chiefly imported from England; most of the impure acid, and a very fair quality of nearly pure acid, used in this country are manufactured here.

Properties.—Impure carbolic acid is rarely colorless. It usually has a more or less dark-brown color, caused by the impurities derived from the coal tar. The better qualities crystallize almost completely below the ordinary temperature, the solidifying point being influenced by the amount of water and of oily impurities present in it. The latter are estimated by agitating the impure acid with one hundred times its bulk of warm water, and allowing the oily matters to separate, when they should measure not over 30 per cent. of the measure of acid employed. The aqueous solution should not have an alkaline reaction upon test-paper, thus indicating that it is not an alkaline solution of carbolic acid; and if it yields a clear solution with water, not less than 20 parts of this solvent should be necessary for this purpose. Its odor is more or less empyreumatic. In all other respects its properties agree with those of pure carbolic acid.

Absolutely pure carbolic acid has a faint aromatic odor, is colorless, crystalline, and does not absorb moisture from the atmosphere (Moss, 1875). Usually, however, it retains a minute quantity of water, by which it becomes deliquescent; with a little more of water it forms an oily liquid at ordinary temperatures, and if traces of the tar products are present, it acquires a reddish color on exposure. Its odor is modified by the presence of a little cresol. It is freely soluble in alcohol, ether, chloroform, bisulphide of carbon, glycerin, the essential and fatty oils, and in glacial acetic acid. The solubility of pure carbolic acid in water is variously stated: the German Pharmacopœia requires that it shall yield a clear solution when shaken with not less than 50, or at most 60 parts of cold water. It is soluble in from 20 to 33 parts of water, the purest being the most soluble (*U. S.*). Between 16° and 17° C. (60.8° and 62.6° F.) it dissolves in 15 parts of water (Hamberg, 1871). It dissolves in a solution of potassa and of other alkalies, and yields with concentrated potassa solution a crystalline mass, which, after being pressed, consists merely of carbolic acid, and is almost free from potassa. (Calvert, 1865.) Baumann (1877) observed that carbolic acid slowly decomposes a boiling solution of potassium carbonate, forming potassium phenol, which may be obtained in crystals from alcoholic ether. The fusing-point of crystallized carbolic acid is influenced by the amount of water with which it is combined; pure carbolic acid fuses at 40° to 41° C. (104° to 105.8° F.), and boils at 180° to 180.5° C. (356° to 357° F.) (Hamberg). The United States Pharmacopœia states that it is fusible at from 34° to 41° C. (93° to 106° F.) (35° C.=95° F. *Br.*), forming an oily liquid, and boiling at from 181.7° to 186° C. (359° to 367° F.) (187.8° C. =370° F. *Br.*), the higher melting and lower boiling points being those of the pure acid. The specific gravity of carbolic acid is 1.065; it coagulates albumen, and separates nitrocellulose in a gelatinous form from collodion. A piece of pine wood dipped into an alkaline solution of the acid and afterwards into muriatic acid assumes in the course of half an hour a deep blue color. According to Tiemann and Haarmann, this color is a characteristic reaction of coniferin. The solution of carbolic acid has no effect on polarized light. The concentrated alcoholic solution yields with ferric chloride a brown liquid, which, on the addition of much water, remains transparent, and assumes a beautiful and permanently blue color (Flückiger, 1872).

The chemical formula of carbolic acid is C_6H_5HO (phenylic alcohol). When heated in sealed tubes with ammonia, it yields but small quantities of phenylamina (anilina $C_6H_5H_2N$). Fused with excess of potassa, oxybenzoic and salicylic acids are found among the products of decomposition. It is oxidized by permanganate of potassium, yielding carbonic and oxalic acids. Concentrated sulphuric acid converts it into sulpho-carbolic acid $C_6H_5HSO_4$. Under the influence of nitric acid several substitution products are formed, the most important of which is picric acid. Substitution compounds are likewise formed with chlorine, iodine, and bromine.

Tests.—The purity of carbolic acid is recognized by the properties described above, and by the absence of all reaction upon blue and red litmus paper.

To estimate the quality of commercial carbolic acid, Schœdler (1872) recommends the heating of three grams in a water-bath to expel alcohol, if present, then the addition of three grams of sulphuric acid and the digestion of the mixture for some time at a temperature of 50° to 60° C. (122° to 144° F.). It is then diluted with water, treated with an excess of carbonate of barium, and filtered from the precipitate, which is well washed. The sulphocarbolate of barium contained in the filtrate is then precipitated by sulphuric acid, the sulphate of barium is collected, washed, ignited, and weighed; 100 parts of barium sulphate correspond to 80.69 parts of anhydrous phenol.

The presence of carbolic acid may be detected, according to Salkowski (1872), by adding to the suspected liquid one-fourth its volume of ammonia, and then a few drops of solution of chlorinated lime (1 part to 20 parts water). On the application of a moderate heat, a blue or greenish color will be produced, either immediately or in the course of fifteen minutes, the color changing to red upon acidulating with sulphuric or muriatic acid; 1 part of carbolic acid in 4000 may thus be detected. Of still greater delicacy (1 in 200,000) is the test suggested by Plugge (1872); when a liquid containing carbolic acid is boiled with a little solution of mercurous nitrate, containing a trace of nitrous acid, a reduction of the mercurous salt occurs, and the liquid assumes, sooner or later, an intense red color.

Pharmaceutical Uses.—For convenience in dispensing pure carbolic acid may be liquefied with 10 per cent. of water, or, as proposed by O. Facilides (1872), with the same quantity of glycerin; 11 grains of this liquid contain 10 grains of carbolic acid.

Off. Prep.—Glyceritum (glycerinum) acidi carbolici, *U. S.*, *Br.;* Suppositoria acidi carbolici, *U. S.;* Suppositoria acidi carbolici cum sapone, *Br.;* Ung. acidi carbolici, *U. S.*

Physiological Action. *On Animals.*—A detailed account of the operation of carbolic acid upon the lower animals may serve to illustrate its action in man when taken in poisonous doses, but can have only a slight bearing upon its therapeutical employment, which is confined almost exclusively to its use in checking fermentation, and as a local stimulant. A very small portion of the acid in water is speedily fatal to the minute organisms which may be present in the liquid. It is equally destructive to ascarides, earthworms, caterpillars, fleas, moths, ants, and other insects. Fish, frogs, and leeches soon die in a solution of five per cent. strength. Two or three drops applied under the wing of a sparrow will produce fatal convulsions. A five per cent. solution administered to dogs occasions convulsion, and then paralysis of sense and motion. After the animal's death there is found congestion of the brain, lungs, and bowels; but the blood is not notably affected. A solution of one part of the acid in four parts of alcohol, applied to a dog's ear, produced circumscribed swelling and an eschar; subsequently the tissues were found mummified and translucent, without being disorganized.

On Man.—The principal effects produced in man by medicinal doses of carbolic acid, as, for instance, six or eight grains in a wineglassful of water, are the following: numbness, followed by a sense of coolness in the mouth and lips; if the stomach is empty, nausea and an uneasy sensation in the abdomen, with vertigo, ringing in the ears, and slight deafness; the force and frequency of the cardiac and arterial impulses decline, and sometimes diarrhœa occurs. The urine is apt to be colored brown or black, according to the quantity of the acid employed, whether it be taken internally or applied to a raw surface of the skin; but this effect is more usual after its external application. It has been noticed in the urine of a nursing infant while the mother was using the acid. This change is by no means of uniform occurrence. It would seem to be peculiarly apt to be present when the urine is albuminous, and especially during Bright's disease. Occasionally in the same cases it varies from day to day, although the dose of the medicine and the condition of the patient appear to be unchanged.

In poisonous doses, of an ounce or more, carbolic acid produces an intense burning pain in the throat and stomach, followed by impaired muscular power and insensibility. The face is pale, the lips and hands livid; the pupils are dilated if death is rapid, otherwise they are contracted; the breath smells of the acid; the tongue is swollen, and a discolored foam is upon the lips; the respiration is stertorous, and the lungs are filled with dry or mucous rhonchi; the pulse may be rapid, or, on the other hand, abnormally slow; the urine is suppressed usually, but sometimes copious; the bowels are generally not disturbed. Death may occur as quickly as three minutes after a large draught of the liquid; but usually in fatal cases life is prolonged from one to three hours. The lesions found after death are: a purplish hue of the skin in dependent parts; a white or brown, dry, and shrivelled condition of the mouth, throat, and œsophagus; the gastric mucous membrane is more or less reddened, but also presents whitish patches, and is easily stripped off. The air-passages contain bloody and frothy mucus; the heart may be engorged or empty, but frequently contains firm clots; the brain is congested; the kidneys present no constant lesions, but in several cases carbolic acid has been detected in the urine. Poisonous effects may follow the external use of the acid, as numerous and even fatal cases attest. The toxical phenomena are chiefly those already mentioned as affecting the nervous and circulatory system, insensibility, feeble pulse, livid skin, and collapse. In cases that terminate favorably, these symptoms are replaced by stupor, debility, a feeble pulse, cold skin, etc. Vomiting, diarrhœa, and either increase or diminution of the secretion of urine have been observed. The local action of carbolic acid, when applied to the sound skin, consists in a burning or tingling sensation, followed by a marked diminution of sensibility. The part then undergoes a sort of mummification, as in the case of the experiments on animals, before noticed. There are cases in which, after the finger had been immersed in strong carbolic acid, this condition was established, and amputation of the part became necessary. The local anæsthesia referred to has been taken advantage of to render certain superficial operations painless.

The treatment of poisoning by carbolic acid consists in evacuating the stomach by copious albuminous drinks, such as milk or white of egg, or by the stomach pump injecting and then withdrawing such liquids. Oil is also of use by rendering the action of the acid less concentrated, and by delaying its absorption. The tendency to collapse should be combated by dry heat, and by enemata containing some alcoholic liquid.

Medical Uses.—The chief use of carbolic acid in medicine is to prevent or delay *fermentation*, especially of the putrefactive sort. Its power, in this respect, is almost identical with that of the closely analogous product, creasote. It is supposed to act by preventing the production and multiplication of certain minute organisms upon which this process is assumed to depend. Whether these organisms are the concomitants or the consequences of the process in question, is, perhaps, not fully demonstrated; but that carbolic acid restricts *suppuration*, and neutralizes the foul *smells* which accompany fermentation and gangrene, as well as those extricated during all forms of *putrefaction*, including the effluvia of dissecting rooms, privies, sewers, drains, etc., has become a matter of familiar experience. Its influence in promoting the cicatrization of wounds is readily understood without the necessity of invoking its antiseptic qualities, for like many allied substances (alcohol, creasote, terebinthinates) it operates as a stimulant to the parts to which it is applied, contracting and hardening them, while it protects them from the action of the atmosphere, and thereby limits those secretions which tend to prevent union in wounds, while it favors the natural processes through which alone healing can take place. Its combined antiseptic and stimulant properties have been found serviceable in many cases of *gangrene*, both traumatic and spontaneous, as in *noma pudendi*, *gangrene of the lung*, and in those cases of fetid discharge from the lungs, which are sometimes so distressing in *phthisis* and *chronic bronchitis*. In these affections it also tends to lessen the secretion of mucus and pus. In the last-named diseases it is best employed in the form of an atomized spray. In a gargle it may be used to cure affections of the *throat* accompanied with a fetid secretion. Its antiseptic virtues are displayed in fermentative or flatulent *dyspepsia*, although they are inferior to those of sulphurous acid and of salicylic acid. It is said to be an efficient remedy for *ascarides* of the rectum when administered by enema and sufficiently diluted to prevent excessive irritation, and also to have caused the expulsion of *tænia*. Its corrugating and more or less caustic and yet anæsthetic operation has been successfully employed in the treatment of *hæmorrhoids*, *venereal vegetations*, *nævi*, *boils*, *carbuncles*, *whitlows*, *uterine ulcers*, etc. Like creasote, it is an efficient palliative for *toothache* due to an exposure of the nerve pulp.

The *dose* of carbolic acid is one or two grains or drops. An atomized inhalation may be used, consisting of two or three drops of the acid in an ounce of water to which a little glycerine has been added. For a gargle, about twenty drops of the acid, in from two to four fluidounces of water and glycerine, may be employed. A preparation known as carbolized cotton is used as a surgical dressing.

The power of the acid to check fermentation has led to its use in the treatment of *saccharine diabetes*, on the supposition that the disease is due to an increase of the ferment which in the liver converts amyloid substance into sugar. The suggestion does not appear to have led to any confirmation of its value.

ACIDUM CARBONICUM.—CARBONIC ACID.

Carbonic anhydrid, E.; *Acide carbonique*, Fr.; *Kohlensäure*, G.
Formula CO_2. Molecular weight 44.

Formation and Preparation.—Carbonic acid gas is produced on the complete combustion of carbon or organic compounds in the presence of an excess of oxygen; diamond and graphite require a high heat for their combustion. Many organic compounds are readily oxidized at the ordinary temperature by chromic or permanganic acid, with the production of carbonic acid gas. But the best sources for preparing carbonic acid in a pure state are whiting, marble-dust, or similar native carbonates, which are decomposed by dilute sulphuric acid in an apparatus provided with a stirrer, to prevent the sulphate of calcium formed from enveloping the undecomposed carbonate. On a small scale and for obtaining a uniform current of carbonic acid gas, fragments of marble and diluted hydrochloric acid are used, whereby calcium chloride is formed, together with some water, and remains in solution: $CaCO_3 + 2HCl$ yields $CaCl_2 + H_2O + CO_2$. Should the gas possess a disagreeable odor, it may be deprived of it, according to Stenhouse, by passing it over granular charcoal; or, according to Hager (1868), by conducting it successively through solutions of ferric sulphate, sodium carbonate, permanganate of potassium and water, by which treatment it is freed from sulphuretted hydrogen and hydrocarbon.

Properties.—Carbonic acid, or more properly carbonic anhydrid, is a colorless, uninflammable gas, which has a slight pungent odor, colors moist litmus paper transiently red, and dissolves at the ordinary temperature in about an equal volume of water. It is heavier than atmospheric air, and is by pressure converted into a very mobile colorless liquid, which on the removal of the pressure boils rapidly, and is partly converted into white flakes of solid carbonic anhydrid. It unites with most of the basic hydrates, forming salts which, with the exception of the alkaline carbonates, are insoluble in water, but dissolve to a slight extent in carbonic acid water, and are decomposed by all mineral and most organic acids. Carbonic acid is bibasic; all the acid carbonates (bicarbonates) are decomposed by heat, carbonic anhydrid being evolved.

Pharmaceutical Uses.—In pharmacy carbonic anhydrid is almost exclusively employed in the preparation of carbonic acid water.

Medical History.—The practice of the ancients in burning aromatic herbs and conveying the fumes by means of tubes and appropriate apparatus into the vagina, is, in reality, an example of treatment by carbonic acid; for this gas is the chief product of the combustion of such substances. It is probable that from a remote period the anti-emetic action of natural mineral waters impregnated with carbonic acid was recognized. It is certain that more than two hundred years ago the effervescing draught of Riverius, which owes its virtues to this gas, was used for the same purpose, and so continues to be employed at the present time. After Priestley had isolated the gas, it was speedily introduced into medicine by the English physicians of the last quarter of the eighteenth century, as a remedy for the low forms of fever called "putrid," and its use to check or prevent vomiting became general. It was also extensively employed by inhalation, and, like other new medicines, was proclaimed by zealous and incautious physicians to be a specific for nearly every disease, including pulmonary consumption.

Physiological Action. *On Animals.*—Dogs obliged to breathe a mixture of one part of carbonic acid with nine parts of atmospheric air, are thrown into an anæsthetic sleep, which leaves no ill effects behind; when the proportion of the former gas is increased to one-fifth, one-fourth, or one-third, the effects are more marked, muscular resolution is more complete, and when the largest proportion is used, the blood in the arteries assumes a dull hue. When the gases are used in equal proportions, and until death ensues, the animal urinates, its pulse grows frequent, the breathing labored, and the surface of a wound livid; after which the respiration fails, the heart beats feebly, and complete muscular relaxation, interrupted by slight spasms, precedes death. The blood is found very dark; the heart contains but little of it and without clots; the lungs are engorged; the bronchia are filled with bloody froth; the vesicular structure presents many apoplectic infarctions. Finally, when the proportion of carbonic acid to oxygen is as three to one, the first effect is convulsion followed by complete anæsthesia even of exposed nervous trunks, and slowness of the pulse; yet, if the inhalation is not continued, the animal revives. If, on the other hand, it is urged to a fatal result, death occurs as in the previous experiment, and the same lesions are found, except that the heart as well as the lungs is gorged with blood. (Demarquay.) It would appear that the gas has no direct influence upon the blood, and that the dark color acquired by this liquid is due to an arrest of respiration depending upon the action of the gas upon the brain and medulla oblongata. When it is slowly administered, and death thereby retarded, the temperature of the body falls, and sugar is found in the urine. The respiration of pure carbonic acid is impossible, since an exchange of gases, which is the essence of the respiratory act, can no more take place in this gas than it can in water, and death by asphyxia is the immediate result.

On Man.—Sufficiently diluted with atmospheric air, this gas is more or less respirable. In the proportion of one-half or more its inhalation causes a prickling in the nostrils and larynx more agreeable than otherwise, together with a sense of constriction and oppression in the chest, headache, giddiness, and ringing in the ears, followed by unconsciousness, dilatation of the pupils, sometimes congestion of the face, and, if relief be not at hand, fatal congestion of the brain. Even when the proportion of the gas is less, it causes more or less giddiness, constriction of the præcordia, and feebleness of the legs; the pulse, which at first is fuller and stronger, becomes feebler, the respiration is slow and shallow, and the mind and senses are more or less confused. In moderate or medicinal portions the primary action of the gas is sensibly stimulant, but secondarily it inclines to repose and sleep. In these experiments on man, no evidence has been given of the anæsthetic influence of the gas, and it is probably not developed until a state of dangerous narcotism is induced. Some cases of death are recorded from the emanations of certain fissures in the earth, like the Grotto del Cane. In the case of a young man who died in this manner in the Grotto of Pyrmont, the appearance of the corpse was that of a person in natural sleep. There was no congestion of the face, the pupils were dilated, and the cornea brilliant; the brain was deeply congested, the lungs distended and not engorged; the jugular veins were also distended, but the heart contained very little blood. These conditions are as opposite as possible to those induced by asphyxia from the fumes of charcoal, and do not perfectly harmonize with those produced in animals, as described above. When the body except the head is immersed in a vessel of this gas, a sense of heat and prickling is experienced over the entire surface, but especially where the integument is delicate, and is accompanied with perspiration and redness. The pulse, according to some, is quickened, according to others is retarded. If the operation is sustained for half an hour, the head throbs and the senses are dulled; the respiration is labored, and borborygmi and colic occur. When a limb is exposed for some time to the action of the gas, the sensibility of the skin is obtunded; and if the exposed surface is a wound, it becomes the seat of smarting pain followed by impaired sensibility; but the tissues grow redder. Water impregnated with the gas causes a prickling sensation in the mouth, fauces, and nostrils, a sense of warmth in the stomach, and a transient cerebral excitement. It also appears to quench thirst far better than water alone. The gas liberated in the stomach is mainly discharged by eructation, but it seems to stimulate the gastric secretions and promote digestion. It also increases the quantity of urine, and is said to augment the oxalates and carbonates in that secretion.

Medical Uses.—The administration of carbonic acid gas by inhalation was orignally in vogue as a remedy for pulmonary *phthisis*, *chronic bronchitis*, and *laryngeal diseases*. Many of the leading English physicians vouched for its efficacy, and very possibly it may have palliated the cough, and lessened the secretions in these affections; but much more efficient remedies have supplanted it. The same remark may be made respecting *asthma*. One of the most useful internal applications of this gas is to allay *vomiting* caused by irritability of the stomach. It often subdues this symptom promptly when given in the effervescing draught, in plain carbonated water, or in champagne wine. The liquid should always be cold, and, if possible, iced. Several cases of *intestinal obstruc-*

tion, the precise nature of which does not appear, have been relieved by allowing carbonic-acid water to escape from a siphon bottle through a long tube into the bowel. In one case relief was obtained by injecting successively the two ingredients of a "soda powder" in solution.

The most important uses of carbonic acid are those in which it is used in water as a local stimulant. There can be no doubt that in its combined stimulant and anæsthetic properties reside the virtues which have long been recognized in the yeast poultice and other fermenting cataplasms, applied to *ulcers*, simple, cancerous, etc. Injections of carbonated water have been found to afford great relief in many cases of *cancer* of the uterus, rectum, and other parts; and a similar result has been obtained from maintaining a current of the gas in contact with the uterus in ulcerated states of that organ, and also in certain cases of uterine *leucorrhœa*, *dysmenorrhœa*, *amenorrhœa*, etc. The carbonic acid gas douche has also been successfully employed to induce *premature labor*.

The treatment of poisoning by this gas consists in measures adapted to expel it from the lungs, to stimulate the nervous system, and to introduce atmospheric air or oxygen in its place. For the first purpose artificial respiration by mechanical and electrical means is indicated; for the second, active stimulation of the skin mechanically, by warmth and by irritants, and the injection of a strong infusion of coffee into the rectum; if any oxygen gas can be procured it may be forced through a laryngeal tube into the lungs.

ACIDUM CATHARTICUM.—Cathartic Acid.

Acide cathartique, Fr.; *Cathartinsäure*, G.
Formula $C_{180}H_{192}N_4O_{82}S$. (?)

Preparation.—Cathartic acid was discovered by Dragendorff and Kubly (1866), and exists in senna leaves combined with magnesium and calcium. The infusion of senna prepared with hot water is concentrated to a syrupy consistence and mixed with an equal bulk of absolute alcohol; the liquid filtered from the precipitated mucilage and salts is mixed with more absolute alcohol as long as a precipitate is produced. This precipitate is washed with alcohol, dissolved in a little water, freed from albumen by a few drops of hydrochloric acid, and the filtrate completely precipitated by the addition of more hydrochloric acid; the impure cathartic acid thus obtained is purified by dissolving in 60 per cent. alcohol and precipitating by ether. T. B. Groves (1868) takes advantage of the colloidal properties of cathartic acid, and purifies it by dissolving the crude cathartate in moderately strong hydrochloric acid, and subjecting the solution to dialysis on a diaphragm of parchment paper.

Properties.—Thus obtained cathartic acid is a brown, and after drying a black, amorphous substance, which is insoluble in water, but dissolves in alkalies, from which solutions it is again precipitated by acids. The cathartates of the alkalies and alkaline earths are soluble in water, but insoluble in alcohol. On boiling the alcoholic solution of cathartic acid with hydrochloric acid, it yields 34 per cent. of glucose, and 65 of *cathartogenic acid*, $C_{132}H_{116}N_4O_{44}S$. (?), which is a yellowish-brown powder, insoluble in water and ether. According to Groves, the long-continued action of heat on cathartates exposed to air in watery solution, is to decompose them, rendering them inert; organic acids added to the aqueous solutions of cathartates, precipitate cathartic acid, but unlike the mineral acids, do not decompose it on boiling.

Medical Action.—This substance appears to be the chief cathartic element of senna. In the dose of from one and a half to three grains, it occasions griping pains and liquid yellow stools.

ACIDUM CHROMICUM, *U.S.*—CHROMIC ACID.

Chromic anhydrid, E.; *Acide chromique*, Fr.; *Chromsäure*, G.
Formula CrO_3. Molecular weight 100.5.

Preparation.—This acid, discovered by Vauquelin (1797), is readily obtained on pouring three measures of concentrated sulphuric acid into two measures of a cold saturated solution of bichromate of potassium in water, the reaction occurring as follows: $K_2Cr_2O_7 + 2H_2SO_4 = 2CrO_3 + 2KHSO_4 + H_2O$. The French Codex gives the following directions: Dissolve, with the aid of heat, one part of bichromate of potassium in 10 parts of water, allow the solution to cool to 25° C. (77° F.), and add in small portions and with continued stirring, 20 parts of sulphuric acid spec. grav. 1.84; set the mixture aside for 24 hours, and then decant the liquid. Collect the crystals in a glass funnel, the neck of which is imperfectly closed with fragments of glass, drain and finally dry the acid by keeping it for two days upon porous tiles in a drying closet at 35° C. (95° F.).

Properties.—Thus obtained, it occurs in needles or quadrangular prisms of a deep crimson-red color, deliquescent, and very soluble in water; the concentrated solution is of a red-brown color, which changes to orange on being diluted. Gradually heated, the crystals assume a blackish-brown color, and then fuse into a reddish-brown liquid at a temperature of 180° to 190° C. (356° to 374° F.), which on cooling becomes a red opaque brittle mass. At a higher heat the acid is decomposed into oxygen and chromic oxide. If strong alcohol is dropped upon the acid, a vigorous action takes place accompanied with increase of temperature and ignition of the alcohol. Chromic acid dissolved in diluted alcohol is gradually deoxidized at the ordinary temperature, the alcohol being converted into aldehyd and acetic acid. The same reduction takes place in the presence of arsenious, sulphurous, and hydrosulphuric acids, and of organic compounds and deoxidizing agents generally.

Chromic acid contains no water of crystallization; its salts have mostly a yellow or yellowish-red color; those of the alkalies and of magnesium are soluble in water; all others dissolve in nitric acid.

Tests.—Sulphuric acid and bichromate of potassium may contaminate chromic acid. The former is detected by adding to its hot aqueous solution some hydrochloric acid, deoxidizing with alcohol until the liquid becomes green, and then adding some chloride of barium, when a white precipitate will be produced; the latter, by concentrating the green solution as much as possible, and adding a concentrated solution of tartaric acid, when crystalline bitartrate of potassium will be separated.

Pharmaceutical Uses.—In prescriptions, chromic acid should never be combined with organic or deoxidizing mineral compounds. In liquid form it should be dissolved in distilled water. The *solution* of the French Codex is made of equal parts of chromic acid and distilled water, and has a specific gravity of 1.47.

Physiological Action.—Chromic acid is one of the most energetic of caustics. At a moderately high temperature it rapidly dissolves all animal tissues immersed in it, including even hair, bones, and teeth. When at ordinary temperatures it is applied to the skin, it renders that tissue first moist, and then brown, and finally black, forming an eschar of one or two lines in thickness, which separates within forty-eight hours, leaving a granulating surface which tends to heal rapidly. According to the degree of its concentration it may be deeply or superficially caustic, or merely astringent and drying.

Medical Uses.—Among caustics none is superior or even equal to chromic acid for the purpose of removing *warty* and other similar growths from the skin and the mucous membranes. *Condylomata*, *warty* growths, especially such as occupy a considerable surface, *vegetations* of the genital, and especially of the female genital, organs, are promptly destroyed by it, and with far less pain than is inflicted by caustic potassa. Chromic acid is one of the best applications that can be made to the *gums* when they tend to ulceration and retraction, especially in scrofulous patients, as well as to scrofulous and syphilitic ulcers of the *pharynx* and the mouth. Similar affections of the interior of the *larynx*, œdema of this organ, and especially tumors of the vocal cords and adjacent parts have been cured by a skilful cauterization with chromic acid, aided by the laryngoscope. A mild solution may at first be used, but subsequently one containing one part of acid to eight of water, or even of twice that strength, may be applied by means of a small, fine, and compact piece of sponge. Various chronic affections of the skin, as the *tineæ*, *sycosis*, and *lupus*, are appropriate for its use. Its prompt and powerful action renders it one of the very best applications for arresting surface *hemorrhage*, and in a diluted state it is a valuable stimulant for indolent *ulcers*. Uterine *hemorrhage*, depending upon laxity of the tissues of the organ, has been successfully treated by the insufflation of a few drops of the acid. In the treatment of *uterine leucorrhœa* no other caustic is more efficient than this; but it should be introduced cautiously by means of a syringe having a lateral opening near the end of its tube, and the superfluous liquid should be withdrawn when the syringe is removed. The previous dilatation of the neck of the uterus facilitates the operation and the cure. If the acid is too strong, it may give rise to permanent stricture of the canal of the cervix. This tendency to cause contraction of the tissues to which it is applied has sometimes been taken advantage of to relieve *incontinence of urine* in the female due to relaxation of the urethra. When this infirmity is connected with *irritable tumor* of the urethra, the acid will sometimes save the necessity of employing cutting instruments. In applying this powerful caustic in a concentrated state, the deliquescent crystals for instance, great care should be taken to protect the adjacent sound tissues by means of adhesive plaster or simple ointment, and all superfluous acid should be immediately removed with a pledget of wet lint. The acid should be applied by means of a glass or porcelain rod or spatula. Diluted solutions may be used with a camel's hair brush, which immediately afterwards should be well washed with water.

ACIDUM CHRYSOPHANICUM.—CHRYSOPHANIC ACID.

Acide chrysophanique, Fr.; *Chrysophansäure*, G.

Formula $C_{14}H_{10}O_4$. Molecular weight 242.

Origin.—This acid was first obtained in a resinous condition by Schrader (1819) from a common lichen, Parmelia parietina, *Lin.*, was obtained pure by Rochleder and Heldt (1843), soon after prepared from rhubarb by Schlossberger and Döpping (1844), and also found in the roots of Rumex, and of cultivated rhubarb. *Parietin*, *parietinic acid*, *rhein*, *rhabarbarin*, *rhabarbaric acid*, *rhaponticin*, *lapathin*, and *rumicin* are names formerly given to the more or less impure acid, as obtained from the sources designated. Attfield (1875) found it in Goa powder (see *Araroba*).

Preparation.—The common wall lichen is exhausted with weak alcohol containing potassa in solution, the tincture precipitated by acetic acid, and the yellow flakes crystallized from alcohol (Rochleder). The precipitate occurring in tincture of rhubarb yields chrysophanic acid on treating it with benzol. Or rhubarb may be exhausted with cold water, and the residue after drying, with benzol; on concentrating the benzol solution chrysophanic acid crystallizes on cooling (Schlossberger). By the last-mentioned process it is abundantly obtained from Goa powder (Attfield).

Properties.—Chrysophanic acid is a granular, pale, or orange-yellow powder, and when pure crystallizes in bright yellow needles or plates, is inodorous and nearly tasteless. It fuses at 162° C. (323.6° F.), and sublimes on carefully regulating the heat. It is almost insoluble in cold water, but imparts a bright yellow color to boiling water, and requires 224 parts of boiling 86 per cent. alcohol for solution. It crystallizes from its concentrated solutions in hot alcohol, amylic alcohol, glacial acetic acid, and ether, and is freely soluble in benzol and the hydrocarbons of coal-tar. Strong sulphuric acid dissolves it with a bright red color, and separates it again in yellow floccules on adding the solution to water. Alkalies dissolve it with a deep-red color; the solutions produce with alum a rose-colored lake, and with lead salts precipitates which may vary in color from yellowish to pinkish, or bright red.

Medical Action and Uses.—Experimenters with this substance do not agree respecting its action. While the greater number declare it to be destitute of purgative properties, some assert that in the dose of seven grains it begins to purge about twenty-four hours after administration, and that its action is maintained for several days. Some assert, and others deny, that it is eliminated by the urine. Probably the purgative action of rhubarb does not depend alone upon this principle. An ointment, made with from twenty to sixty grains of the acid melted with an ounce of lard, has been found extremely efficient in chronic *psoriasis*. When applied to the face or scalp, it is very apt to cause redness of the eyes, and erythema with swelling of the skin, followed by desquamation of the cuticle. It has the further inconvenience of staining the skin and the hair yellow, especially after the use of soap and water, and of dyeing the linen of a permanent dingy-purple color. The stain of the skin and hair may be removed by means of a weak solution of caustic potash. In consequence of these annoyances some patients refuse to continue its use.

ACIDUM CITRICUM, *U.S.*, *Br.*—CITRIC ACID.

Acidum citri s. limonum s. limonorum.—*Acide citrique; Acide du citron,* Fr.; *Citronensäure,* G.

Formula $H_2O.H_3C_6H_5O_7$. Molecular weight 210.

Origin.—This acid occurs in a large number of plants, either in the free state, or combined with potassium or calcium, and frequently associated with malic acid. It has been found in the rhizomes of Asarum europæum and Sanguinaria canadensis, in the tubers of dahlia and Jerusalem artichoke, in the herb of lactuca and tobacco, and in many fruits, such as capsicum, tomatoes, tamarinds, cherries, gooseberries, raspberries, whortleberries, cranberries, blackberries, strawberries, etc. It occurs most abundantly, however, and as free acid, in the fruits of the Aurantiaceæ, and is prepared in large quantity from the juice of the lemon and the lime.

Preparation.—Citric acid is manufactured in England on a large scale from lemon and lime juice, which is obtained from Italy. The juice is exported, either in its natural condition, or considerably concentrated by evaporation, or else in the form of a crystalline powder, as citrate of calcium or magnesium. Recently Messrs. Powers & Weightman have undertaken to prepare it in this country from sour oranges raised in Florida. The juice is clarified by ebullition, or if obtained from unsound fruits, by allowing it to undergo the vinous fermentation. After decantation and straining, an excess of chalk (carbonate of calcium) is added, and finally some milk of lime. The citrate of calcium thus formed being less soluble in hot than in cold water, the mixture is heated to boiling, and while hot the clear liquid is drawn off from the precipitated citrate of calcium, which is washed with some boiling water for the purpose of removing all the extractive matter. The calcium citrate is now decomposed by diluted sulphuric acid in such a proportion as to form sulphate of calcium, and to leave a little sulphuric acid in excess. 10 parts of citrate of calcium require about 9 parts of sulphuric acid diluted with from 50 to 60 parts of water. The solution of citric acid is drawn off from the precipitated sulphate of calcium, and the latter washed with cold water. The liquid with the washings is evaporated by steam-heat to a syrupy consistence, and then allowed to crystallize in suitable tanks lined with lead. The presence of some sulphuric acid appears to favor crystallization, which is prevented or considerably retarded by acid citrate of calcium. The crystals are redissolved in a small quantity of water, and the solution is treated with animal charcoal, and then evaporated to crystallize. These directions agree in the main with those given in the British Pharmacopœia. Citric acid may be prepared by this process from the juice of other acidulous fruits; Granger has recently (1873) described the manipulations necessary to obtain it advantageously from whortleberries.

Properties.—Citric acid crystallizes in colorless rhombic prisms, which have an agreeable acid taste. It dissolves in three-fourths of its weight of cold, and in half its weight of boiling water; it is also soluble in alcohol and in ether (insoluble in pure ether, *Br.*). When a solution is made by dissolving 34 grains of the crystals in one ounce of water, it resembles lemon-juice in strength, and in the nature of its acid properties, and, like lemon-juice, it undergoes decomposition, and becomes mouldy by keeping. The crystals are permanent in dry air; but in a damp atmosphere they become moist, and gradually deliquesce. They melt at 100° C. (212° F.) in their water of crystallization; the anhydrous acid fuses at 150° C. (302° F.), and at a higher heat is decomposed, evolving empyreumatic vapors of an odor resembling that of burnt sugar, and producing a bulky charcoal, which is finally burned without leaving any residue.

Citric acid is a tribasic acid having the formula $H_3C_6H_5O_7$, or, as met with in the crystallized condition, $H_3C_6H_5O_7 + H_2O$. The water of crystallization is expelled at 100° C., and at 155° C. (311° F.) another molecule of water is given off, *aconitic acid*, $H_3C_6H_3O_6$, remaining behind, which is identical with the acids that have been isolated from aconite, yarrow, and other plants. Like citric acid it forms three series of salts, either one, two, or three atoms of hydrogen being replaceable by a basylous radical.

The citrates of the alkalies are all soluble in water; the neutral citrates of the heavy metals are mostly insoluble in water, but dissolve in nitric, and many also in citric acid. Ferric and aluminium citrates are not precipitated by alkalies. That the calcium citrate is soluble in cold, and insoluble in hot water has been already mentioned. If lime-water is not completely neutralized by solution of citric acid, no precipitate will occur until the liquid is heated to boiling. 70 grains of citric acid dissolved in distilled water are neutralized by 1000 grain measures of the volumetric solution of soda (*Br.*).

Impurities and Adulterations.—The impurities which may be present in citric acid in consequence of carelessness in its manufacture, may be sulphuric acid, calcium, iron, lead, and copper. Minute fragments of metallic lead are occasionally observed adhering to some of the crystals. Sulphuric acid is readily detected in the aqueous solution of citric acid by the white precipitate occurring with chloride of barium; iron by the blue color occasioned by ferrocyanide of potassium; and lead and copper by the black coloration or precipitate resulting from sulphuretted hydrogen. For the detection of calcium, it is advisable to neutralize the citric acid solution with ammonia, then to acidulate with acetic acid, and add oxalate of ammonium, when a white precipitate of oxalate of calcium will appear.

Tartaric acid is occasionally used as an adulteration, and oxalic acid and various crystallized salts are said to have been employed for the same purpose. Such frauds are usually accomplished by mixing the foreign compounds in a crystalline form with the acid, and it is therefore necessary to employ a larger quantity, say several ounces, of the large and small crystals, to be triturated in a mortar into powder. Many of the salts will be found to be insoluble in alcohol, and may thus be detected, or by the residue left on incinerating a portion of the powder upon platinum foil. The aqueous solution of the powder is neutralized with ammonia, and then acidulated with acetic acid. Upon adding chloride of calcium, oxalic acid, if present, will be precipitated as white oxalate of calcium. The clear filtrate, neutralized with ammonia, will deposit white tartrate of calcium if tartaric acid be present, and the filtrate from it will, on boiling, throw down citrate of calcium. Tartaric acid may also be recognized by dissolving some of the powder in diluted alcohol, and adding a concentrated solution of acetate of potassium, when a white crystalline precipitate of bitartrate of potassium will occur. Or a number of crystals of different sizes are placed upon a glass plate in some potassa solution. The crystals of citric acid will remain transparent, while the crystals of tartaric acid will become opaque in consequence of the formation of bitartrate of potassium.

Off. Prep.—Ferri et ammon. citras, Ferri et quiniæ citras, *Br.;* Ferri pyrophosphas, *U. S.;* Liquor ammonii citr., Liq. bismuthi et ammon. citr., *Br.;* Liq. ferri citr., Liq. potass. citr., *U. S.;* Liq. magnes. citr., Lith. citras, Potass. citras, *U. S.*, *Br.;* Sodæ citro-tartras effervescens, *Br.;* Syrupus acidi citrici, *U. S.*

Physiological Action.—Experiments with citric acid on cats, rabbits, and other animals, illustrate the necessity of caution in founding opinions upon such grounds exclusively. To these creatures citric acid is a powerful poison, lowering sensibility and the heart's force, and producing violent tetanic spasms. That these phenomena are not occasioned by gastric irritation is proved by the absence after death of all inflammatory lesions of the stomach. The blood appears to have been unusually liquid. In man, on the other hand, not only are no spasmodic or other alarming symptoms produced by citric acid, but it does not diminish the coagulability of the blood; so far from this, indeed, in the form of lemon-juice it is of all agents the most efficient in correcting that incoagulability of the blood which is characteristic of scurvy. When largely administered, it increases the acidity of the urine, causing a deposit of free uric acid.

Medical Uses.—The most useful application of lemon-juice and citric acid is to the prevention and cure of *scurvy*, a purpose which long and extensive experience has proved them admirably fitted to fulfil. Of the two, lemon-juice is by far the most efficacious, and the opinion that its efficiency is not due to the acid alone, is shown not only by this comparison, but also by the well-known fact that many fresh vegetables are endowed with a similar power. The use of lemon-juice in the treatment of acute articular *rheumatism* was at one time confidently relied on, but is no longer in vogue, and the article is employed only as a means of assuaging the thirst and reducing the febrile heat, as it also is in various other diseases of which *fever* is a prominent symptom. It may also be used with some advantage during *hemorrhage*, but its direct effect upon this symptom is slight, indeed, when compared with that of the mineral acids. The practice of arresting post-partum hemorrhage by squeezing out the juice of a cut lemon within the cavity of the uterus, deserves attention, less from the coagulating action of the acid than from the stimulation exerted by it upon the interior of the womb, which is at the same time mechanically irritated. It is of some advantage in *jaundice* depending upon congestion of the liver, and may be employed as an antidote to alkaline and narcotic poisons. It forms an agreeable application in *diphtheritic angina* and in *gangrenous sore mouth*, and has been used with striking advantage to relieve *pruritus* of the genital organs.

ACIDUM FORMICICUM.—Formic Acid.

Acide formique, Fr.; *Ameisensäure*, G.
Formula $HCHO_2$. Molecular weight 46.

Origin and Preparation.—It is found in ants (*Formica rufa*, Lin.), in some caterpillars, old oil of turpentine, nettles and other plants, and is formed by the action of black oxide of manganese and sulphuric acid or of chlorinated lime upon sugar, starch, and other carbohydrates and allied compounds. Lorin (1865) observed that, in the presence of glycerin and some water, oxalic acid is readily decomposed into formic acid and carbonic acid gas; $C_2H_2O_4$ yields $CH_2O_2 + CO_2$. Berthelot prepares it by heating in a retort 10 parts each of oxalic acid and glycerin and 1 or 2 parts of water to a little over 100° C. (212° F.). After about 12 hours the decomposition is complete, and the formic acid still remaining in the retort is obtained by adding repeatedly 5 parts of water and distilling.

Properties.—Anhydrous formic acid is a colorless liquid of 1.235 sp. gr., crystallizing below the freezing point of water, having an acid odor, and producing a burning sensation when applied to the skin. Diluted with water, it is less caustic. It is readily soluble in water and alcohol. Its salts are soluble in water, and impart to solutions of ferric salts a dark brownish-red color which disappears on the addition of hydrochloric acid. When heated with solutions of the salts of mercury, silver, gold, and allied metals, these are reduced to the metallic state. The lead salt is nearly insoluble in alcohol. The following preparations have been employed:—

SPIRITUS FORMICARUM, P. G. 10 parts of recently gathered bruised ants and 15 parts each of alcohol and water are macerated for 2 days, after which 20 parts are distilled. It is a colorless liquid of an acid reaction, which, when mixed with $\frac{1}{20}$ of its weight of solution of subacetate of lead, becomes filled with feathery crystals.

AMMONII FORMIAS, NH_4CHO_2, is obtained by neutralizing the acid with ammonia and evaporating to crystallization. It is in colorless prisms of a refreshing pungent taste, fuses at about 100° C. (212° F.), and when rapidly heated to 180° C. (356° F.) is decomposed into hydrocyanic acid and water; NH_4CHO_2 yields $HCNO + 2H_2O$.

Physiological Action.—Upon the skin this acid acts as an irritant and vesicant, and if its contact is prolonged it may produce a slough. Administered to rabbits it produces inflammation of the gastro-intestinal mucous membrane and a discharge of bloody urine. Two drachms in a pint of water occasioned excitement of the circulation, increased heat, hurried breathing, and diuresis, in a horse. In man similar effects have been noted. In gouty patients it is reported to have caused a discharge of muddy and ill-smelling urine.

Medical Uses.—Formic acid was at one time used internally as a stimulant as ammonia is generally employed; and externally, like that irritant, for the relief of local *neuralgic* and *rheumatic* pains, etc. The German Pharmacopœia contains a *spiritus formicarum* which is prescribed in doses of from twenty to sixty drops. Formiate of ammonia has been used in chronic *paralysis* and in *epilepsy*, but uselessly. *Dose*, about five grains.

ACIDUM GALLICUM, *U. S.*, *Br.*—Gallic Acid.

Acide gallique, Fr.; *Gallussäure*, G.
Formula $H_3C_7H_3O_5.H_2O$. Molecular weight 188.

Origin.—Gallic acid is found in nutgalls, sumach, uva ursi, and in a number of other astringent plants. It is most advantageously prepared from galls by

Scheele's process, as modified by Pelouze and Robiquet, for which the Pharmacopœia gives the following directions :—

Preparation.—Take of Nutgall in fine powder 36 troyounces; purified Animal Charcoal and Distilled Water, each a sufficient quantity. Mix the nutgall with sufficient distilled water to form a thin paste, and expose the mixture to the air, in a shallow glass or porcelain vessel, in a warm place, for a month, occasionally stirring it with a glass rod, and adding from time to time sufficient distilled water to preserve the semifluid consistence. Then submit the paste to expression, and, rejecting the expressed liquid, boil the residue in eight pints of distilled water for a few minutes, and filter, while hot, through purified animal charcoal. Set the liquid aside that crystals may form, and dry them on bibulous paper. If the crystals be not sufficiently free from color, they may be purified by dissolving them in boiling distilled water, filtering through a fresh portion of purified animal charcoal, and again crystallizing. *U. S.*

The process of the British Pharmacopœia is, with the following modifications, essentially the same: The coarsely powdered galls and water are exposed for six weeks at a temperature of between 15° and 21° C. (60° and 70° F.); the mass is then boiled with more distilled water, the crystals formed in the strained liquid are strongly pressed between bibulous paper, and then recrystallized from boiling distilled water without the use of animal charcoal.

Other processes have from time to time been suggested, the most important of which are based upon the observation of Liebig that tannin, when boiled for some time with somewhat diluted sulphuric or muriatic acid, or for a few seconds with potassa solution, is converted into gallic acid.

The officinal directions are so clear that the preparation of gallic acid by them presents no difficulties, and the only additional precaution that deserves to be mentioned is the avoidance of its contact with iron and iron salts, which would impart to the acid a color difficult to remove.

Formation.—The conversion of tannin into gallic acid has been the subject of much controversy, involving numerous researches. It was at first supposed that gallic acid existed ready formed in galls; the experiments of Pelouze (1833) proved that most of it is formed from the tannin contained therein, and this conversion he supposed to be due to the oxidizing influence of oxygen, by which carbonic acid was eliminated. Robiquet (1837) found that the tannin of galls is converted into gallic acid without the admission of oxygen and without the evolution of gas. He ascribed this to the action of a ferment present in the galls, which was subsequently named *pectase.* Laroque's experiments (1841) supported this view. That the growth of mould upon the infusion of galls is without influence upon the production of gallic acid was proven by Winckler (1835). C. Wetherill (1847) advanced for the first time the opinion that gallic acid differs from tannin merely by containing additional water, and he was supported in this theory by the investigations of Mulder (1848). Meanwhile Liebig had suggested that in the transformation of tannin into gallic acid a carbohydrate was liberated; and Strecker's experiments (1854) appeared to furnish conclusive proof that tannin is a glucoside, which on being boiled with diluted mineral acids yields theoretically 82.5 per cent. of gallic acid. The quantity obtained was, however, in excess of this figure, and Stenhouse, Knop, Rochleder, and others proved that gallic acid, almost equalling the weight of tannin used, could be thus obtained. Robiquet (1854) considered this result due to molecular change accompanied by hydration, whereby tannin is transformed into gallic acid just as cane-sugar under similar influences is transformed into grape-sugar. This view, however, did not explain why, on the treatment of tannin with diluted acids, glucose was obtained in variable quantities. Hlasiwetz (1867) suggested that it probably was not a true glucoside, owing to the difficulty with which the glucose is obtained. The relation of the two compounds to each other appears to be finally settled by the recent researches of

H. Schiff, Sac, and J. Löwe (1871 and '72), according to which pure tannin is *digallic acid*, an anhydrid of gallic acid, the conversion of the former into the latter occurring as follows: $C_{14}H_{10}O_9 + H_2O = 2C_7H_6O_5$; and the sugar observed in the preparation of gallic acid is referable to the glucose which naturally exists in galls, and from which tannin is with difficulty purified. Löwe prepared pure tannin from galls, and Schiff succeeded in converting gallic acid into tannin absolutely free from glucose.

Properties.—Gallic acid is in fine white or pale fawn-colored silky needles, which have a slightly acid and astringent taste, and are inodorous. It is soluble in 100 parts of cold and three parts of boiling water. The solution has an acid reaction, and gives no precipitate with ferrous sulphate. With ferric salts a bluish-black precipitate is obtained, which disappears on boiling. It is not precipitated by solution of gelatin except in the presence of gum, and yields no insoluble compounds with vegetable alkaloids. Gallic acid is freely soluble in alcohol, less in ether. At 100° C. (212° F.), it loses 9.5 per cent. of water of crystallization. Heated to between 200° and 215°C. (392° and 419°F.), it yields carbonic acid gas and a sublimate of pyrogallic acid $= C_6H_6O_3$. It is entirely dissipated by heat.

The formula of crystallized gallic acid is $H_3C_7H_3O_5.H_2O$. Most of its salts, those with the alkalies excepted, are insoluble in water. When perfectly dry, they keep unaltered, but in the presence of water and particularly of alkaline liquids, they are speedily decomposed, becoming brown and black. Solutions of salts of silver, gold, platinum, and the allied metals, are gradually reduced by gallic acid and its salts at the ordinary temperature.

The solutions of the salts of *pyrogallic acid*, like the moist acid itself, become reddish and dark brown on oxidation; and readily reduce the salts of the metals mentioned before. The acid is used in connection with silver nitrate in photography, and for hair dyes and marking inks. Stains produced by this acid in linen are best removed by washing with alcoholic solution of oxalic acid and exposure to the sun.

Impurities and Adulterations.—Tannin is indicated in the aqueous solution of gallic acid by the white curdy precipitate produced on the addition of a solution of gelatin. Resinous substances would be insoluble in boiling water; sugar and dextrin would remain undissolved on treatment with spirit of ether, and mineral admixtures would remain behind upon heating the acid to redness.

Off. Prep.—Glycerinum (Glyceritum) acidi gallici, *U. S.*, *Br.*

Medical Action and Uses.—Although gallic acid does not display any astringency in its taste, or in its application to raw or bleeding surfaces, it certainly exerts a powerful control over all forms of passive hemorrhage when taken internally, as well as upon several of the secretions, and notably upon the urine and the sweat. Unlike tannic acid, it has no constipating effect upon the bowels. It is, perhaps, the first in value of the medicines used in *menorrhagia*. It should be given between the periods as well as during the flow, and in doses of from ten to twenty grains a day, in pilular form. Of similar affections in which it is useful, may be mentioned *purpura*, *epistaxis*, *hæmoptysis*, *hæmatemesis*, *hæmaturia*, and *intestinal hemorrhage*. To inordinate secretions which this acid tends to control belong *night-sweats*, and other forms of profuse perspiration, and excessive secretion of urine in *Bright's disease*. Its influence in the last-named affection is often very prompt and salutary, since it not only reduces the total discharge of urine, but in a still larger proportion the loss of albumen. It is very efficient in correcting *pyrosis*, an annoying symptom of various dyspeptic conditions. Locally, it has been used in an ointment for the treatment of *alopecia*. The *dose* of gallic acid is from five to twenty grains, repeated several times a day, according to the urgency of the case. The glycerite is a convenient form of administering it.

ACIDUM HYDRIODICUM.—Hydriodic Acid.

Acidum iodhydricum.—Acide iodhydrique, Fr.; *Jodwasserstoffsäure*, G.
Formula HI. Molecular weight 128.

Preparation.—As formerly officinal in the U. S. Pharmacopœia, it was prepared of such strength that six fluidounces contained the hydriodic acid from 480 grains of iodine. The process adopted was the one originally suggested by Gay-Lussac, modified by Le Royer and Dumas, according to which thirty grains of iodine are mixed with five fluidounces of water and sulphuretted hydrogen is passed into the mixture until the color of iodine has disappeared. More iodine is now dissolved in the liquid, again sulphuretted hydrogen is passed into it until it is decolorized, and this process is repeated until all the iodine has been used. The liquid is then boiled until the odor of sulphuretted hydrogen is no longer perceived, filtered from the sulphur, and the filter washed with distilled water until the filtrate measures six fluidounces. It contains about 15 per cent. HI.

In the presence of water iodine and sulphuretted hydrogen react with each other, the hydrogen uniting with the former, liberating sulphur; $2I_2+2H_2S$ yield $4HI+S_2$. The sulphur separates as a fine powder, which would cover the iodine and prevent the further reaction; to obviate this difficulty, a small quantity is first converted into hydriodic acid, which is a good solvent for iodine, and, with proper management, no iodine will be lost by remaining enveloped by the sulphur.

The process recommended by Buchanan (1837) consisted in dissolving 264 grains of tartaric acid and 330 grains of potassium iodide, each in 1½ fluidounces of water, mixing the solutions, agitating for some time, straining from the precipitated bitartrate of potassium, and diluting with water to obtain 6¼ fluidounces. This acid speedily decomposes, for which reason J. Murdoch (1855) proposed to preserve it by sugar. It contains about 8 per cent HI.

Properties.—Pure hydriodic acid is a colorless irrespirable and uninflammable gas, having the density 4.37 and an odor resembling that of hydrochloric acid. The aqueous solution is colorless, has a strong acid reaction, and a pungent, afterwards styptic sour taste. The concentrated aqueous solution of the acid, saturated at 0° C. (32° F.), has the spec. grav. 1.99. The acid formerly officinal had the spec. grav. 1.112. The most concentrated acid obtainable by distillation boils at 127° C. (260.6° F.), contains 57.75 per cent. HI, and has the spec. grav. 1.708. Topsöe (1870) found an acid having at 13.5° C. (56.3° F.) the density 1.102 to contain 13.09, and if of spec. grav. 1.126 to contain 15.73 per cent. of HI. Exposed to the air, this acid is decomposed, the hydrogen being oxidized to form water, and iodine liberated, coloring the liquid red-brown. The addition of a small quantity of hyposulphite of sodium as suggested by Dunn (1868) will for a time prevent the change. Pharmaceutically hydriodic acid is a very unsatisfactory preparation.

It possesses no medicinal value.

ACIDUM HYDROBROMICUM.—Hydrobromic Acid.

Acidum bromohydricum.—Acide hydrobromique, Fr.; *Bromwasserstoffsäure, Hydrobromsäure*, G.
Formula HBr. Molecular weight 81.

Formation.—This acid is formed by the direct union of its elements at a red heat, by the decomposition of sulphydric acid and other hydrogen compounds by bromine, and by the action of water upon the sulphur, phosphorus, and other compounds of bromine.

Preparation.—Markoe (1875) recommended the following procedure: 1 lb. of phosphorus is spread over the bottom of a one-gallon jar, covered with water, and the jar half filled with ice, after which a large funnel is inserted into the throat of the jar, a funnel tube adjusted so as to reach a short distance above the phosphorus, and the jar surrounded with ice. 3 or 4 lbs. of bromine may now be very slowly added through the funnel tube, care being taken to prevent the accumulation in the jar of uncombined bromine, which would give rise to an explosion when reacting with phosphorus. The two elements unite to form pentabromide of phosphorus, PBr_5; and this reacting with water forms phosphoric and hydrobromic acids: $PBr_5 + 4H_2O$ yields $H_3PO_4 + 5HBr$. After the reaction is completed, the excess of phosphorus is removed, and the aqueous liquid distilled until hydrobromic acid ceases to come over. The syrupy residue left in the retort, when properly diluted, is utilized as phosphoric acid.

Fothergill's formula is an adaptation of that of Dr. D. C. Wade (1875), in which potassium bromide is decomposed by tartaric acid, 80 grains of the former requiring 100 grains of the latter, resulting in the formation of hydrobromic acid and potassium bitartrate (cream of tartar), the latter being mostly deposited. The liquid, however, retains some of this salt, and contains some undecomposed potassium bromide. The difficulties of distilling hydrobromic acid by decomposing potassium bromide with sulphuric acid have been overcome by Dr. Squibb (1878) as follows: 7 parts by weight of sulphuric acid, sp. gr. 1.838 at 15.6° C. (60° F.), are added to one part of water, and the mixture allowed to cool, when it is slowly, and with constant stirring, added to a hot solution of 6 parts of potassium bromide in 6 parts of water. A decomposition into hydrobromic acid and sulphate of potassium will take place; $2KBr + H_2SO_4$ yields $2HBr + K_2SO_4$; on setting the mixture aside for 24 hours, the salt crystallizes, the liquid is poured off into a retort, and the crystalline mass broken up, transferred to a funnel, and washed with two parts of water to recover adhering hydrobromic acid. The washings are likewise poured into the retort, which is placed upon a sand bath, or set upon a wire gauze, and the whole is then distilled nearly to dryness. The distillate, which weighs about 10 parts, is assayed with normal solution of soda, and then diluted with distilled water so as to contain 34 per cent. of HBr. When of this strength, the acid represents one-half the bromine strength of an equal weight of potassium bromide.

Properties.—Pure hydrobromic acid is a colorless gas of a pungent and irritating odor, and produces dense white fumes in a moist atmosphere. The solution of the strength proposed by Dr. Squibb is a colorless, odorless, limpid liquid, of a strongly acid taste, and of the specific gravity 1.274 at 15.6° C. (60° F.). It contains 33.58 bromine, .42 hydrogen, and 66 water. When heated, water and a weak acid distil over, and the temperature rises to 125.5° C. (258° F.), when an acid passes over, which, according to Topsöe (1870), has at 14° C. (57.2° F.) the specific gravity 1.490, and contains 48.17 per cent. HBr.

Tests.—Hydrobromic acid should evaporate without leaving any residue. It is not precipitated by barium chloride, showing the absence of sulphuric acid, and yields, like hydrochloric acid, white precipitates with solutions of lead, mercurous and silver salts. Bromide of silver is nearly insoluble in *dilute* ammonia water, which dissolves silver chloride readily; on the subsequent addition of nitric acid, only a slight turbidity should be produced. If of the strength indicated above, 20 grains of it, when treated with nitrate of silver in excess, will yield a precipitate, which, after washing and drying, weighs 15.98 grains, and when heated in chlorine gas is converted into chloride of silver weighing 12.2 grains.

Physiological Action.—In its diluted state, and particularly when prepared by decomposing bromide of potassium with tartaric acid, it has an agreeable acidulous taste; but the pure acid is as corrosive as concentrated muriatic acid. It has most of the physiological and therapeutic actions of the bromides, but is less apt to provoke an acneiform eruption.

Medical Uses.—It was first employed to prevent the headache occasioned by quinia, and also by iron, by combining it with those medicines, and also to palliate the nervous irritability or disorders for which they are often prescribed. It soon appeared to be, in many cases, an appropriate substitute for bromide of potassium, and to equal that salt in the energy, although not in the duration, of its action upon the nervous system. In combination with quinia and iron, its own comparatively transient influence forms an appropriate preparation for their more permanent action. It especially seems to prevent the tinnitus aurium and the disorder of vision which sometimes follow the use of large doses of quinia. It appears to co-operate with digitalis as well as with quinia and iron in improving the tone of the heart when weak and irritable. Like the bromides, it has been successfully employed in a variety of nervous disorders induced by reflex irritation, such as *vomiting*, *cough*, *muscular spasm*, *whooping cough*, and *neuralgia*, and in *coughs* excited by *bronchial* or *laryngeal* irritation. In cases also of *cerebral hyperæmia* due to excessive mental activity in study, business, etc., it appears to have the same influence as the bromides. In *tinnitus aurium* and other subjective sensations in the ear, especially those of a throbbing or knocking character, depending upon vascular congestion, the medicine has proved very efficient. Unlike the bromides, it appears to be more injurious than useful in *epilepsy*, aggravating the attacks and rendering them more frequent. Hydrobromate of quinia, being very soluble in water, is more suitable than the neutral sulphate for hypodermic use. The dose of hydrobromic acid is from thirty minims to a fluidrachm, diluted. The hydrobromate of quinia may be prepared thus: ℞. Potassii bromid. 162 gr.; Acid. tartaric. 198 gr.; Quiniæ sulph. 60 gr.; Aquæ f℥iij.—M. Filter. Dose, thirty minims to one fluidrachm.

ACIDUM HYDROCYANICUM DILUTUM, *U.S.*, *Br.*—
Diluted Hydrocyanic Acid.

Acidum hydrocyanatum s. borussicum.—*Prussic acid*, E.; *Acide cyanhydrique s. hydrocyanique*, Fr.; *Cyanwasserstoff-Säure*, *Blausäure*, G.

Formula CNH = HCy. Molecular weight 27.

Origin.—Hydrocyanic acid has been found in the root of Janipha Manihot, and in the bark, leaves, flowers, and seeds of many shrubs and trees belonging to the sub-orders Amygdaleæ and Pomeæ of the order Rosaceæ. It occurs in the free state only in some of the more juicy parts of these plants, but a larger quantity is formed on macerating the parts indicated in cold water, when the amygdalin contained therein is split by the action of emulsin, or a similar ferment, into sugar, oil of bitter almonds, and hydrocyanic acid: $C_{20}H_{27}NO_{11}$ (amygdalin) + $2H_2O$ yields $2C_6H_{12}O_6$ (glucose) + C_7H_6O (oil of bitter almonds) + HCN (hydrocyanic acid). It is likewise found among the products of the reaction of nitric and nitrous acids upon many organic compounds, and of gaseous ammonia upon incandescent charcoal. For medicinal purposes it is mostly prepared by the decomposition of ferrocyanide of potassium by means of sulphuric acid.

Preparation.—Take of Ferrocyanide of Potassium two troyounces; Sulphuric Acid a troyounce and a half; Distilled Water a sufficient quantity. Mix the acid with four fluidounces of distilled water, and pour the mixture, when cool, into a glass retort. To this add the ferrocyanide of potassium, dissolved in ten fluidounces of distilled water. Pour eight fluidounces of distilled water into a cooled receiver, and, having attached this to the retort, distil, by means of a sand-bath, with a moderate heat, six fluidounces. Lastly, add to the product five fluidounces of distilled water, or as much as may be sufficient to render the diluted hydrocyanic acid of such a strength, that twelve and seven-tenths grains of nitrate of silver, dissolved in distilled water, may be accurately saturated by one hundred grains of the acid. *U. S.*

The process of the British Pharmacopœia is identical with the foregoing, differing merely in the use of British officinal measures and weights and in the ordering of a *slow* distillation.

On mixing diluted sulphuric acid with the solution of ferrocyanide of potassium in the cold, only one-half of the latter salt is decomposed, with the formation of sulphate of potassium and hydroferrocyanic acid, thus: $K_4FeC_6N_6$ (ferrocyanide of potassium) $+ 2H_2SO_4$ yields $2K_2SO_4 + H_4FeC_6N_6$ (hydroferrocyanic acid). This last compound may be obtained by agitating the mixture with some ether, when the acid will be separated, floating upon the liquid. On the application of heat to the mixture, this acid reacts with the remaining ferrocyanide of potassium and sulphuric acid, yielding hydrocyanic acid which distils over, sulphate of potassium which remains in solution, and ferrocyanide of iron and potassium, Everitt's salt, which precipitates as a white powder, rapidly turning green and finally blue in the presence of oxygen. The reaction is explained in the following: $H_4FeC_6N_6 + K_4FeC_6N_6 + H_2SO_4 = 6HCN$ (hydrocyanic acid) $+ K_2SO_4 + K_2Fe(FeC_6N_6)$ (Everitt's salt). Two molecules of ferrocyanide of potassium with three of sulphuric acid yield, therefore, finally 6 molecules of hydrocyanic acid, 3 of potassium sulphate, and 1 of Everitt's salt.

The preparation of officinal hydrocyanic acid by the above process presents no difficulties. If the acid be distilled over a naked fire, the safety of the retort would be endangered by concussions. The Pharmacopœia very properly orders it to be placed in a sand-bath; or an ash-bath may be substituted for it. The complete decomposition of the potassium ferrocyanide and the distillation of the hydrocyanic acid are readily effected, the entire amount being obtainable at a temperature little exceeding that of boiling water. The contamination of the distillate with the contents of the retort, which may occur in consequence of spirting, is easily prevented by substituting a flask for the retort, or by keeping the neck of the latter in a slightly elevated position. The strength of the distillate is determined by weighing 100 grains of it in a small beaker containing some distilled water, and precipitating completely with nitrate of silver; the precipitate of nitrate of silver is collected upon a tared filter, washed, dried at 100° C. (212° F.), and weighed. From the excess of this weight over 10 grains, the amount of distilled water is easily calculated, which must be added to the distillate, the precise weight of which has been ascertained, in order to obtain it of the officinal strength. After proper dilution, it should at once be put into clean small vials, well corked.

Diluted hydrocyanic acid may be advantageously prepared from several cyanides. Cyanide of potassium, however, is not well adapted for this purpose, owing to the difficulty of obtaining it absolutely pure; but even if the salt were decomposed by the requisite quantity of tartaric acid to form bitartrate of potassium, the portion of the latter salt remaining in solution would tend to speedily decompose the acid, unless distillation were resorted to. A convenient method for obtaining an acid suitable for immediate use is the following:—

Take of Cyanide of Silver fifty grains and a half; Muriatic Acid forty-one grains; Distilled Water a fluidounce. Mix the muriatic acid with the distilled water, add the cyanide of silver, and shake the whole together in a well-stopped vial. When the precipitate formed has subsided, pour off the clear liquid, and keep it for use. *U. S.*

The muriatic acid decomposes the silver cyanide, forming insoluble silver chloride and hydrocyanic acid; thus, $AgCy + HCl = AgCl + HCy$.

The French Codex employs a mixture of cyanide of mercury and chloride of ammonium, the latter being used to produce readily soluble and fusible double salts. The mixture is treated with muriatic acid, and the resulting gas passed first over marble to remove muriatic acid, and then over chloride of calcium to remove water, into a narrow tube placed in a refrigerating mixture. The anhydrous acid is condensed, and is diluted with nine times its weight of distilled water. This process presents no advantages whatever. On the contrary, owing to the concentration of the acid as at first condensed, precautions are necessary to avoid dangerous results in handling this concentrated acid.

Properties.—Officinal hydrocyanic acid is a colorless liquid, having a peculiar odor, resembling that of oil of bitter almonds. Its specific gravity is 0.997 (*Br.*). It reddens litmus paper slightly and transiently, and with alkalies yields crystallizable salts having a strong alkaline reaction. The medicinal acid contains two per cent. of anhydrous acid; and 100 grains of it must yield, with nitrate of silver, a precipitate which after drying weighs ten grains, and is completely soluble in boiling nitric acid. 270 grains of the medicinal acid, rendered alkaline by the addition of solution of soda, require 1000 grain measures of the volumetric solution of nitrate of silver to be added before a permanent precipitate begins to form (*Br.*).

The composition of hydrocyanic acid is expressed by the formula $HCN = HCy$. It is the hydride of the radical cyanogen.

Under various circumstances hydrocyanic acid is decomposed on keeping, evolving ammonia and depositing a brown or blackish substance containing paracyanogen, C_3N_3 or C_6N_6. The causes of these changes have not been fully explained; it is, however, well known that the presence of alkalies and exposure to the light favor decomposition; and since by heating hydrocyanic acid in the presence of free mineral acids formiate of ammonium is apt to be produced, it will be seen that even recently prepared dilute hydrocyanic acid may be prone to change, and that, if altered, the decomposition cannot be arrested by distillation except after the previous addition of sufficient sulphuric acid. The addition of a minute quantity of muriatic acid, and of some alcohol in place of a portion of the water, to the recently prepared acid, appears to retard that change, but does not altogether prevent it. The stronger the hydrocyanic acid is the more liable it is to decomposition. The acid known as Scheele's acid, which contains 5 per cent. of HCy, is, therefore, not adapted for medicinal use.

Another difficulty in preserving the strength of hydrocyanic acid must be attributed to its volatility, and the loss suffered by the medicinal acid on the frequent opening of the vial containing it. This has recently (1873 and '74) been the subject of investigation by A. Towerzey and others; and although J. Williams states that an addition of 20 per cent. of glycerin will preserve acid up to the strength of about 5 per cent., it appears better by far to abandon the present medicinal hydrocyanic acid altogether, as suggested by G. A. Zwick, and to adopt in its place, like the Prussian Pharmacopœia of 1862, a still more diluted acid containing $\frac{1}{10}$ per cent. of HCy, which has been admitted into the German Pharmacopœia (1872) under the name of *Aqua amygdalarum amararum concentrata.* This will preserve its strength even in partly filled bottles for several months.

HYDROCYANIC ETHER, C_2H_5CN. Prepared according to Pelouze's process (1834), by distilling sulphovinate of barium with potassium cyanide, it has a garlicky odor from impurities, which are difficult to remove. A purer product is obtained, according to Williamson (1853), by digesting iodide of ethyl with 4 parts of alcohol containing an equivalent quantity of potassium cyanide until decomposed, and then distilling. When perfectly pure, it has an agreeable ethereal odor, suggesting that of hydrocyanic acid, and boils at 97° C. (206.6° F.). It is poisonous, but less so than hydrocyanic acid.

Impurities.—Sulphuric acid is recognized by the white precipitate produced on the addition of chloride of barium. Muriatic and phosphoric acids are detected by adding solution of borax, evaporating to dryness, and dissolving the residue in diluted nitric acid; a white precipitate with nitrate of silver will indicate the former, and a yellow precipitate with molybdate of ammonium the latter impurity. On the addition of a few drops of solution of corrosive sublimate, and heating to boiling, a reduction of the mercuric salt to calomel or to mercury will indicate the presence of formic acid.

Off. Prep.—Vapor acidi hydrocyanici, *Br.*

Physiological Action.—This acid is hostile to all forms of life. However absorbed into the tissues of vegetables, it arrests their functions more or less completely. Under its influence woody stems shrink and grow dry, and succulent plants exude their moisture through the integument. All animals are affected by it, but birds and mammals more than reptiles and fishes. Of all poisons it produces its effects most rapidly, sometimes too rapidly to be analyzed or even accurately observed. The following summary represents them in their usual order: 1. Difficult breathing, slow full pulse, giddiness, and loss of muscular power. 2. Spasms, dilated pupils, loss of consciousness, vomiting, muscular rigidity, with cessation of the pulse and heart's action. 3. Muscular relaxation and collapse, with abolished or impaired sensibility, feeble pulse, and death by asthenia, or in convulsions induced by peripheral irritation. If the dose is not fatal, the animal passes from complete resolution to exaggerated reflex irritability, and apparently sensibility as well; this condition is usually followed by deep sleep. After death the eyes have a glassy lustre, the pupils are usually dilated, and cadaveric rigidity is very marked. If death has been gradual, the blood is found dark and uncoagulated, distending both sides of the heart; but if the poison has been rapidily fatal, the left side of the heart is empty and contracted, but the right is filled with blood. In rapid death from this poison the blood of both systems may exhibit the arterial hue. The cause of this phenomenon is undetermined. The extreme rapidity of the action of the poison and the nature of its effects, as well as the results of special experiments, render it probable that they are due to its direct influence upon the heart itself, and not upon the blood alone, nor upon that and the cerebro-spinal centres primarily. The nervous symptoms appear to be secondary, and due to the withdrawal of blood from those centres. Experiments upon the horse and the hyena show that those animals are nearly insusceptible to the influence of the poison; the elephant, on the other hand, is destroyed by a relatively small dose of it.

In man, the acid, when taken in medicinal but still over-active doses, may produce the following symptoms: irritation of the throat, salivation, warmth at the epigastrium, lightness of the head, dizziness, buzzing in the ears, headache, numbness, a dusky countenance, staggering, constriction of the chest, palpitation of the heart, a frequent or abnormally slow pulse, weariness and drowsiness. Poisonous but not fatal doses have produced the following effects: insensibility, usually a feeble pulse, dilated pupils, a turgid and dusky face, heat of head, convulsions or rigidity, or both in succession, and no paralysis. Consciousness and muscular power return rapidly, considering the gravity of the initial symptoms. In fatal cases it is remarkable that there are no convulsions, but relaxation rather. The pupils are usually dilated and the eyes lustrous, and the pulse sometimes grows slower until extinction. After death the skin is purplish, and all the internal veins are gorged with blood which is dark and uncoagulated. The eyes retain their peculiar glistening aspect. The mucous membrane of the stomach is usually congested.

Medical Uses.—The dangerous potency of the medicine necessarily restricts its use in medicine. It has been employed with a certain advantage in the treatment of *whooping cough*, but is, at best, a palliative merely. The same may be said of its influence in cases of purely *nervous cough*, spasmodic *dysphagia*, and *angina pectoris*. In *gastralgia* there is perhaps more reason to anticipate advantage from the medicine, and, as the disease is often rebellious, the possibility of relieving it by prussic acid should not be overlooked. Most of the cases supposed to illustrate its efficacy were clearly not examples of pure gastralgia, but of painful dyspepsia, and very possibly instances of gastric ulcer were included among them. Probably in all the single element pain was most beneficially influenced: in some, *vomiting* was palliated or arrested. These effects appear to indicate an anæsthetic action in the acid, which is more distinctly manifested by the topical use of the medicine in various *diseases of the skin*, in which tingling, itching, and other distressing sensations exist.

The average *dose* of diluted hydrocyanic acid is two or three minims, given several times a day in some neutral vehicle with the addition of a few drops of alcohol. It should be dispensed in vials covered with black paper or varnish, to prevent the decomposing action of the light; and a minimum dose should be directed when a fresh prescription is made. From thirty minims to a fluidrachm, in a fluidounce of distilled water or rose-water, forms an appropriate lotion, which, however, should not be applied to the skin unless it is perfectly unbroken.

There is no antidote to the poisonous action of hydrocyanic acid. The most efficient remedy consists in the stimulation produced by the shock of cold water dashed at intervals upon the chest and spine. Subordinate in efficiency, but not to be neglected, are the application of ammonia to the nostrils, the stimulus of induced electricity, artificial respiration, and the judicious agitation of the patient.

ACIDUM LACTICUM, *U. S.*—LACTIC ACID.

Acide lactique, Fr.; *Milchsäure*, G.

Formula $HC_3H_5O_3$. Molecular weight 90.

Origin.—Lactic acid was discovered by Scheele in sour milk, in which it results from the spontaneous fermentation of the sugar of milk under the influence of the casein; $C_{12}H_{24}O_{12}$ (milk sugar) yields $4HC_3H_5O_3$ (lactic acid). This transformation of the former into the latter is called the *lactic fermentation*. A similar change is produced in dextrin, glucose, cane-sugar, etc., by the action of casein, and other protein compounds; lactic acid is, therefore, met with in many vegetable products which have turned sour. T. & H. Smith's *thebolactic acid* of opium is identical with the lactic acid of milk; but the *sarcolactic acid*, discovered by Liebig in the juice of flesh, although it has the same ultimate composition, differs from the former in the solubility of its zinc salt in absolute alcohol. During lactic fermentation, other acids, a peculiar gum, and mannite are sometimes formed.

Preparation.—100 parts of sugar are dissolved in sufficient water to yield a solution of 8° or 10° B.; 8 or 10 parts of fresh cheese and 50 parts of prepared chalk are added, and the mixture placed for several weeks in a sunny place, when lactate of calcium will be found crystallized (Pelouze). Boutron and Frémy dissolve 300 grams of milk sugar in 4 litres of skimmed milk, expose the mixture to a temperature of from 15° to 20° C. (59° to 68° F.), and neutralize every other day with bicarbonate of sodium. When it ceases to acquire an acid reaction, the liquid is boiled, filtered, and carefully evaporated to a syrupy consistence; this is dissolved in strong alcohol, the sodium precipitated by sulphuric acid, and the lactic acid converted into lactate of calcium by the addition of chalk. Wackenroder operates in the same manner, except that an excess of chalk is added before fermentation begins, and the mixture is kept at 24° C. (75.2° F.), and the lactate of calcium is recrystallized from boiling water. This salt, obtained by one of the foregoing processes, is then decomposed by an ascertained accurate amount of sulphuric or oxalic acid. If, during fermentation, the lactic acid is neutralized by commercial zinc-white, lactate of zinc is obtained, which may be decomposed by sulphuretted hydrogen. Lautemann, who proposed this modification (1860), followed in the main Bensch's directions, dissolving 6 pounds of cane-sugar and ½ ounce of tartaric acid in 35 pounds of boiling water, adding after two days 4 ounces of old cheese diffused in 8 pounds of sour milk, and exposing the mass to a temperature of 40° to 50° C. (104° to 122° F.).

Properties.—Officinal lactic acid is a syrupy, nearly transparent, pale wine-yellow liquid, having a slight, bland odor, a very sour taste, and the specific gravity 1.212 (1.24 P. G.); the pure acid is colorless, inodorous, and has the specific gravity 1.215 at 20.5° C. (68.9° F.). It unites in all proportions with water and alcohol, and is soluble in ether. It coagulates milk and albumen. Heated in the air, it decomposes, giving off a suffocating odor, and leaving a spongy charcoal, which is finally completely consumed. It displaces carbonic and acetic acids from their compounds, yielding salts which are soluble in water, and mostly also in alcohol. 90 grains of the officinal acid are neutralized by not less than 75 grains of bicarbonate of potassium, indicating not less than 75 per cent. of $HC_3H_5O_3$. *Sarcolactic* or *paralactic acid* is converted into the ordinary kind by heating it for some time to 130° or 140° C. (266° or 284° F.), and dissolving the resulting anhydrid in boiling water (Strecker, 1858).

Impurities.—Treated with a hot solution of potassa, lactic acid is not materially colored; if it readily becomes brown, extractive matters are present. Dissolved in strong alcohol, gum and some mineral salts are left behind. Treated with ether, glycerin, glucose, mannite, and most salts remain undissolved. Acetic and butyric acids are recognized by their odor, which becomes more apparent on warming. For detecting other organic and mineral acids, their special tests may be applied. In the diluted acid, calcium salts are indicated by oxalate of ammonium; lead, by hydrosulphuric acid; zinc, after neutralization with ammonia, by sulphydrate of ammonium; sulphuric acid, by chloride of barium; muriatic acid, by nitrate of silver; and oxalic acid, by chloride of calcium, after previously diluting the acid with 20 times its quantity of water, and neutralizing with ammonia.

Off. Prep.—Ferri lactas, *U. S.*

Medical Uses.—Lactic acid has been employed in the treatment of various forms of *dyspepsia*, but chiefly in those presumed to depend upon debility of the stomach, and then as a solvent for pepsin. Some years ago Cantani suggested that, in addition to the use of an exclusively animal diet in *diabetes*, an agent ought to be employed which would prevent the waste of the tissues by furnishing an appropriate substance in their stead. For this end he proposed lactic acid, which he believed would supply the very product which the deranged liver was no longer capable of furnishing. Whatever may be thought of the theory, it appears certain that, in the hands of the physician named and in those of Dr. Balfour, several cases of diabetes treated by this medicine were improved by it more than by any other means whatever, the secretion of urine falling to the normal standard, while it became free of sugar, and the patients regained their flesh and strength. From two to four drachms, diluted in from eight to ten ounces of water, were taken during the day. The remarkable solubility of false membranes in lactic acid led to its use in *diphtheria* and in *croup* (pseudo-membranous laryngitis); and the reports of several observers appear to prove that when this acid is applied with a mop in the former, and by atomization or the syringe in the latter disease, it contributes in a remarkable degree to the cure. Experience does not appear to have determined the precise value of this treatment. For the purpose last described a solution was used of one part of the acid in twenty parts of water.

ACIDUM MURIATICUM, *U. S.*—Muriatic Acid.

Acidum hydrochloricum, Br.; *Acidum hydrochloratum s. chlorhydricum.—Hydrochloric acid*, E.; *Acide chlorhydrique s. muriatique*, Fr.; *Salzsäure*, G. Formula HCl. Molecular weight 36.5.

ACIDUM MURIATICUM DILUTUM, *U. S.*—Diluted Muriatic Acid.

Acidum hydrochloricum dilutum, Br.—*Acide chlorhydrique dilué*, Fr.; *Verdünnte Salzsäure*, G.

The specific gravity of muriatic acid is 1.16, and of diluted muriatic acid 1.038 *U. S.*, 1.052 *Br.*

Origin.—Muriatic acid occurs in the uncombined state among the gases emitted by active volcanoes, and in combination its radical, chlorine, is found in numerous minerals, prominent among which is chloride of sodium or common salt, which is also one of the most important constituents of sea-water, and the source of nearly all the muriatic acid of commerce.

Preparation.—Enormous quantities of muriatic acid are produced in the preparation of carbonate of sodium, for which purpose it is necessary to convert the chloride into sulphate of sodium. The escaping gas is made to pass through long vertical cylinders, which are filled with coke, over which water is made to trickle. The water, dissolving the acid in its descent, is collected below or allowed to run to waste. If the acid is intended for uses in the arts, a purer article is required, and the gas is then made to pass through a series of stone receivers having the shape of large Woulfe's bottles, the first of which is empty, while the other five or six contain a certain quantity of water. The stills consist of horizontal iron cylinders, into which equal weights of common salt and sulphuric acid are introduced, after which heat is applied. The first receiver retains any sodium sulphate and sulphuric acid which may be mechanically carried over, the gas being absorbed by the water in the other receivers.

By this process 117 parts of chloride of sodium require 98 parts of concentrated, or a correspondingly larger quantity of a somewhat weaker, sulphuric acid. The first reaction results in the liberation of one-half of the muriatic acid and the production of acid sulphate of sodium; $2NaCl + H_2SO_4$ yields $HCl + NaCl + NaHSO_4$. The decomposition of the remaining chloride by the acid sulphate of sodium is effected at a temperature beyond 200° C. (392° F.), but on the large scale a much higher heat is found necessary; the reaction takes place as follows: $NaCl + NaHSO_4 = HCl + Na_2SO_4$. The salt cake remaining in the retort is worked up into Glauber's salt by dissolving it in water and crystallizing, or it is used for the preparation of soda. The acid thus obtained has a lighter or deeper yellow color, due to a small quantity of ferric chloride dissolved in it. If otherwise pure, and of sufficient strength, it may be employed for preparing ferrous and ferric chlorides.

For most pharmaceutical operations a purer acid is requisite, which is obtained by distilling chloride of sodium and sulphuric acid in the proportions given above, using glass retorts having a capacity of 5 or 6 gallons, and collecting the acid in suitable glass receivers; a number of these retorts are usually arranged in a properly constructed furnace having the requisite number of sand-baths, each of which is large enough to receive one retort, and may be sufficiently heated to recover all hydrochloric acid, with the production of sodium sulphate. In the pharmaceutical laboratory, however, it is usually preferable to employ the sulphuric acid in such a quantity that acid sulphate of sodium is formed, since the muriatic acid is then obtained at a lower temperature: $NaCl + H_2SO_4 = HCl + NaHSO_4$. For three parts of dry chloride of sodium but little more than five parts of concentrated sulphuric acid are required, and these are the proportions employed in the following process, which likewise contains the necessary details for successfully carrying on the operation :—

Take of Chloride of Sodium dried 48 ounces; Sulphuric Acid 44 fluidounces; Water 36 fluidounces; Distilled Water 50 fluidounces. Pour the sulphuric acid slowly into thirty-two ounces of the water, and, when the mixture has cooled, add it to the chloride of sodium previously introduced into a flask having the capacity of at least one gallon. Connect the flask by corks and a bent glass tube with a three-necked wash-bottle, furnished with a safety tube, and containing the remaining four ounces of the water; then, applying heat to the flask, conduct the disengaged gas through the wash-bottle into a second bottle containing the distilled water by a bent tube, dipping about half an inch below the surface, and let the process be continued until the product measures sixty-six ounces, or the liquid has acquired a specific gravity of 1.16. The bottle containing the distilled water must be kept cool during the whole operation. *Br.*

DILUTED MURIATIC ACID.—Take of Muriatic Acid four troyounces; Distilled Water a sufficient quantity. Mix the acid in a glass vessel, with sufficient distilled water to make the diluted acid measure a pint. *U. S.* The diluted acid of the British Pharmacopœia is made by adding to 3060 grains of muriatic acid sufficient distilled water, until the mixture, at 15.5° C. (60° F.), after it has been shaken, measures one imperial pint. The specific gravity of diluted muriatic acid is 1.038 *U. S.*, 1.052 *Br.*, 1.060 *P. G.*

Properties.—1. MURIATIC ACID GAS.—It is colorless, has a pungent, acid, suffocating odor, and, when inhaled, is highly irritating, though less so than chlorine. Its specific gravity is 1.247. It strongly reddens blue litmus paper, does not support combustion, and in contact with the atmosphere produces grayish-white fumes by condensing the moisture of the air. It may be condensed into a colorless liquid by a pressure of one atmosphere, and a refrigerating mixture of solid carbonic acid and ether. This liquid exerts at 10° C. (50° F.) a pressure equal to 40 atmospheres. Its composition is HCl, or equal volumes of hydrogen and chlorine, united without condensation.

2. CRUDE MURIATIC ACID.—This is officinal in the German Pharmacopœia, according to which it should have a specific gravity of from 1.160 to 1.170, corresponding to 30 and 33 per cent. of HCl. It is of a yellowish color, and usually contains traces of sulphuric and sulphurous acids, aluminum, and iron. It should, however, be free from arsenic, which may be detected, according to Bettendorff (1869), by adding one gram of stannous chloride to ten grams of the acid, and either heating or setting aside for half an hour, when a brown turbidity or precipitate will occur, consisting of metallic arsenic. One-millionth part of arsenic may thus be detected, provided the acid has not been diluted. After the precipitate has settled, the clear liquid may be carefully decanted or filtered, and afterwards distilled, when it will be free from arsenic and tin.

3. OFFICINAL MURIATIC ACID.—It is a colorless liquid, having the specific gravity 1.160, and emitting white vapors in contact with the air. It gives with nitrate of silver a white curdy precipitate, which is soluble in ammonia, and insoluble in nitric acid. 114.8 grains by weight, mixed with half an ounce of distilled water, require for neutralization 1000 grain measures of the volumetric solution of soda (*Br.*). The density of the pure muriatic acid of the German Pharmacopœia is 1.124, and it contains 25 per cent. HCl.

Water absorbs at 0° C. (32° F.), the barometer being 760 mm., 505.1 volumes of muriatic acid gas. The concentrated acid, on being heated, loses gas, becoming weaker on boiling until it has reached the specific gravity 1.101 at 15° C. (59° F.), contains 20.17 per cent. HCl, and distils at 110° C. (230° F.). According to Dalton, a weaker acid, on boiling, becomes stronger until it has attained the same density.

Muriatic acid of the specific gravity 1.01 at 25° C. (77° F.) contains, according to E. Davy, 2.02 per cent. of gas, and for every additional 2.02 per cent. increases in density at the ratio of 0.01, so that an acid of 1.10 specific gravity contains 20.20 per cent., and, if of specific gravity 1.19, contains 38.38 per cent. of gas. These figures differ little from those ascertained by A. Ure, from whose results the following table is condensed, giving the percentage of chlorine, of hydrochloric acid gas, and of the aqueous acid of specific gravity 1.200, contained in aqueous muriatic acid of different densities:—

p. grav.	Per cent. chlorine.	Per ct. gaseous HCl.	P. c. aqueous acid sp. gr. 1.20	Sp. grav.	Per cent. chlorine.	Per ct. gaseous HCl.	P. c. aqueous acid sp. gr. 1.20
1.2000	39.675	40.777	100	1.0980	19.440	19.980	49
1.1822	35.707	36.700	90	1.0960	19.044	19.572	48
1.1721	33.724	34.660	85	1.0939	18.647	19.165	47
1.1701	33.328	34.252	84	1.0919	18.250	18.757	46
1.1681	32.931	33.845	83	1.0899	17.854	18.349	45
1.1661	32.535	33.437	82	1.0879	17.457	17.941	44
1.1641	32.136	33.029	81	1.0859	17.060	17.534	43
1.1620	31.746	32.621	80	1.0838	16.664	17.126	42
1.1599	31.343	32.213	79	1.0818	16.267	16.718	41
1.1578	30.946	31.805	78	1.0798	15.870	16.310	40
1.1557	30.550	31 398	77	1.0778	15.474	15.902	39
1.1537	30.153	30.990	76	1.0758	15.077	15.494	38
1.1515	29.757	30.582	75	1.0738	14.680	15.087	37
1.1494	29 361	30.174	74	1.0718	14.284	14.676	36
1.1473	28.964	29.767	73	1.0697	13.887	14.271	35
1.1452	28.567	29.359	72	1.0677	13.490	13.863	34
1.1431	28.171	28.951	71	1.0657	13.094	13.456	33
1.1410	27.772	28.544	70	1.0637	12.697	13.049	32
1.1389	27.376	28.136	69	1.0617	12.300	12.641	31
1.1369	26.979	27.728	68	1.0597	11.903	12.233	30
1.1349	26.583	27.321	67	1.0577	11.506	11.825	29
1.1328	26.186	26.913	66	1.0557	11.109	11.418	28
1.1308	25.789	26.505	65	1.0537	10.712	11.010	27
1.1287	25.392	26.098	64	1.0517	10.316	10.602	26
1.1267	24.996	25.690	63	1.0497	9.919	10.194	25
1.1247	24.599	25.282	62	1.0477	9.522	9.786	24
1.1226	24.202	24 874	61	1.0457	9.126	9.379	23
1.1206	23.805	24.466	60	1.0437	8.729	8.971	22
1.1185	23.408	24.058	59	1.0417	8.332	8.563	21
1.1164	23.012	23.650	58	1.0397	7.935	8.155	20
1.1143	22.615	23.242	57	1.0377	7.538	7.747	19
1.1123	22.218	22.834	56	1.0357	7.141	7.340	18
1.1102	21.822	22.426	55	1.0337	6.745	6.932	17
1.1082	21.425	22.019	54	1.0318	6.348	6.524	16
1.1061	21 028	21.611	53	1.0298	5.951	6.116	15
1.1041	20.632	21.203	52	1.0200	3.968	4.078	10
1.1020	20.235	20.796	51	1.0100	1.984	2.039	5
1.1000	19.837	20.388	50				

This table agrees nearly with the figures ascertained by J. Kolb (1872).

Impurities and Tests.—Muriatic acid evaporates completely without leaving any residue (saline impurities). When diluted with at least four times its volume of distilled water, it yields no precipitate with sulphuretted hydrogen (lead, arsenic), chloride of barium (sulphuric acid), or ammonia in excess (lead, iron); it is not colored red by sulphocyanide of potassium (iron), or blue by a mixture of starch-paste and iodide of potassium (chlorine), and does not tarnish or alter the color of bright copper foil when boiled with it (arsenic). To test it for sulphurous acid or arsenic, put a few pieces of pure zinc into a rather long test-tube and introduce the hydrochloric acid, diluted with two parts of water, which should fill about one-tenth part of the tube. Into the upper part of the tube place a small bunch of cotton moistened with solution of acetate of lead, and cover the mouth of the tube with a piece of white filtering paper moistened with solution of nitrate of silver. After the evolution of hydrogen gas has continued for half an hour, neither the cotton nor the paper should be blackened, proving the absence of sulphurous acid in the former case, and of arsenic in the latter (P. G.). Under the conditions described, sulphurous acid evolves sulphuretted hydrogen, which blackens the lead salt; and arsenic yields arseniuretted hydrogen, which does not affect lead acetate, but blackens nitrate of silver.

Pharmaceutical Uses.—Hydrochloric acid is employed in numerous processes, either on account of its properties as a solvent, for decomposing certain compounds with the view of liberating certain constituents (sulphur, carbonic acid, hydrocyanic acid, etc.), or for the purpose of generating chlorine. It is used in the preparation of nitromuriatic acid, and of the various officinal chlorides, and for promoting the precipitation of resin of podophyllum.

Physiological Action.—Injected into the veins of an animal, it coagulates the blood, but not so strongly as sulphuric acid. Given to man in small doses it occasions a sense of warmth in the stomach, and arterial excitement, with a decided tendency to cerebral intoxication. Its protracted use causes salivation. In a concentrated form, it attacks the tissues as a caustic, but less powerfully than nitric or sulphuric acid. An ounce of the officinal acid has been taken without causing death.

Medical Uses.—Muriatic acid was, at one time, extensively employed in *low fevers*, probably upon theoretical grounds which have disappeared along with the practice. It was vaunted in *dyspepsia*, *scrofula*, and other affections involving debility; but as it was associated with cinchona, its share in whatever benefit accrued is more than doubtful. Perhaps upon better grounds it may be recommended for constitutional *syphilis*, when mercury and iodine are inappropriate. But, not improbably, its use in this disease may be attributed to its sometimes causing salivation. It has been employed in *calculous* complaints, and perhaps advantageously, in so far as they were associated with dyspeptic disorders. In this way, possibly, it may be found useful in eczema and psoriasis, and other *diseases of the skin* which sometimes depend upon digestive derangements. Muriatic acid was, at one time, regarded as a most valuable agent in the treatment of *diphtheria*; but recent experience has shown that the local affection is of subordinate importance, and that the removal of the exudation does not in the least modify the disease. Moreover, chlorate of potassium is more eligible than the acid as a palliative of the pharyngeal inflammation. The same may be said, even more emphatically, of gangrenous, mercurial, scorbutic, and other forms of ulcerative *stomatitis*. A poisonous dose of this acid should be counteracted by magnesia, soap, bicarbonate of soda, or, in the absence of these, by albumen. The dose of the stronger acid is from five to thirty minims; of the diluted acid, from twenty to sixty minims, largely diluted, and taken through a glass tube. As a gargle, one or two fluidrachms of the stronger acid may be diluted with ten or twelve ounces of barley-water sweetened with honey.

ACIDUM NITRICUM, *U. S.*, *Br.*—NITRIC ACID.

Acidum nitri s. azoticum, Spiritus nitri acidus.—Acide azotique s. nitrique, Fr.; *Salpetersäure,* G.

Formula HNO_3. Molecular weight 63.

ACIDUM NITRICUM DILUTUM, *U. S.*, *Br.*—DILUTED NITRIC ACID.

Acide azotique dilué, Fr.; *Verdünnte Salpetersäure,* G.

The specific gravity of nitric acid is 1.42, and of diluted nitric acid 1.068 *U. S.*, 1.101 *Br.*

Origin.—Nitric acid occurs chiefly in combination with the alkalies and alkaline earths, and in localities where vegetable or animal matter has undergone putrefaction. It is found in the juice of many plants, and in small quantities in rain and snow-water. It is prepared for medicinal and technical purposes by decomposing the nitrate of sodium or of potassium by sulphuric acid.

Preparation.—It is prepared on the large scale in apparatus constructed like that used in the manufacture of muriatic acid. The sulphuric acid acts upon nitrate of potassium, forming acid sulphate of potassium and liberating the nitric acid, thus $KNO_3+H_2SO_4=KHSO_4+HNO_3$. The resulting acid salt does not decompose another molecule of potassium nitrate, except at so high a temperature that most of the nitric acid then given off will be decomposed into nitrous acid and oxygen. One molecule, or 101 parts of potassium nitrate will, therefore, require one molecule or 98 parts of concentrated sulphuric acid. The same amount of nitric acid may be obtained from one molecule or 85 parts of sodium nitrate; but, according to Wittstein (1838), the sulphuric acid requires to be diluted with one-fourth its weight of water, to prevent the mass in the retort from being carried over into the receiver, the foaming being prevented by supplying the acid sodium sulphate with the necessary water of crystallization. Graham has shown that the reaction of acid sodium sulphate upon sodium nitrate occurs at a much lower temperature than between the corresponding potassium salts; hence, all the nitric acid may be obtained from two molecules or 170 parts of sodium nitrate with 98 parts of sulphuric acid, the decomposition furnishing sulphate of sodium. $2NaNO_3+H_2SO_4$ yields $2HNO_3+Na_2SO_4$. The violent foaming of the residue towards the close of the operation is prevented by the addition of some water or by the use of a weaker sulphuric acid. Stieren recommends (1865) the employment of 21 pounds of sulphuric acid, specific gravity 1.717, for 24 pounds of nitrate of sodium, as a charge for a retort of 5 or 6 gallons capacity; about one-fourth of the residue in the retort consists of acid sulphate of sodium, the remainder being neutral sulphate.

In the manufacture of nitric acid from nitrate of sodium, sulphuric acid may be replaced by manganous chloride, sulphate of iron, sulphate of magnesium, and similar salts, the metals of which remain as oxides in the retort with the sodium salt; but in most cases the heat necessary to effect the reaction is sufficient to decompose a considerable portion of the nitric acid.

As obtained on the large scale, it usually contains some hyponitric acid, which imparts to it a red or yellow color. This is removed by applying to it a moderate heat, and after the red vapors have escaped the acid is diluted to the desired strength.

The nitrates of sodium and potassium, as they occur in commerce, contain variable quantities of chlorides, from which, if used in the above process, hydrochloric acid is liberated, and this reacting with some of the nitric acid produces chlorine, which, for this reason, may contaminate the nitric acid. If the acid is desired in a pure state, the nitrates must be previously purified by repeated recrystallization, or the impure acid rectified either by itself or over some nitrate. The first portion of the distillate contains the chlorine, and the receiver is changed when the condensed liquid ceases to produce a curdy precipitate with nitrate of silver. Iodine, if present from the nitrate of sodium, will likewise be found in this part of the distillate. The distillation is continued into the new receiver until about one-fifth or one-sixth is left in the retort, from which, if the heat is continued, hyponitric acid is again produced. Formerly the chlorine and iodine were removed from the crude acid by nitrate of silver; the acid was carefully decanted from the precipitate and rectified. The process of direct rectification, as already described, is more advantageous, from one-half to three-fourths being obtainable in the pure state, according to the purity of the crude acid used.

Properties.—1. NITRIC ANHYDRID. This was discovered by St. Clair Deville (1849) in decomposing pure crystallized nitrate of silver by absolutely dry chlorine gas. It forms colorless shining prisms, which fuse at about 30° C. (86° F.) into a liquid boiling near 50° C. (122° F.), and deliquesce rapidly when in contact with moist air. Its composition is N_2O_5, and combining with one molecule of water, H_2O, it forms two molecules of nitric acid, $2HNO_3$.

2. CRUDE NITRIC ACID. As met with in commerce, it is either colorless or of a pale yellowish color, and contains the impurities mentioned above, together with a little iron. It is often called *aqua fortis;* the weaker kind is of about 1.21 specific gravity, being known as single aqua fortis; and the stronger, of specific gravity 1.37, as double aqua fortis. Crude nitric acid of the German Pharmacopœia has a specific gravity of from 1.323 to 1.331, corresponding to 51 and 52 per cent. of nitric acid.

3. PURE NITRIC ACID. It is a colorless liquid, wholly volatilized by heat. The concentrated acid or hydrogen nitrate, corresponding in composition to the formula HNO_3, has at 0° C. (32° F.) the specific gravity 1.559. When exposed to the light, or heated to near its boiling point, it is decomposed partly into water and hyponitric acid, so that its boiling point is not constant. Nor is the boiling point of weaker acids constant. Those below and above the specific gravity 1.42 have a constantly rising boiling point until the acid in the retort has been raised or lowered in strength, to correspond to the formula $2HNO_3.3H_2O$, when its boiling point will be stationary at 121° C. (250° F.), and it will have at 15.5° C. (60° F.) the specific gravity 1.42 (Graham). This strength of nitric acid has been adopted as the officinal standard in the United States, British, and French Pharmacopœias. According to Roscoe, nitric acid containing between 70 and 65 per cent. of hydrogen nitrate yields, after continued boiling, a liquid the boiling point of which is 120.5° C. (249° F.) at a barometer pressure of 735 mm., and the specific gravity of which is 1.414 at 15.5° C. (60° F.). It contains 68 per cent. of hydrogen nitrate, while Graham's acid should contain 69.96 per cent. The existence of a definite hydrate having a constant boiling point appears, therefore, somewhat doubtful.

Nitric acid is a powerful oxidizing agent, converting most metals into oxides or nitrates, and decomposing most organic compounds. Exposed to the direct sunlight, even if of less than the officinal strength, it is partly decomposed, yielding hyponitric acid. It combines with most of the basylous radicals, all its compounds being soluble in water, with the exception of a few so-called basic nitrates, such as subnitrate of bismuth.

The density of nitric acid varies with its strength. In taking its specific gravity, the absence of notable quantities of hyponitric acid should be ascertained, since they increase the density. The following table, drawn up by J. Kolb (1866), agrees nearly with the older one of Ure, which is based upon a maximum density of 1.500 at 15.5° (60° F.), and an acid, having, according to him, a composition represented by the formula $4HNO_3.H_2O$.

Per cent. HNO_3.	Specific gravity.		Per cent. HNO_3.	Specific gravity.		Per cent. HNO_3.	Specific gravity.	
	At 0° C.	At 15° C.		At 0° C.	At 15° C.		At 0° C.	At 15° C.
100.00	1.559	1.530	56.10	1.371	1.353	35.00	1.234	1.218
90.00	1.522	1.495	55.00	1.365	1.346	33.86	1.226	1.211
85.00	1.503	1.478	54.00	1.359	1.341	32.00	1.214	1.198
80.00	1.484	1.460	53.81	1.358	1.339	31.00	1.207	1.192
75.00	1.465	1.442	53.00	1.353	1.335	30.00	1.200	1.185
73.00	1.457	1.435	52.33	1.349	1.331	29.00	1.194	1.179
69.96	1.444	1.423	50,99	1.341	1.323	28.00	1.187	1.172
69.20	1.441	1.419	49.97	1.334	1.317	27.00	1.180	1.166
68.00	1.435	1.414	49.00	1.328	1.312	25.71	1.171	1.157
67.00	1.430	1.410	48.00	1.321	1.304	23.00	1.153	1.138
66.00	1.425	1.405	47.18	1.315	1.298	20.00	1.132	1.120
65.07	1.420	1.400	46.64	1.312	1.295	17.47	1.115	1.105
64.00	1.415	1.395	45.00	1.300	1.284	15.00	1.099	1.089
63.59	1.413	1.393	43.53	1.291	1.274	13.00	1.085	1.077
62.00	1.404	1.386	42.00	1.280	1.264	11.41	1.075	1.067
60.00	1.393	1.374	41.00	1.274	1.257	7.22	1.050	1.045
59.59	1.391	1.372	40.00	1.267	1.251	4.00	1.026	1.022
58.88	1.387	1.368	39.00	1.260	1.244	2.00	1.013	1.010
58.00	1.382	1.363	37.95	1.253	1.237	0.00	1.000	0.999
57.00	1.376	1.358	36.00	1.240	1.225			

Preparation of Diluted Nitric Acid.—Take of Nitric Acid three troyounces; Distilled Water a sufficient quantity. Mix the acid, in a glass vessel, with sufficient distilled water to make the diluted acid measure a pint. The specific gravity of diluted nitric acid is 1.068. The corresponding preparation of the British Pharmacopœia is made by diluting six fluidounces of the officinal nitric acid with sufficient distilled water, so that the mixture shall measure 31 fluidounces at a temperature of 15.5° C. (60° F.); or 2400 grains of nitric acid are made, by the addition of distilled water, to measure one imperial pint. Its specific gravity is 1.101, and 361.3 grains of it (6 fluidrachms) require for neutralization 1000 grain-measures of the volumetric solution of soda, corresponding to 14.95 per cent. of anhydrid.

Preparation of Fuming Nitric Acid.—Acidum nitricum fumans, *P. G.* Syn. Acidum nitroso-nitricum; Spiritus nitri fumans.—Acide azotique fumante, *Fr.;* Rauchende Salpetersäure, *G.*

If one-half the amount of sulphuric acid is employed as stated above for the preparation of nitric acid from potassium nitrate, and the heat is finally increased until the reaction between the acid sulphate and the remaining nitrate of potassium has been completed, the distillate will be nitric acid containing a considerable quantity of hyponitric acid, to which it owes its brown-red color. It emits vapors of the same color, when in contact with the air, which are of a suffocating odor. It requires to be kept in a cool place, and caution should be exercised in removing the stopper, lest a portion of the liquid should be violently ejected with the escaping vapors. The German Pharmacopœia requires for this preparation a specific gravity of from 1.520 to 1.525. The so-called *nitrous acid* of our commerce is a similar, but weaker article, consisting of nitric acid which is colored red by variable quantities of hyponitric acid. If nitrous acid gas, N_2O_3, is conducted into nitric acid, a corresponding quantity of hyponitric acid N_2O_4 is formed; thus: $N_2O_3 + 2HNO_3 = 2N_2O_4 + H_2O$.

Impurities.—Such as are likely to be present have been mentioned above. Mineral impurities are left behind as a fixed residue on evaporation. Iodine is detected by agitating the acid with chloroform, which will acquire a reddish color. If the color appears only after the addition of sulphuretted hydrogen, iodic acid has been present. Diluted with distilled water, it should not produce any precipitate with nitrate of silver (chlorine or hydrochloric acid), nitrate of barium (sulphuric acid), or sulphuretted hydrogen either before or after neutralization with ammonia (metals); the diluted acid should not be colored red by sulphocyanide of potassium (iron), and should not decolorize a drop of solution of potassium permanganate (hyponitric acid).

Pharmaceutical Uses.—Nitric acid is largely used for dissolving metals (bismuth, iron, mercury, and silver), for the oxidation of ferrous to ferric compounds, and of phosphorus to phosphoric acid, and in the preparation of nitrous ether and nitrite of amyl.

Physiological Action.—When injected into the bloodvessels of animals it is said not to coagulate the blood, or to do so very imperfectly. Upon the tissues with which the strong acid comes in contact it produces a caustic action, staining the skin yellow, rendering the pharynx and œsophagus white, and causing erosions and ulcers, some of the latter perforating, in the stomach. The small intestine is generally intact, but the glands of the large intestine are ulcerated, showing, perhaps, the excretion of the acid partly through them. If medicinal doses are long continued, unless precautions are taken, the acid impairs and may destroy the enamel of the teeth. It increases the appetite and augments the secretion of the urine. A white coating generally covers the tongue; the mouth at first grows dry, but later the salivary secretion may become profuse, when the gums grow spongy and bleed, and the teeth are loosened. If continued, it occasions dyspepsia, colic, foul breath, headache, feverishness, debility, and derangement of the bowels. These symptoms are said to be occasioned by nitric acid baths as well as by the internal use of the acid.

Medical Uses.—Formerly used as a *disinfectant*, it was abandoned on account of the irritating quality of its fumes, and of the introduction of chlorine and various other more efficient and less annoying agents. It was given internally in *typhus* and other low types of *fever* with presumed, but by no means demonstrated, advantage. In periodical, and especially *intermittent*, fevers, it has been proved to be one of the most efficient substitutes for cinchona, and indeed to cure many cases in which quinine was inoperative. From six to eight drops of the acid, properly diluted, should be given every six hours without regard to remissions or exacerbations. It was formerly used in the treatment of *dysentery*, and other bowel affections, on the recommendation of Hope, who employed nitrous acid ♏xxx, and laudanum ♏xx in camphor water f℥iv, of which mixture a tablespoonful was given every two hours. It at one time enjoyed a certain reputation in *whooping-cough*, for which very large doses were administered. As far as it did good the effect was probably due to the counterirritant action of the acid upon the fauces. By the same agency it doubtless palliates the cough of *bronchitis*, and *hoarseness* due to over-exertion of the voice; it also promotes the cure of syphilitic and other *ulcers* of the throat. When used long enough to incite ptyalism it is reputed to have cured constitutional *syphilis*. In the last-named disease it has been seldom prescribed since the introduction of iodide of potassium. It would seem to allay the thirst of *diabetes;* and in chronic enlargement of the *liver* in scorbutic, strumous, and syphilitic subjects, as well as in *jaundice* depending upon hepatic congestion, and in *scrofula* of the lymphatic glands, it appears to have been often efficacious. In chronic *impetigo* it has sometimes proved successful when other medicines were ineffectual. Externally, nitric acid has been much employed as a caustic for the *bites of rabid animals, poisonous serpents* and *insects*, etc. As already intimated, it forms an excellent ingredient of gargles for the treatment of syphilitic and other obstinate *ulcers* of the throat, as well as for sloughing sores in the mouth. It is an efficient application to ulcerated gums produced by mercury. In both of the last-mentioned cases it is superseded by chlorate of potassium. Lotions or foot baths containing nitric acid are useful in the treatment of *chilblains;* and general baths feebly acidulated by its means have been recommended for *infantile jaundice.* It is a very useful application to *periostoses* when used so as to maintain a slight irritation of the skin; and as a caustic it is often resorted to for the destruction of *warts,* venereal and non-specific, and of *condylomata* and *hemorrhoids.* For these purposes its action should be limited to the diseased structure by means of cerate; or lint saturated with concentrated nitric acid, and adapted to the part in shape and size, may be allowed to remain in contact with it for a sufficient time. The part may have its sensibility blunted by carbolic acid, by rhigolene or other anæsthetic vapor, or by cold; or the patient may be etherized during the operation. In *caries* of the bones, and *sloughing* of the soft parts, the acid may be used to hasten the separation of the diseased tissue. The *dose* of the stronger acid is from five to twenty minims, and of the diluted acid from twenty-five to fifty minims, three or four times a day, largely diluted. It should always be taken through a glass tube, and immediately afterwards the mouth should be washed with a solution of bicarbonate of sodium.

ACIDUM NITROMURIATICUM, *U. S.*—NITROMURIATIC ACID.

Acidum chloro-nitrosum, P. G.; *Acidum nitro-hydrochloricum, Aqua regia s. regis.—Acide chloro-azotique s. chloro-nitreux, Eau régale,* Fr.; *Salpetersalzsäure, Königswasser,* G.

Preparation.—Take of Nitric Acid three troyounces; Muriatic Acid five troyounces. Mix the acids in a glass vessel, and, when effervescence has ceased, keep the product in a well-stopped bottle, in a cool place, protected from the light. *U. S.*

The French Codex directs 1 part of nitric acid spec. grav. 1.32 and 3 parts of muriatic acid spec. grav. 1.17; the German Pharmacopœia gives the same proportions, but the density of the acids is 1.185 and 1.124 respectively.

ACIDUM NITROMURIATICUM DILUTUM, *U. S.*—DILUTED NITROMURIATIC ACID.

Acidum nitro-hydrochloricum dilutum, Br.; *Acide chlorazotique dilué,* Fr.; *Verdünnte Salpetersalzsäure,* G.

Preparation.—Take of Nitric Acid a troyounce and a half; Muriatic Acid two troyounces and a half; Distilled Water a sufficient quantity. Mix the acids in a well-stopped bottle, having the capacity of a pint. Shake them together occasionally during twenty-four hours, and then add sufficient distilled water to make the diluted acid measure a pint. Lastly, keep it in a cool place, protected from the light. *U. S.*

According to the British Pharmacopœia three fluidounces of nitric acid are mixed with four fluidounces of muriatic acid, and allowed to remain in a bottle the mouth of which is partially closed; twenty-five fluidounces of distilled water are then added in successive portions, the bottle shaken after each addition, and the mixture is preserved in a stoppered bottle.

On mixing nitric with muriatic acid, a decomposition takes place resulting in the liberation of chlorine and the formation of chloronitrous acid and water, thus: $HNO_3+3HCl=Cl_2+NOCl$ (chloronitrous acid) $+2H_2O$. This preparation has received the name of *aqua regia* from its property of dissolving gold, the king of metals, which is due to the presence of free chlorine; for the same reason are dissolved platinum, calomel, and all other metals and compounds which yield soluble chlorides. Its activity therefore depends upon the amount of free chlorine contained in it. Chloronitrous acid or nitro-oxylic chloride, in its pure state, is a yellowish-red liquid, which boils at —5° C. (23° F.). Gay-Lussac, its discoverer, described also a compound of the composition $NOCl_2$, which may perhaps be contained in concentrated nitromuriatic acid. Water decomposes it into hyponitric and hydrochloric acids. According to the older views nitromuriatic acid is essentially a mixture of chlorine and hyponitric acid NO_2, the reaction being explained as follows: $HCl + HNO_3 = Cl_2 + NO_2 + H_2O$.

As the stability of these compounds is influenced by temperature and by water, it is obvious that the composition of nitromuriatic acid must vary with the proportion and the strength of the acids employed, and with the temperature at which they have been mixed.

Properties.—Nitromuriatic acid is a liquid, having a deep golden-yellow color, and the odor of chlorine. It readily dissolves gold-leaf, and is wholly volatilized by heat. It should be kept in a cool and dark place, and dispensed in dark-colored bottles. It should not be kept on hand for a long time, and may well be made extemporaneously, provided that the reaction between the acids has been completed and the effervescence has ceased before it is dispensed.

In the diluted nitromuriatic acid the chloronitrous acid has probably been decomposed by the water into hydrochloric and nitrous acids, thus: $2NOCl + H_2O = 2HCl + N_2O_3$. On account of the free chlorine contained in it, it should likewise be kept in a cool place, and protected from the light.

Physiological Action.—Like its constituent acids, it acts as a powerful corrosive poison when taken pure and in large quantities. In smaller doses it is very apt to disagree with the stomach, and it readily attacks the enamel of the teeth. When mixed with the water of a warm bath, so as slightly to acidulate it, it is absorbed by the skin, greatly increasing the acidity of the urine, and, after several repetitions of the bath, exciting a burning sensation in the mouth and throat, a considerable flow of saliva, superficial ulcers of the mouth, and redness and swelling of the gums. The bowels are more frequently moved, and there is sometimes an increased tendency to urination. The secretion of bile is said also to be augmented.

Medical Uses.—This acid has been employed for many of the same purposes as nitric acid, such as diseases of the *liver*, *scrofula*, *syphilis*, *cutaneous affections*, and chronic *rheumatism*, and there does not appear to be any sufficient ground for preferring it to the simpler nitric or muriatic acid, at least as an internal medicine. As originally used, it was applied in the form of a general warm bath, which contained no less than thirty-two fluidounces of the acid. A foot and a sponging bath of like strength were also employed, and several folds of flannel immersed in the liquid of the bath were wrapped around the body. The use of this regimen for at least two months was recommended. At the present time the literal application of nitromuriatic baths is seldom resorted to; but there is good reason to believe that in a much less energetic form they are sometimes of marked utility. Foot-baths and lotions, as well as cloths wet with acidulated water, applied over the hepatic region, we have several times employed with decided advantage in cases of slight *jaundice* accompanied with *dyspepsia*, hepatic tenderness and fulness, and hypochondriasis in persons who used alcohol to excess.

The risk of its injuring the teeth should render physicians very circumspect in the internal use of this acid; and fortunately there are no conditions in which it is appropriate that cannot as well be treated by safer medicines. The *dose* of the stronger acid is three or four drops, and of the diluted acid from ten to twenty drops, largely diluted, and imbibed through a glass tube. The antidotes are the same as those employed for its component acids.

ACIDUM OXALICUM, *U. S.*—OXALIC ACID.

Acide oxalique s. carboneux, Fr.; *Oxalsäure, Kleesäure*, G.

Formula $H_2C_2O_4,2H_2O$. Molecular weight 126.

Origin and Formation.—Oxalic acid occurs in combination with ammonium in guano, and with calcium in a large number of plants, among which may be mentioned the following officinal drugs: rhubarb, curcuma, ginger, squill, orris, valerian, quassia, etc. It is found as acid potassium oxalate in the leaves and stalks of phytolacca, belladonna, and several species of rumex, rheum, and oxalis, taking its name from the last-named genus. Some urinary calculi consist of oxalate of calcium, which is also found in the gall-bladder, in uterine mucus, in some urinary sediments, in most lichens, and many vegetable tissues. It is formed by the action of nitric acid upon most organic compounds, and sugar, gum, sawdust, and other organic bodies yield oxalates when gradually heated to redness with excess of potassium or sodium hydrate. (Gay-Lussac, 1829.)

Preparation.—One part of sugar, molasses, or starch is mixed in a retort with eight parts of nitric acid spec. grav. 1.38; a gradually increased heat is applied until the liquid finally boils, and red nitrous acid vapors cease to be given off; it is then concentrated by evaporation to one-sixth of its volume, and set aside to crystallize. The crystals are drained from the mother liquor and recrystallized from hot water. This is the process of Scheele and Bergman (1776), modified in the strength of nitric acid by Schlesinger (1841). Any excess of nitric acid may be recovered in the receiver, and the nitrous acid gas evolved may be utilized in the manufacture of sulphuric acid. L. Thompson (1848) recommends the use of a weaker nitric acid of 1.245 density, in order to avoid the generation of formic acid by the decomposition of oxalic acid. Schlesinger obtained from 100 parts of sugar 58 to 60 parts of handsomely crystallized oxalic acid; Thompson, from the same quantity of sugar, 63 parts of acid, and by utilizing the mother liquor in each subsequent charge of the retort, from 107 to 115 parts of oxalic acid.

If the nitric acid employed is insufficient in quantity, a corresponding amount of the sugar will be converted into saccharic acid.

E. Stieren (1865) recommends the dark mother liquors obtained in the preparation of tartaric acid as a source for oxalic acid. They are advantageously worked up for this purpose by adding to 20 parts thereof, previously warmed, two parts of nitric acid spec. grav. 1.33. After the extrication of the nitrous acid vapors, more nitric acid is gradually added until red vapors are no longer given off. When the liquid is suitably concentrated and crystallized, the crystals are to be purified by recrystallization.

Most of the oxalic acid is made by a process based upon Gay-Lussac's observations mentioned above. Dale observed that caustic soda would not produce it from sawdust until it was mixed with potassa. Two molecules of the former and one of the latter are dissolved in water to form a solution of 1.35 spec. grav., which is mixed with sufficient sawdust to obtain a pasty mass, and then heated, with constant stirring, upon iron plates. After it has been kept at a temperature of 204.5° C. (400° F.) for one or two hours, the heat is extended until the mass is quite dry, care being taken that no charring takes place. The gray powder contains 28 to 30 per cent. of oxalic acid combined with the alkalies; it is washed with solution of carbonate of sodium, by which the potassium is removed as carbonate; the oxalate of sodium is boiled with milk of lime, whereby caustic soda and oxalate of calcium are formed, and the latter is decomposed by sulphuric acid; the oxalic acid is purified by recrystallization. By this process sawdust yields about half its weight of oxalic acid. (*American*

Journal of Pharmacy, 1863, p. 359.) 323,366 lbs. of oxalic acid were imported into the United States in 1867, and 655,000 lbs. in 1877.

Properties.—Oxalic acid crystallizes from its aqueous solution in flat, oblique, rhombic prisms, which are colorless, transparent, and soluble in about 8 parts of water at the ordinary temperature and in nearly all proportions at the boiling temperature. Nitric acid increases their solubility in cold water. They dissolve in 2½ parts of cold and 1.8 parts of boiling strong alcohol, and are but little soluble in ether. Oxalic acid fuses at 98° C. (208.4° F.), and at about 160° C. (320° F.) sublimes partly unaltered and is partly decomposed into carbonic acid and carbonic oxide, without leaving any residue. The same decomposition takes place when oxalic acid is heated with strong sulphuric acid. The commercial acid usually leaves upon platinum foil a small quantity of charcoal which is finally consumed. Heated with glycerin to little above the temperature of boiling water it is decomposed into carbonic and formic acids. In chemical affinity it is one of the strongest acids, yielding salts which are mostly insoluble or slightly soluble in water, but which dissolve in diluted nitric acid. Oxalic acid yields with lime-water, and the soluble oxalates with all soluble calcium salts, a white precipitate which is insoluble in oxalic and acetic acids. The acid potassium oxalates are popularly called *salt of sorrel*, also *salt of lemon*, and are employed for removing iron stains from paper, linen, leather, etc.; but at present oxalic acid is usually substituted for this purpose.

The composition of oxalic acid, dried at 100° C. (212° F.) or obtained by sublimation, is expressed by the formula $C_2H_2O_4$; crystallized from water it is $C_2H_2O_4.2H_2O$.

Impurities.—Mineral impurities are left behind on incinerating the oxalic acid upon platinum foil; organic impurities will blacken concentrated sulphuric acid on boiling. Sulphuric acid, if present, will produce with nitrate of barium a white precipitate which is insoluble in diluted nitric acid.

Pharmaceutical Uses.—As a test for calcium salts and for preparing ferri oxalas, *U. S.*

Physiological Action.—Oxalic acid is not used in medicine. From its resemblance to Epsom salts many cases of poisoning by it have occurred. Its taste is intensely sour; when swallowed, it, in general, soon occasions vomiting, with burning pain and constriction of the throat and stomach; the ejected matters are dark colored, and may contain blood. When the pain is very severe, collapse may speedily ensue, with drowsiness or stupor. Sometimes these symptoms are unaccountably delayed. In some cases death is rapid, occurring within from three to twenty minutes; in others it has been postponed until the twenty-third day; in others still an excessive dose has been promptly vomited, and, after comparatively slight symptoms, the patients have recovered. The quantity of the acid fatal to life is equally indeterminate. At least one case is recorded in which death occurred in eight hours. The usual *post-mortem* lesions are: dark discoloration of the œsophagus and stomach, gelatiniform softening of the mucous membrane, and even perforation of the coats of the stomach. The blood is said to present an unusually bright color. The appropriate antidote to this poison is lime in the form of powdered chalk mixed with water. If this is not at hand, slaked lime, as dried whitewash, may be resorted to until the better preparation can be procured.

ACIDUM PHOSPHORICUM.—PHOSPHORIC ACID.

Acide phosphorique, Fr.; *Phosphorsäure*, G.

Varieties and Origin.—Anhydrous phosphoric acid or metaphosphoric anhydrid is obtained in snow-white flakes on burning dry phosphorus in dry oxygen or atmospheric air. It has the composition P_2O_5, and attracts moisture with avidity, whereby it is converted into monobasic *metaphosphoric acid;* $P_2O_5+H_2O$ yields $2HPO_3$, which is the formula of glacial phosphoric acid. This acid is, however, not prepared in the manner indicated, but is obtained from bones, which are the calcium compound of the tribasic *orthophosphoric acid,* H_3PO_4. A third modification is the bibasic *diphosphoric* or *pyrophosphoric acid,* having the formula $H_4P_2O_7$. Rother (1876) regards the following as the correct formulas: metaphosphoric acid, $H_2P_2O_6$; pyrophosphoric acid, $H_4P_2O_7$; and orthophosphoric acid, $H_6P_2O_8$. The three acids differ from each other in the following reactions of their aqueous solutions: *metaphosphoric acid* coagulates albumen and produces white precipitates with chloride of barium and chloride of calcium, and a transparent gelatinous precipitate with nitrate of silver. *Pyrophosphoric acid* does not affect albumen, chloride of calcium, or chloride of barium; but produces a white precipitate with nitrate of silver on the addition of a little ammonia. *Orthophosphoric acid* does not affect albumen, chloride of calcium, or chloride of barium, and produces with nitrate of silver a yellow precipitate on the addition of some ammonia.

Phosphoric acid, met with in the combined state in the mineral, vegetable, and animal kingdom, is orthophosphoric acid. Pyrophosphates are obtained by heating to redness orthophosphates containing one atom of basylous hydrogen or ammonium (see Sodii pyrophosphas). Metaphosphoric acid is produced on heating ortho- or pyrophosphoric acid or their ammonium compounds to redness.

ACIDUM PHOSPHORICUM GLACIALE, *U. S.*—GLACIAL PHOSPHORIC ACID.

Acide phosphorique glacial, Fr.; *Glasige Phosphorsäure,* G.
Formula HPO_3. Molecular weight 80.

Preparation.—About equal parts of bones burned to whiteness, and sulphuric acid diluted with 15 parts of water, are digested for some time until the insoluble part has been converted into white smooth sulphate of calcium; the liquid, containing sulphuric and phosphoric acids and holding calcium and magnesium phosphates in solution, is removed by filtration and washing with water, neutralized with ammonia or carbonate of ammonium, separated from the precipitated phosphates, and evaporated to dryness. The ammonium phosphate is then heated in a platinum crucible to redness until the ammonia has been completely driven off. Porcelain capsules are corroded in this last operation. The fused acid is poured upon polished iron plates, and, when cool, put into bottles.

Thus prepared, phosphoric acid contains a little sodium, to free it from which Neustadtl (1861) proposes to precipitate the neutralized acid with barium chloride, and to decompose the resulting phosphate of barium, after it has been thoroughly washed, with sulphuric acid; the acid filtrate is then evaporated and heated to redness.

Properties.—Glacial phosphoric acid is in colorless transparent, glass-like masses, which are slowly deliquescent in the air, and soluble in water and in alcohol; the solution has a strongly acid taste. Its composition and the reaction of its solution have been mentioned above. Chemically pure metaphosphoric acid is a soft gum-like mass, becoming solid and glass-like only through the presence of some sodium or other phosphates (Brescius, 1867).

Impurities.—We have found (1860) commercial glacial phosphoric acid to contain from 76.46 to 83.48 per cent. of phosphoric anhydrid against the calculated quantity of 88.75. The impurities consist of excess of water and occasionally of calcium and magnesium phosphates. Prescott obtained (1872) from the commercial acid an amount of soda corresponding to from .023 and

.038 per cent. of sodium phosphate. Brescius found in a sample 15.3 per cent. of soda.

The aqueous solution of glacial phosphoric acid is not precipitated on standing for two days, after having been saturated with hydrosulphuric acid (arsenic, lead). When boiled for some time, and then supersaturated with ammonia, no precipitate is produced, with the exception of a slight turbidness (calcium, magnesium). With caustic potassa in excess, ammonia is not evolved. If completely precipitated by acetate of lead, the filtrate, after the excess of lead has been removed by sulphuretted hydrogen, leaves, on evaporation, only a very minute residue (potassium, sodium).

ACIDUM PHOSPHORICUM DILUTUM, *U. S.*, *Br.*—DILUTED PHOSPHORIC ACID.

Acide phosphorique médicinal, Fr.; *Verdünnte Phosphorsäure*, G.

Formula H_3PO_4. Molecular weight 98. The specific gravity is 1.056 U. S., 1.08 Br.

Preparation and Properties.—Take of Phosphorus three hundred and sixty grains; Nitric Acid five troyounces, or a sufficient quantity; Distilled Water a sufficient quantity. Mix five troyounces of nitric acid with half a pint of distilled water, in a porcelain capsule, of the capacity of two pints. Add the phosphorus, and invert over it a glass funnel of such dimensions that its rim may rest on the inside of the capsule, near the surface of the liquid. Place the capsule on a sand-bath, and apply a moderate heat until the phosphorus is dissolved, and red vapors cease to rise. If the reaction becomes too violent, add a little distilled water; and, if the red vapors cease to be evolved before the phosphorus is all dissolved, gradually add nitric acid, diluted to the same extent as before with distilled water, until the solution is effected. Then removing the funnel, continue the heat until the excess of nitric acid is driven off, and a syrupy liquid, free from odor and weighing two ounces, remains. Lastly, mix this, when cold, with sufficient distilled water to make it measure twenty fluidounces, and filter through paper. *U. S.*

The process of the British Pharmacopœia is identical with the foregoing in principle, but varies from it in the details; it is as follows:—

Take of Phosphorus four hundred and thirteen grains; Nitric Acid six fluidounces; Distilled Water a sufficient quantity. Put the nitric acid, diluted with eight ounces of distilled water into a tubulated retort connected with a Liebig's condenser, and having added the phosphorus, apply a gentle heat so as to slowly distil five fluidounces of liquid. Return this to the retort and continue the distillation, occasionally returning the distillate until the phosphorus has entirely disappeared. Transfer the contents of the retort to a porcelain dish of hard well-enamelled ware, and evaporate the liquid until it is reduced to four fluidounces; then, transferring it to a platinum vessel, continue the evaporation until it is reduced to two fluidounces and orange-colored vapors are no longer formed. Mix it now with distilled water, until, when cold, it measures one pint (imperial). *Br.*

The U. S. Pharmacopœia has admitted an alternative process, which is as follows:—

Diluted phosphoric acid may also be prepared by dissolving a troyounce of Glacial Phosphoric Acid in three fluidounces of Distilled Water, adding to the solution forty grains of Nitric Acid, boiling it until reduced to a syrupy consistence and free from the odor of nitric acid, and then adding sufficient distilled water to make the diluted acid measure twelve fluidounces and a half.

When phosphorus is treated with a weak nitric acid, no reaction will take place in the cold, but at an elevated temperature it is oxidized into phosphorous and phosphoric acids, according to the strength of the acid employed. Concentrated nitric acid oxidizes it at once into phosphoric acid. The reaction, which is moderate in the beginning, rapidly becomes violent, the phosphorus is ignited, and nitrous acid vapors are so copiously disengaged that an explosion is likely to occur, particularly if the operation is performed in a retort, shattering the vessel and throwing the hot acid and burning phosphorus in all directions. This danger is avoided by the use of a diluted nitric acid, as directed by both Pharmacopœias. The strength directed by the British Pharmacopœia is preferable, the oxidation of the phosphorus taking place uniformly, more rapidly, and with perfect safety, when an acid of about 1.22 specific gravity is used. The acid, as diluted by the U. S. Pharmacopœia, has the specific gravity 1.17; its strength may be increased to the former by mixing equal weights of the officinal acid and distilled water. It is important, however, that a *moderate* heat only be applied, sufficient to fuse the phosphorus and to induce the reaction; about 50° C. (122° F.) will suffice. Considerable heat being produced by the oxidation, the subsequent heating should be carefully watched. With nitric acid of less strength, a higher degree of heat is requisite to commence and sustain the reaction, and much nitric acid will either distil over or be lost. A retort is not necessary, if the operation is skilfully performed, the inverted funnel over the porcelain capsule, as first recommended by Procter, commends itself for convenience and simplicity of arrangement. No nitric acid will be lost by spirting, and most of that volatilized during the process will be condensed within the funnel, and fall back into the capsule, if the heat has not been raised too high. The operation may be considered successful, if no particles of the fused phosphorus are carried to the surface of the liquid, and nitrous acid vapors are regularly extricated. After the phosphorus has been completely dissolved, the funnel is removed, and the heat gradually raised to boiling, when the phosphorous acid contained in the liquid will be oxidized to phosphoric acid, red vapors being often evolved quite copiously as soon as a sufficient concentration has been attained.

Prof. Markoe (1875) has proposed a process in which the oxidation of the phosphorus is effected through the intervention of iodine and bromine, and at a low temperature. Two troyounces of phosphorus and 12 troyounces of water are put into a flask or stone jar, 10 grains of iodine are added, and then 60 grains of bromine by drops; when the reaction has ceased, add 12 troyounces of nitric acid; set the vessel in cold water, and when in about 24 hours the solution has been effected, evaporate the liquid until all the iodine, bromine, and nitric acid has been expelled. In this process some bromide and iodide of phosphorus is formed and decomposed by the water with the formation of phosphoric, hydrobromic, and hydriodic acids, from the last two of which, reacting with the nitric acid present, bromine and iodine are again produced, which again act upon the phosphorus, etc. It is very important to follow the above directions strictly, since the incautious addition of bromine to phosphorus and nitric acid may cause a dangerous explosion. Should phosphorous acid still be present, nitric acid must be dropped in as long as red vapors are given off. The concentration of the liquid by heat is necessary, in order to expel the excess of nitric acid, which is accomplished when a glass rod moistened with ammonia and held over the capsule ceases to produce white fumes. Should the liquid become too dense before all the nitric acid has evaporated, it is advisable to dilute it somewhat with boiling water and concentrate again. After the cooled concentrated acid has been dissolved in the requisite quantity of distilled water, it is filtered if necessary.

Phosphorus contaminated with arsenic will yield an acid containing this element as arsenic acid, which is removed by saturating the dilute liquid contained in a flask with sulphuretted hydrogen gas, and setting it aside for two or three days, then heating to expel the gas, filtering from the sulphur and sulphide of arsenic, and concentrating by evaporation.

For the preparation of the diluted from the glacial phosphoric acid, the latter should always be tested beforehand to ascertain whether it is not too largely contaminated with impurities. By boiling the aqueous solution, the metaphosphoric is gradually converted into orthophosphoric acid. According to the experiments of Littleton Thompson, this appears to be more easily effected when the solution is made of one part of glacial phosphoric acid with two parts of water, and then boiled for ten or fifteen minutes. (*The Pharmacist*, 1874, p. 130.)

In the presence of nitric acid this change takes place to some extent in the diluted solution, and if sufficiently concentrated by boiling, the removal of the last traces of nitric acid is accomplished with no greater difficulty than in the first process. When diluted afterwards to its proper strength, this acid should produce no precipitate in the course of several hours when mixed with an equal bulk of officinal tincture of chloride of iron. Should such a precipitate occur, the boiling must be resumed until the acid responds to this test. The precipitate referred to appears to be due to the presence of some meta- or pyro-phosphoric acid.

Properties.—Diluted phosphoric acid is a clear, colorless, and inodorous acid liquid, which answers to the tests mentioned above. 100 grains of it are neutralized by $23\frac{4}{10}$ grains of potassium carbonate without producing a precipitate (*U. S.*). For the stronger acid of the British Pharmacopœia the following test is given: 355 grains of it poured upon 180 grains of pure oxide of lead, free from carbonate leave after evaporation and heating to dull redness a residue weighing 215.5 grains. 6 fluidrachms correspond to 35.5 grains of P_2O_5, or to 40 grains of HPO_3. The following table by R. Hoffmann indicates the strength of phosphoric acid in phosphoric anhydrid P_2O_5 :—

Sp. gravity.	Per cent.	Sp. gravity.	Per cent.	Sp. gravity.	Per cent.	Sp. gravity.	Per ct.
1.009	1	1.089	11	1.182	21	1.288	31
1.017	2	1.098	12	1.192	22	1.299	32
1.025	3	1.106	13	1.202	23	1.310	33
1.032	4	1.115	14	1.212	24	1.321	34
1.039	5	1.124	15	1.223	25	1.333	35
1.047	6	1.133	16	1.233	26	1.345	36
1.055	7	1.142	17	1.244	27	1.357	37
1.062	8	1.151	18	1.254	28	1.369	38
1.071	9	1.161	19	1.265	29	1.381	39
1.080	10	1.171	20	1.277	30	1 393	40

Impurities are detected in the same manner as in the glacial acid, except that when testing for calcium and magnesium boiling is not required before supersaturating with ammonia. Hydrochloric acid is detected by the curdy white precipitate occurring with nitrate of silver; sulphuric acid by a white precipitate with barium chloride; nitric acid by the black coloration produced on adding a crystal of ferrous sulphate and afterwards some concentrated sulphuric acid; and phosphorous acid by the speedy decoloration of a drop of solution of potassium permanganate, or by the precipitate of calomel when heated with solution of corrosive sublimate.

Off. Prep.—Ammon. phosphas, Syrupus ferri phosphatis, *Br.*

Physiological Action and Medical Uses.—The views expressed by different writers in regard to the degree and mode of action of phosphoric acid are not easily harmonized. According to J. Ashburton Thompson, "the complete oxidation of the phosphorus is calculated to destroy its therapeutical properties entirely." Burness declares that "it is not astringent, but forms soluble compounds with albumen and fibrin," while Hoffman states that as a hæmostatic "it is better than other astringents." Burness further declares that "if continued for some time it causes cough and expectoration, passive congestion, especially in the extremities; pain in the bones, a febrile state with profuse perspiration, followed by diarrhœa, depression of the mental powers, and pain in the generative organs;" and, in opposition to all of these, Dr. J. B. Andrews affirms that although it is a powerful stimulant of the brain and nervous system, "in no case does it disturb the digestion or prove an irritant to the stomach, even when its administration is prolonged." According to Sundelin, it is a powerful excitant of the genital organs; while Andrews agrees with Neligan that it exerts no direct influence upon the generative function.

According to Andrews, the sensations produced by a dose of from forty drops to three drachms of the acid were those of moderate alcoholic stimulation. When a larger dose was taken there was a feeling of drowsiness and inertness that continued for some hours. It was employed by this physician in many cases of insane *melancholy* and of persons whose minds had been overtaxed and who had become nervous and timid, as where the application of the mind induced a sense of weariness and inability to continue the occupation. But as its use was supplemented by "relaxation from business and labor" and "some suitable tonic," the share of phosphoric acid in the patient's improvement is more than problematical. It has been used, on theoretical grounds, in the treatment of *dyspepsia*, with an excessive proportion of earthy phosphates in the urine; in *scrofulous caries* and in *exostoses* of the bones; to correct *night-sweats* in phthisis and other hectical diseases; in *hæmoptysis* and in *catarrhal affections* of the lungs and of the genito-urinary organs; in *jaundice*, and in *diabetes*. In the last named disease it has a remarkable power of diminishing thirst, and consequently of lessening the harassing secretion of urine. At the same time, it affords an agreeable acidulous beverage. The *dose* of diluted phosphoric acid is from twenty minims to a fluidrachm sufficiently diluted to be agreeable to the taste.

ACIDUM PICRICUM.—Picric Acid.

Acidum carbazoticum.—Carbazotic, or nitrophenisic acid; Trinitrophenol, E.; *Acide picrique, carbazotique, nitroxanthique, etc.; Jaune-amer*, Fr.; *Pikrinsäure, Trinitrocarbolsäure, Welter'sches Bitter*, G.

Formula $HC_6H_2(NO_2)_3O$. Molecular weight 229.

Preparation.—This acid was discovered by Hausmann (1788), and its composition investigated by Liebig, Dumas, and others. It may be obtained by the action of nitric acid upon salicin and its derivatives, phloridzin, indigo, aloes, benzoin, silk, and other substances, and is best prepared by gradually adding carbolic acid to fuming nitric acid and heating the mixture, when, on cooling, the new compound will crystallize and may be purified by washing with cold water and recrystallizing from boiling water or diluted alcohol. $C_6H_6O + 3HNO_3$ yields $C_6H_3(NO_2)_3O + 3H_2O$.

Properties.—Picric acid crystallizes in bright yellow needles or scales, which, on being heated, melt and sublime without decomposition, forming yellow suffocating vapors which condense again to crystals. It has an acid and extremely bitter taste, dissolves at 15° C. (59° F.) in 86 parts of water, forming a bright yellow solution, and is readily soluble in alcohol and ether. Its solutions stain the skin and other organic matter permanently yellow; hence its use in dyeing. The aqueous solution precipitates gelatin. It unites with bases, forming salts which are mostly yellow, have a bitter taste, and are explosive by percussion or when heated. The potassium picrate requires 260 parts of water of 15° C. (59° F.), but only 14 parts of boiling water for solution.

Tests.—The above described properties are sufficient for recognizing the acid. When rapidly heated upon platinum foil, it takes fire and burns with a sooty flame, without leaving any fixed residue.

Physiological Action and Uses.—When given continuously to rabbits it causes emaciation, diarrhœa, ecchymosis in the intestine, yellowness of the conjunctiva and of the urine; and in large doses, nausea, diarrhœa, flatulence, depression, and twitching of the cutaneous muscles. After death the red blood disks are found dissolved in part, and in the white corpuscles the nuclei exhibit a lively molecular movement. The acid, and also its salts, given to man induce a yellowness of the conjunctiva, skin, and urine. This fact is of interest as illustrating the mode of production of jaundice in certain cases, as in yellow fever and acute yellow atrophy of the liver. Picrate of ammonium has been used in the treatment of *intermittent fever* and of *trichiniasis*, upon theoretical grounds, but fruitlessly. At present it does not appear to possess any therapeutical value.

ACIDUM SALICYLICUM.—SALICYLIC ACID.

Acide salicylique, Fr.; *Salicylsäure*, G.
Formula $H_2C_7H_4O_3$. Molecular weight 138.

Origin and Formation.—It occurs as methyl-salicylic ether in the leaves of Gaultheria procumbens and Andromeda Leschenaultii, and is formed from salicin, indigo, and some other organic matters by adding them to hydrate of potassium heated to fusion.

Preparation.—It may be prepared from oil of wintergreen by heating it with strong solution of potassa as long as methylic alcohol is given off, and decomposing the resulting salicylate of potassium by muriatic acid. But it is at present extensively prepared, according to Kolbe (1874), from carbolic acid. As the first step dry carbolate of sodium is prepared, which is introduced into a retort; dry carbonic acid gas is passed through it, while heat is applied, gradually increased from 100° C. (212° F.) to 220° C. (428° F.), and not over 250° C. (464° F.). By this operation carbonic acid is made to enter into the molecule of phenol, producing salicylate of sodium and carbonate of sodium, while one-half of the carbolic acid distils over; $2(NaC_6H_5O)+CO_2$ yields $Na_2C_7H_4O_3+C_6H_6O$. The residue in the retort is now dissolved in boiling water, filtered if necessary, and decomposed by muriatic acid, when, on cooling, impure salicylic acid having a brown or reddish-brown color is precipitated in the form of a crystalline powder; this reaction occurs as follows: $Na_2C_7H_4O_3+2HCl=2NaCl+H_2C_7H_4O_3$ (salicylic acid), chloride of sodium remaining in solution. The impure acid thus obtained is further purified by dissolving it in boiling water or weak alcohol, treating the solution with animal charcoal, and crystallizing the filtrate after the addition of a little muriatic acid. A. Rautert recommends (1875) the purification of it by distillation with steam previously heated to 170° C. (338° F.), by which some black resin is left as a residue; by recrystallization from boiling water a little carbolic acid is removed. Contact with iron or with materials containing iron is to be avoided, since a reddish color is thereby imparted. According to Squibb (1877), it is best purified by subliming it with the aid of steam-heat.

Properties.—Thus obtained salicylic acid is in small acicular crystals—white, inodorous, and of a sweetish, acidulous, somewhat acrid taste. The commercial article frequently has a yellowish or brownish tinge. It fuses at 155° C. (311° F.), and if carefully heated sublimes unaltered. When rapidly heated to between 220° and 230° C. (428° and 446° F.), it is decomposed into carbonic acid gas and phenol; $C_7H_6O_3$ yields $CO_2+C_6H_6O$. It is sparingly soluble in cold water, but dissolves freely in boiling water, crystallizing, when slowly cooled, in long, slender needles. The solubility in water is considerably increased by the addition of phosphates and acetates of the alkalies and of borax, the solution made with the latter gradually acquiring a bitter taste. It dissolves freely in wood spirit, alcohol, and ether, particularly when heated. Its solution in 5 parts of boiling oil of turpentine congeals on cooling. C. Becker (1875) observed that one part of salicylic acid and two parts of olive oil, heated together, form a homogeneous mixture. The alcoholic solution evaporated spontaneously yields the acid in large oblique quadrangular prisms. The aqueous solution imparts a deep violet color to ferric chloride. It effervesces with carbonates, behaving as a monobasic acid; but under certain circumstances a second hydrogen atom may be replaced by metals, yielding Piria's neutral salicylates (1855), which are decomposed by carbonic acid. Combined with alkalies the solution of salicylic acid turns brown in contact with the air. On dry distillation the salicylates are decomposed, yielding carbonic and carbolic acids.

Impurities.—According to J. Williams (1878), salicylic acid, prepared by Kolbe's process, is contaminated with another acid, which he provisionally names *cresyl-salicylic acid*, and which remains in the mother liquor on neutralizing a solution in hot water with carbonate of calcium; if the precipitated salicylate of calcium be purified by recrystallization from boiling water and afterwards decomposed by hydrochloric acid, pure salicylic acid is obtained. The presence of carbolic acid can be detected by the lower fusing and boiling point and by Plugge's test (see page 32). The aqueous solution, to which a little nitric acid has been added, is not precipitated by chloride of barium (sulphuric acid), or by nitrate of silver (hydrochloric acid). Heated upon platinum foil, salicylic acid evaporates without leaving any residue (mineral impurities).

Medical History.—As long ago as 1855 Bertagnini is said to have studied its physiological action in experiments upon himself; and in 1874, Kolbe, besides producing the acid synthetically, illustrated its anti-putrid and anti-fermentative actions.

Physiological Action. *On Vegetables, etc.*—Plants watered with a solution of this acid speedily die. It prevents various reactions in organic products, *e. g.*, hindering the development of prussic acid in a mixture of amygdalin and almond emulsion; of the acrid principle of mustard on the addition of water; the souring of beer, milk, etc. Added to urine it prevents its putrefactive fermentation, and arrests this process after it has commenced. When given internally, or injected into the bladder, as an acid or in saline combination, it prevents the fermentation of the urine in that organ, and restores its acid reaction when it is lost. It has no strictly deodorizing action, and, therefore, is not available in a great many cases in which foul smells, and not their cause, must be attacked. It, however, deodorizes ammoniacal urine, probably by a chemical action. Salicin neither deodorizes nor preserves organic compounds, but when taken internally it has the same effect as salicylic acid in preventing the fermentation of urine in the bladder, because in the system it is converted into that acid.

On Animals.—About a grain of salicylate of soda introduced under the skin of a frog renders the animal languid, and then occasions complete motor paralysis and arrest of the heart. Guinea-pigs, after a dose of from 60 to 70 grains, grow rapidly weak, lie on the belly, and drag their limbs, which are moved spasmodically; then respiration grows shallower until it ceases. From such experiments Rochefontaine concluded that the acid, 1, impairs general and reflex sensibility by its action on the brain and spinal marrow; 2, muscular contractility and excito-motility are suspended later; 3, respiratory movements are arrested; and, 4, the heart ceases to beat. The experiments of Laborde, furnishing the same general results, led him also to conclude that the salt acts upon the nerve centres and not upon the nerves. Other experimenters found that the acid does not reduce the pulse-rate or the temperature in healthy animals, nor modify their sensibility. More recent observers (Danewsky) claim that the primary action of salicylate of soda is to increase the force of the cardiac systole and the arterial tension; but that secondarily the pulse grows feebler and more frequent or infrequent, the latter especially after large doses. Of these effects the former is interpreted as showing an action of the medicine upon the vagus, and the latter a paralysis of the excito-motor nerves of the heart. The salt does not modify the temperature in health, but only in fever, which is thus explained: febrile heat results from a diminished activity of the circulation due to a lessened power in the heart and arteries. Like digitalis and quinia, salicylate of soda increases the cardio-vascular tension and lowers the temperature. According to Fürbringer's experiments on animals, the acid has no power of reducing the temperature in inflammatory fever, but displays such a power in septic fever; but Zimmerman, on the other hand, after injecting putrid liquids into the veins of rabbits, did not find that the resulting fever was controlled by the acid. It would be difficult to harmonize such conflicting results.

On Man.—The experiments of Ringer and Busy with salicin upon healthy children appear to show that it has no influence upon the temperature; that under full medicinal doses a dusky flush suffuses the face on slight excitement, while the expression becomes dull and heavy. Less constant symptoms are deafness, noises in the ears, frontal headache, trembling of the hands, and quickened breathing. Very large doses occasion severe headache, marked muscular weakness, tremor, and irritability. Tingling may be felt in the extremities, and the voice becomes husky; the breathing is hurried, but there is no dyspnœa; large doses often repeated raise the pulse-rate to 140, and render the beats feeble. Other observers have noted an intermittent or a slower pulse among the physiological effects of this medicine; while the greater number declare that in healthy persons, and in medicinal doses, it does not affect the pulse at all. Such has certainly been the case after doses of forty and even seventy-five grains, which produced buzzing in the ears and a state of semi-intoxication. A similar dissidence exists in regard to its influence upon the temperature in health. The singular opinion has been expressed that it is only sedative to the calorific function when it acts as a diuretic. On the whole, there is no reason to believe that in healthy persons it reduces the temperature. During the use of salicylic acid and its compounds the urine gives a violet color on the addition of solution of perchloride of iron. Its passage through the system is very rapid, for in a case of extrophy of the bladder its presence in the urine was demonstrated in about eight minutes after seventy-five grains of salicylate of soda had been taken. But its excretion does not cease for several days after the medicine has been suspended. It appears, however, to undergo a change before elimination, since the urine containing it does not check the fermentation of yeast. According to Byasson, salicylic acid appears in the urine "partly unchanged." It increases the elimination of uric acid and nitrogenous compounds. Besides its elimination with the urine, it is also excreted in a small proportion with the sweat and with the serum of blisters; it is generally thought not to be discoverable in the saliva; but one observer (Musy) found it there. Salicin appears to render the sweat alkaline or neutral even in rheumatic patients with acid urine; but the evidence of this operation is not conclusive. To its promotion of urinary elimination must be attributed its alleged action in removing yellowness of the skin in jaundice. The local action of salicylic acid is that of an irritant, and is due in part to its insolubility. Thus it irritates the throat, causing dryness and heat in it, and in many cases occasions so much vomiting as to render its continued use impossible. The salicylate of sodium is not liable to this objection.

The occasional toxical effects produced by this acid and its compounds are partly local and partly general. The former consist mainly of the irritations just referred to, but they are by no means usual, and often excessive doses are employed without injury. Thus a patient affected with rheumatism took six drachms of salicylate of sodium in the course of twenty-two hours; he suffered no pain in the stomach, but, on the contrary, his appetite was improved (Ewald). But in other cases the effects are fitted to inspire anxiety. Thus Ewald reports that a woman became affected with alarming symptoms after using the acid or its sodium salt. After a drachm of the latter there was repeatedly observed delirium like that from alcohol, but more frequently extreme jactitation, and even maniacal fury; also roaring in the ears, disorders of vision, and loss of muscular power in the limbs. This last symptom sometimes reaches the degree of complete resolution; and the gastric disturbance may resemble that produced by a corrosive poison. In children it occurs most frequently, as well as the prostration of the nervous system. In a case of acute articular rheumatism, a rapid cure appeared about to occur, when, besides buzzing in the ears and profuse sweats, there was extreme prostration, and the patient died suddenly on sitting up to eat (Empis). In another case, a girl of fifteen took by mistake seven drachms of salicylate of sodium within a few hours; besides the other symptoms already mentioned, she had dilated pupils, impaired vision, and strabismus, and became melancholic. Red spots appeared transiently on the skin; there was vomiting, but no diarrhœa; the urine contained albumen (Peterson); it sometimes contains blood, or casts. Abelin states that acute nephritis may occur during its use. It follows from the above that salicylic acid, and in a less degree its salts, should not be given in large doses to persons having a weak heart, or who are otherwise greatly debilitated, or, at least, not without counteracting their toxical tendencies with nutrients and diffusible stimulants.

Medical Uses. *Acute Articular Rheumatism.*—If salicylic acid and its compounds are curative of any disease, it is this. That it reduces the pulse-rate, and in a much greater degree the temperature (from 103° F. to 98° F.), the latter in nearly all cases, there is no doubt. Whether it removes the disease as well as, or better than, some other remedies is not quite so certain. For acute articular rheumatism is a general disease in which not only the joints, but several internal organs, and especially the heart, are apt to be involved. Now, it is on all hands admitted, that salicine, salicylic acid, and its compounds exert no preventive influence whatever on these complications, nor prevent relapses; and some even go so far as to maintain that their development or occurrence is favored by the medicines. This opinion is probably due to the rapid relief obtained in many cases from pain and fever, and the imprudent exposure which is apt to follow. It is very certain that when complications do occur, the medicines in question are altogether ineffectual. Not only so, but heart affections may arise while the patient is under their fullest influence. It is, therefore, altogether probable that these medicines have no anti-rheumatic virtues, and that they relieve inflammatory rheumatism merely by repressing two of its symptoms, very much as quinia, and aconite, and veratrum, and opium may do. In a series of over one hundred cases of rheumatism, the average time during which the acid was administered was a little over six days, the extremes being one and thirty-one days. The average quantity of salicylic acid taken by each patient was about 400 grains. This result does not bear out the claim of the medicine to be a specific remedy for the disease in question. Moreover, it is certain that the anti-febrile influence of the medicine is not specific, for in certain cases of hyperpyrexia occurring in rheumatism it not only failed to reduce the temperature, but during its use the temperature rose from 101° to 107°. It would be unfair, in presenting a summary of this subject, to withhold the positive declaration of one of the most competent among the advocates of the medicine, Dr. Broadbent, who says: "I have yet to see the case of genuine acute rheumatism without complication in which the pain is not entirely gone and the temperature normal, after six consecutive doses of twenty grains, at intervals of an hour, on two successive days." That in certain cases it should have appeared to be "prompt and decisive," or to have "acted like a charm," or to be "the only radical remedy for acute rheumatism," leaves out of view entirely the natural history of the disease, which, in thousands of cases, runs its course to cure within a week, and without any specific treatment. We have not met with any detailed comparison between the treatment of rheumatism by this medicine and by sodium bicarbonate; but it is probable that the latter approach much nearer to the character of a true remedy than the former, whose use may rather be compared with that of opium which was once in vogue, and which was vaunted to control the pain and fever of rheumatism, but, as was soon discovered, at the expense of the heart's integrity. If salicin or its derivatives are to be used, the preference should be given to the former, which, owing to its solubility, is more readily administered than the acid, and is less disagreeable than the sodium compound. But doses of not less than thirty grains every two hours are required until its specific effects are distinctly developed.

In *gout*, these medicines are said by some to palliate pain, and promote the elimination of uric acid, etc., but credible results prove nothing in its favor. A case of rheumatic *tetanus* is said to have been cured by salicylic acid.

If we cannot say that authors are unanimous in asserting its uselessness in *intermittent fever*, we can at least declare that there is no proof of its utility. In this case is presented an apt illustration of the error of deducing the therapeutical uses of a medicine from its apparent physiological action; for this acid and its compounds, whose physiological operation seems so closely to resemble that of quinia, is powerless to cure the disease for which quinia is a specific remedy. Salicylate of quinia has been recommended as an anti-periodic medicine, and doubtless it is such, as far as it contains quinia. In *scarlatina* and *variola* salicylic acid neither mitigates the disease nor tends to prevent complications or sequelæ. As to *typhoid fever*, in which a full trial of the medicine has been made, the general result appears to be that it does not improve the typhoid state, nor reduce the splenic swelling, nor diminish the stools, nor alter their qualities, nor lessen the customary debility and emaciation, nor improve the patient's feelings, nor shorten the attack, nor lessen the mortality of the disease. Reporters are not agreed even as to its influence upon the pulse and temperature; and some among them charge that it excites or exaggerates delirium; produces nausea, prostration, albuminuria, and even suppression of urine. (Sée; Murchison.)

In *acute inflammations* the evidence respecting the medicine in question is very contradictory; for while, on the one hand, they are affirmed to be "wholly uninfluenced by it," that it does "not in the least degree prevent the supervention of fresh inflammation," and that, "while it reduces the temperature, it does not in the least modify the local processes," it is alleged, on the other hand, to be the "surest antiphlogistic." It is true that this latter judgment is qualified by the statement that it even "excels quinia," which is quite conceivable, since it is now well settled that there is no constant relation between the reduction of the pulse in febrile affections and the cure of the disease which renders the pulse frequent. In the report of one physician (Riess) who vaunts the antiphlogistic virtues of salicin, the mortality from pneumonia is stated to have been 11 out of 35 cases, or nearly 32 per cent., a result which no one is entitled to boast of. A similar verdict must be given in regard to *diphtheria*. While one reports that in thirty-one cases it was "uniformly curative," and another that it "modifies favorably the exudation," and a third that it also "arrests the fever," a fourth (Abelin) "derived none of the advantages from its use which various physicians ascribe to it, and found that, except in reducing the temperature and the pulse-rate, its results were entirely negative, or else that it irritated the throat, and occasioned diarrhœa, albuminuria, or congestion of the lungs;" and

Sée could discern no appreciable influence exerted by it on the disease. Even in the case of *aphthæ*, which some declare that it causes to heal rapidly, and of *thrush*, for which it has been vaunted as a specific, others allege that it is neither better nor worse than chlorate of potassium, or than the alkaline solutions in general. Enemas containing one part of the acid to 300 parts of water, with a little alcohol to perfect solution, are said to lessen the frequency, correct the fetor, and improve the quality of the stools in *dysentery*. It has been used in the hectic fever of *phthisis*, because it is capable of reducing the temperature, without regard to the serious injury it causes by deranging the digestion, and its absolute nullity as a palliative of any symptom peculiar to pulmonary consumption. Very probably it may be profitable in correcting the fetor of the breath in certain cases of this disease; for it does so in *fetid bronchitis* and even in *gangrene of the lung*, both when administered by the stomach and also when inhaled from an atomized solution. Salicin has been found efficient in preventing the development of acute *coryza* when given in doses of from twenty to forty grains; and also in mitigating the symptoms of *hay-fever*. It has been thought to moderate the pain of *lumbago*. In *neuralgia* of a periodical type, and not amenable to quinia, it is said to have been very efficient in doses of from twenty to forty grains, given every hour for three or four hours. Even *diabetes* is alleged to have got well under the influence of this medicine! A case of *favus* is reported to have been cured by a saturated alcoholic solution of salicylic acid; and chronic *eczema* is stated to have been benefited by a similar preparation. As an external application it has also been a good deal used as a dressing for *wounds* and *ulcers*, and especially for those which tend to *gangrene*. Sometimes the acid is applied as a fine powder, sometimes in a one per cent. solution. Indeed, a claim has been made that it is a perfect substitute for carbolic acid, over which it has the advantage of being inodorous, unirritating, and, when absorbed, not poisonous. It is, however, irritating unless in a very weak solution. Its somewhat styptic qualities have caused it to be used topically in *uterine catarrh*, *leucorrhœa*, and *chronic dysentery*, and even to arrest slight *hemorrhages*. A salicylate of iron has been employed for like purposes. One part of the powdered acid mixed with five parts of starch is said to correct *fetor* of the axillæ, feet, etc. Given by the mouth or rectum it tends to diminish fetor of the *stools* in diarrhœa and dysentery.

Administration.—It is probable that salicin, salicylic acid, and salicylate of sodium are equally efficacious. Salicin, although not very soluble, may be given in water in the dose of from ten to forty grains; and salicylic acid, in wafers, and in similar doses. It is better to give the smaller dose and repeat it frequently than to administer a full dose at once. These substances may be administered in powdered liquorice extract. The salicylate of sodium is now generally preferred to the other forms of the medicine, on account of its solubility. Not less than sixty or seventy grains should be given in divided doses at half-hour intervals; and twice or thrice this quantity may be administered within the twenty-four hours. If it disagrees with the stomach, tincture of orange-peel, of cardamom, or of ginger may be added, or a drop or two of chloroform added to each dose, or it may be dissolved in an aromatic infusion.

Various formulæ for administering salicylic acid are really solutions of its salts: *e. g.* ℞. Salicylic Acid 120 grs.; Solution of Acetate of Ammonium fl℥ij; Water fl℥vj.—M. Each fluidounce contains 15 grs. of the salt. Or, ℞. Salicylic Acid 100 grs.; Borax 80 grs.; Water fl℥xvj.—M. Or, ℞. Salicylic Acid 120 grs.; Borax 60 grs.; Glycerin q. s.—Mix the acid and borax with fl℥iv of glycerin, heat until solution is complete, and add glycerin to make the whole measure fl℥j. This contains 25 per cent. of the acid. For external use a solution of one part of the acid in 300 parts of water is recommended. Cotton saturated with a hot solution of the acid, from 3 to 10 per cent. strong, and properly dried, has been used as a surgical dressing.

ACIDUM SUCCINICUM, *P. G.*—Succinic Acid.

Sal succini volatile.—*Acide succinique*, Fr.; *Bernsteinsäure*, G.
Formula $H_2C_4H_4O_4$. Molecular weight 118.

Origin.—Succinic acid exists in amber, in different species of Lactuca, Artemisia, and other plants, and in many animal liquids. It is formed in the oxidation of wax, spermaceti, butyric, stearic, and some other fatty acids, of valerianic acid, benzoic acid, and other organic compounds; in the vinous fermentation of sugar; by the deoxidation or under the influence of casein as a ferment from asparagin, tartrates, malates, aconitates, fumarates, etc. It was observed by Agricola (1550), and recognized as an acid by Lemery (1675).

Preparation.—For medicinal use, succinic acid is prepared by the dry distillation of coarsely powdered amber, from a glass retort, which is entirely imbedded in sand, and the short neck of which is connected with a large receiver. The heat is gradually increased to about 280° C. (536° F.), and kept at this temperature as long as white vapors are evolved. The distillate consists of succinic acid crystallized in the neck of the retort, while the receiver contains oil of amber and an aqueous solution of acetic and succinic acids. On concentrating this solution, more succinic acid is obtained.

Properties.—The impure acid is in yellowish or brownish prismatic crystals, which have the odor of oil of amber and an acid empyreumatic taste. It fuses between 160° and 180° C. (320° and 356° F.), dissolves in 2.2 parts of boiling and 28 parts of cold water, and is freely soluble in alcohol, slightly in ether, and insoluble in oil of turpentine. The pure acid is inodorous. With the alkalies and magnesia it forms salts which are readily soluble in water; the salts with most other metals are less freely or not at all soluble in water, but dissolve in solution of potassium acetate. The neutral solutions produce with ferric chloride, red-brown precipitates.

Tests.—A concentrated aqueous solution of the acid does not produce a precipitate with potassium acetate (absence of tartaric acid), nor with chloride of barium (sulphuric acid), chloride of calcium (oxalic acid), sulphuretted hydrogen, nor after neutralization, with sulphydrate of ammonium (metals). When treated with soda in excess, an ammoniacal odor is not generated, and when heated upon platinum foil the odor of caramel is not observed (sugar), nor is there finally any fixed residue left (salts).

Pharmaceutical Uses.—It is employed for preparing

Liquor ammonii succinatis (succinici, *P. G.*) s. *Liq. cornu cervi succinici.* One part of succinic acid is dissolved in eight parts of warm water, and neutralized by one part or a sufficient quantity of pyro-oleous carbonate of ammonium; the solution is set aside for twenty-four hours and then filtered. It has a brownish or brown color, remains clear when mixed with three times its weight of alcohol, and when evaporated and ignited leaves no residue. Pure ammonium succinate is sometimes used for estimating the iron in ferric salts.

Medical Action and Uses.—There is no reason to believe that this acid possesses any active properties or medicinal virtues. It has been taken in doses of from sixty to one hundred and twenty grains without any definite effects. It is excreted partly by the skin, but chiefly with the urine either unchanged, or, as has been asserted, in the form of hippuric acid. It has been alleged to raise the pulse, promote diaphoresis, and the bronchial secretions, and augment the activity of the nervous centres; and has been prescribed in *rheumatism*, *bronchitis*, and *hysteria* and various other spasmodic affections. Even if its apparent utility had been demonstrated, the objection may fairly be made that the acid was not used alone but as a succinate of ammonium and with empyreumatic oils, etc. The *dose* of the acid may be stated to be between five and fifteen grains.

ACIDUM SULPHURICUM, *U. S.*, *Br.*—SULPHURIC ACID.

Acidum sulfuricum, P. G.—*Oil of vitriol*, E.; *Acide sulphurique*, *Huile de vitriol*, Fr.; *Schwefelsäure*, *Vitriolöl*, G.

ACIDUM SULPHURICUM DILUTUM, *U. S.*, *Br.*—DILUTED SULPHURIC ACID.

Acide sulphurique dilué, Fr.; *Verdünnte Schwefelsäure*, G.

The specific gravity of sulphuric acid is 1.843 and of dilute sulphuric acid 1.082 *U. S.*, 1.094 *Br.*

Origin.—Sulphuric acid is found in the free state in certain springs, emanating from volcanoes, and in the salivary glands of some mollusks; but it mostly occurs combined with various bases both in the mineral and organic kingdoms.

Preparation.—1. SULPHURIC ACID.—Sulphur or iron pyrites is burned in a furnace arranged in such a manner that the sulphurous acid gas is mixed with atmospheric air; in the same furnace by the heat of the burning sulphur, nitric acid is generated from a mixture of nitrate of sodium and sulphuric acid, the vapors of nitric acid being carried with the mixed sulphurous acid and air into a large leaden chamber, where the current of these gases comes in contact with a jet of steam. The sulphurous acid, in the presence of water, acts upon the nitric acid, thus: $3SO_2+2HNO_3+2H_2O=2NO+3H_2SO_4$. Nitric oxide and sulphuric acid are produced; the latter, being condensed, dissolves in the water, which covers the floor of the lead chamber to the depth of about two inches. The nitric oxide at the moment of its formation, is at once oxidized by the oxygen, which entered the lead chamber with the sulphurous acid gas, into nitrous and hyponitric acids, N_2O_3 and NO_2, both of which are decomposed in the presence of sufficient water into nitric acid and nitric oxide, the reaction being explained by the following equations: $3N_2O_3+H_2O=2HNO_3+4NO$ and $3NO_2+H_2O=NO+2HNO_3$. The nitric acid regenerated in this manner again reacts upon some sulphurous acid gas, oxidizing it to sulphuric acid, and becoming reconverted into nitric oxide. It will be observed, that, theoretically, a given quantity of nitric acid is capable of oxidizing an unlimited amount of sulphurous acid; the limit in practice is occasioned by the loss of the nitrogen compounds which remain dissolved in the diluted sulphuric acid, finally drawn from the chambers. If the nitric acid could be used once only, it is obvious that 170 parts or 2 molecules of the nitrate of sodium could furnish sufficient merely to oxidize the sulphurous acid resulting from 96 parts or 3 atoms of sulphur, while practically about 5 or 6 parts are sufficient.

Through the condensation of the sulphuric acid in the chamber, room is made for a fresh quantity of sulphurous acid gas and air, while the nitrogen contained in the air accumulates and is removed through a chimney, after it has finally passed through a lead chamber filled with coke over which sulphuric acid is made to trickle, thus dissolving the nitric oxide contained in the nitrogen. The acid, thus charged with this gas, is passed in the form of spray into another smaller chamber placed near the furnace, so that the sulphurous acid and air, in passing through this, may carry the nitric oxide into the first large lead chamber, there to be utilized in effecting the oxidation of the sulphurous acid. Instead of introducing nitric acid vapors with the mixed sulphurous acid and air, as described above, the apparatus is sometimes arranged in such a manner that in the second chamber a number of earthen vessels nearly filled with nitric acid, by means of a tube from the top of the chamber, are placed upon shelves above each other; or where nitrous acid is obtained in sufficient quantity, as in the manufacture of oxalic acid, this is used in place of nitric acid, with the same success.

The number of lead chambers varies from four to seven, and the gases are made to pass through all in succession. The central one is larger, and placed several feet lower than the others, so that the sulphuric acid condensing in the latter will flow into the former. When the acid in the chamber has attained the specific gravity 1.52 to 1.58, it is drawn off and evaporated in shallow leaden pans until it has reached a density of 1.70 to 1.75. In this operation sulphurous, nitrous, and nitric acids are expelled, and sulphates of iron, lead, and calcium deposited, the salts resulting from the corrosion of the vessels and the impurities of the water. The acid is now usually dark-colored, due to accidental organic admixtures. If further evaporated in the lead pans, the metal would be corroded and much acid volatilized. The final concentration must therefore be effected in platinum stills; the first portion of the distillate consisting of a weaker acid, the receiver is changed as soon as it has attained the desired density.

2. NORDHAUSEN OIL OF VITRIOL, so named because it was first manufactured near Nordhausen in Saxony, is obtained from ferric sulphate, which is made by allowing ferrous sulphate to oxidize in the air. It is distilled in small earthen retorts, which are placed horizontally in a furnace and connected with earthen receivers. Each retort is charged with from 2 to 3 lbs. of the dry salt, and yields about 50 per cent. of acid, which consists of about one molecule each of sulphuric anhydrid and hydrogen sulphate, $SO_3.H_2SO_4$. Ferric oxide remains behind, and is used under the name of *colcothar* or *rouge* for polishing glass and metals.

3. DILUTED SULPHURIC ACID.—Take of Sulphuric Acid two troyounces; Distilled Water a sufficient quantity. Add the acid gradually to fourteen fluidounces of distilled water, and mix them. After twenty-four hours, filter through paper, and pass sufficient distilled water through the filter to make the diluted acid measure a pint. *U. S.*

The direction of the Pharmacopœia to add *the acid to the water* must be observed in all cases, and more particularly if larger quantities of acid are to be diluted. Filtration through paper or decantation is necessary only when pure sulphuric acid has not been used, to remove the sulphate of lead, which is deposited from the commercial acid on diluting with water. Its spec. grav. is 1.082. The British Pharmacopœia dilutes 7 fluidounces of sulphuric acid with sufficient water to make the liquid when cooled to 15.5° C. (60° F.) measure 83½ fluidounces. *Or* 1350 grains of the acid are diluted as before to measure one pint (imperial). This acid has the specific gravity 1.094, and 359 grains of it require for neutralization 1000 grain measures of the volumetric solution of soda, corresponding to 11.14 of sulphuric anhydrid, SO_3. The German Pharmacopœia admits for diluted sulphuric acid a specific gravity, varying between 1.113 and 1.117.

Properties. 1. SULPHURIC ANHYDRID OR ANHYDROUS SULPHURIC ACID.—This distils first when Nordhausen oil of vitriol is heated. At ordinary temperature it forms long, colorless prisms, having in quantity somewhat the aspect of asbestos. It fuses at about of 20° C. (68° F.) to a colorless liquid, and boils above 35° C. (95° F.) A modification of it has a higher fusing and boiling point. Both kinds attract moisture with great avidity, and in contact with the air give off white fumes. Its composition is SO_3.

2. NORDHAUSEN OIL OF VITRIOL.—This is officinal in Germany under the name of *Acidum sulfuricum fumans*. It is a brownish, oily liquid, emitting white suffocating fumes, and having a specific gravity of from 1.860 to 1.900. Near 0° C. (32° F.) it forms colorless flat crystals, and between 40° and 50° C. (104° and 122° F.) it boils, sulphuric anhydrid distilling over.

3. COMMERCIAL SULPHURIC ACID, ACIDUM SULFURICUM CRUDUM, P. G.—It forms a colorless, inodorous, oily liquid, intensely acid and corrosive, and

having a specific gravity of from 1.830 to 1.835. It holds a small quantity of lead sulphate in solution, which, however, does not render it unfit for pharmaceutical purposes, if it is otherwise pure, since that salt is precipitated when the acid is diluted with water or alcohol. Traces of nitric acid are likewise occasionally present. Sulphuric acid is more readily made by the manufacturer of this strength than of the strength and purity required by the Pharmacopœia; such an acid must be prepared by distilling the commercial acid from a glass retort, which is placed in a deep sand bath, surrounded by sand and covered with a metallic hood; the neck of the retort is connected without luting with a suitable receiver, which is changed when about one-eighth or one-sixth of the acid has come over; the subsequent portion will have the required specific gravity. It is important that an acid free from arsenic should be selected for distillation.

4. Pure Sulphuric Acid.—It resembles the commercial acid in its physical properties, but differs from it in having the specific gravity 1.843. It does not become turbid, and yields no black precipitate with sulphuretted hydrogen when diluted with six times its volume of distilled water, showing the absence of lead. The acid must be free from arsenic, the presence of which would be indicated by a yellow precipitate occurring in the diluted acid with sulphuretted hydrogen, or more rapidly by Bettendorff's method (see page 22). A concentrated solution of ferrous sulphate poured upon the surface of the concentrated acid does not develop a purple color where the two liquids unite, showing the absence of nitrogen oxides. The officinal acid contains 96.8 per cent. of hydrogen sulphate H_2SO_4, corresponding to 79 per cent. of the anhydrid SO_3. 50.6 grains of it, mixed with an ounce of distilled water, require for neutralization 1000 grain-measures of the volumetric solution of soda (*Br.*).

The specific gravities of sulphuric acid of different strength, as ascertained by Vauquelin, Darcet, Bineau, Dalton, and Ure vary in some cases considerably. The following is Ure's table for a temperature of 15.5° C. (60° F.):—

Pr. ct. H_2SO_4	Specific gravity.	Per ct. SO_3.	Pr. ct. H_2SO_4	Specific gravity.	Per ct. SO_3.	Pr. ct. H_2SO_4	Specific gravity.	Per ct. SO_3.	Pr. ct. H_2SO_4	Specific gravity.	Per ct. SO_3.
100	1.8485	81.54	75	1.6520	61.15	50	1.3884	40.77	25	1.1792	20.38
99	1.8475	80.72	74	1.6415	60.34	49	1.3788	39.95	24	1.1706	19.57
98	1.8460	79.90	73	1.6321	59.55	48	1.3697	39.14	23	1.1626	18.75
97	1.8439	79.09	72	1.6204	58.71	47	1.3612	38.32	22	1.1549	17.94
96	1.8410	78.28	71	1.6090	57.89	46	1.3530	37.51	21	1.1480	17.12
95	1.8376	77.40	70	1.5975	57.08	45	1.3440	36.69	20	1.1410	16.31
94	1.8336	76.65	69	1.5868	56.26	44	1.3345	35.88	19	1.1330	15.49
93	1.8290	75.83	68	1.5760	55.45	43	1.3255	35.06	18	1.1246	14.68
92	1.8233	75.02	67	1.5648	54.63	42	1.3165	34.25	17	1.1165	13.86
91	1.8179	74.20	66	1.5503	53.82	41	1.3080	33.43	16	1.1090	13.05
90	1.8115	73.39	65	1.5390	53.00	40	1.2999	32.61	15	1.1019	12.23
89	1.8043	72.57	64	1.5280	52.18	39	1.2913	31.80	14	1.0953	11.41
88	1.7962	71.75	63	1.5170	51.37	38	1.2826	30.98	13	1.0887	10.60
87	1.7870	70.94	62	1.5066	50.55	37	1.2740	30.17	12	1.0809	9.78
86	1.7774	70.12	61	1.4960	49.74	36	1.2654	29.35	11	1.0743	8.97
85	1.7673	69.31	60	1.4860	48.92	35	1.2572	28.54	10	1.0682	8.15
84	1.7570	68.49	59	1.4760	48.11	34	1.2490	27.72	9	1.0614	7.34
83	1.7465	67.68	58	1.4660	47.29	33	1.2409	26.91	8	1.0544	6.52
82	1.7360	66.86	57	1.4560	46.58	32	1.2334	26.09	7	1.0477	5.71
81	1.7245	66.05	56	1.4460	45.68	31	1.2260	25.28	6	1.0405	4.89
80	1.7120	65.23	55	1.4360	44.85	30	1.2184	24.46	5	1.0336	4.08
79	1.6993	64.42	54	1.4265	44.03	29	1.2108	23.65	4	1.0268	3.26
78	1.6870	63.60	53	1.4170	43.22	28	1.2032	22.83	3	1.0206	2.446
77	1.6750	62.78	52	1.4073	42.40	27	1.1956	22.01	2	1.0140	1.63
76	1.6630	61.97	51	1.3977	41.58	26	1.1876	21.20	1	1.0074	0.8154

Sulphuric acid is one of the strongest of acids. It forms salts which are generally crystallizable and soluble in water. The sulphates of barium and lead are entirely insoluble in water and diluted acids; hence, their soluble salts furnish the best reagents for sulphuric acid in its uncombined or combined state.

Impurities.—The most important impurities, arsenic, lead, and nitrogen oxides have been mentioned before. Saline additions, sometimes made to increase the specific gravity of weaker acids, are recognized by the fixed residue left on evaporating a small quantity from a platinum dish or crucible. For the detection of sulphurous acid, Warington recommends (1868) the suspension in a quart bottle, half filled with the sulphuric acid, of a strip of paper colored blue by iodide of starch, which will be bleached by the sulphurous acid; a paper covered with starch and iodide of potassium, suspended in a similar manner, becomes blue in the presence of nitrogen oxides.

Arsenic is found principally in sulphuric acid manufactured from pyrites, more rarely if made from sulphur; for this reason, the sulphuric acid manufactured in the United States is often free from this contamination.

Purification of Sulphuric Acid.—To remove nitrogen compounds, Maxwell Lyte recommends (1864) the addition to the sulphuric acid of $\frac{1}{4}$ or $\frac{1}{2}$ per cent. of oxalic acid, and then exposure to heat until this compound is completely decomposed. To remove arsenic, Bussy and Buignet (1863 and 1864) oxidize this metal, if present as arsenious acid, to arsenic acid, and then distil nine-tenths of the sulphuric acid, after having previously added some sulphate of ammonium. A. Buchner (1863) avoids distillation in such a case, by reducing the arsenic, if present as arsenic acid, to arsenious acid by heating the sulphuric acid with a little charcoal. Muriatic acid gas is then passed through the liquid, and the arsenic is entirely eliminated from the hot acid as chloride of arsenic.

Pharmaceutical Uses.—Sulphuric acid is largely used in numerous pharmaceutical processes for the liberation of acids (hydrocyanic, hydrochloric, nitric, citric, tartaric); in the preparation of alkaloids, pyroxylon, and oil of wine; for generating hydrogen with zinc and water; for decomposing certain organic compounds, as in the purification of chloroform, and for the preparation of sulphurous acid, the medicinal sulphates, and of *Acidum sulphuricum aromaticum.*

The *Mixtura sulfurica acida*, P. G., s. *Elixir acidum Halleri*, is prepared by dropping, with continued stirring, 1 part of pure sulphuric acid into 3 parts of alcohol; it is a colorless liquid having nearly the specific gravity of water.

Physiological Action.—In a concentrated state, sulphuric acid abstracts the water from organized matter, turning it black and exposing its carbonaceous elements in the form of charcoal. Injected into the veins, it coagulates the blood and carbonizes it. When swallowed in a concentrated form, it destroys all the tissues it touches, and in this condition, as well as when somewhat less strong, it produces severe pain in the throat, œsophagus, and stomach, with violent efforts at vomiting, and collapse. The urine is sometimes albuminous or bloody. The mind remains clear. Even when death does not directly occur, it often does so at a later period, owing to stricture of the œsophagus or intestine resulting from ulceration of the lining membrane. In medicinal doses it diminishes thirst, restrains sweats depending on debility, improves the appetite, probably by stimulating the stomach, acidifies the secretions, and reduces the frequency of the pulse. Its action upon the teeth, even when it is greatly diluted, is exceedingly injurious, and by continued use it exhausts the digestive functions, and causes diarrhœa, with debility and emaciation.

Medical Uses.—The corrosive action of sulphuric acid has been made use of to correct inversion and also eversion of the eyelid (*ectropion* and *entropion*) by forming an eschar upon the convex or projecting surface of the part, which in cicatrizing contracts the tissues and corrects the deformity. It has sometimes been employed as an escharotic application to various infecting or ill-conditioned *ulcers*, and particularly in *gangrene* of the mouth, and in *caries* of the bones, and also for the extirpation of *cancers*. In the last case, a paste is applied to the tumors, formed of asbestos, powdered sulphate of zinc, or saffron, saturated with sulphuric acid. The operation is tedious, very painful, and as uncertain as any other for the same purpose. An ointment composed of one part of the acid to eight parts of lard has been recommended for *tinea capitis;* and in the treatment of *scabies* it is often successful either in ointment or lotion, and has the advantage over sulphur ointment of being without unpleasant smell. Internally, sulphuric acid in the diluted or aromatic form is much used in chronic diseases with a tendency to a dissolution of the blood, such as *scurvy* and *purpura*, as well as in other and especially uterine passive *hemorrhages*. It is thought to be particularly useful in mucous hemorrhages and fluxes, because the acid is eliminated by the mucous membranes; but this explanation would not apply to blood diseases, whether chronic or acute, and especially to *fevers* of a low type, in which it is reputed to be useful. Still less would it apply to *colliquative sweating*, for which this medicine is one of the very best remedies. Nor can it be assumed to explain the efficacy of the acid in *diarrhœa*, *cholera morbus*, and even *epidemic cholera*. In the last-mentioned cases the most probable view is that its operation is local, and in its nature astringent. So far as it acts by being taken into the blood, it probably operates in the same manner, but from within instead of from without. Its apparent power of preventing, as well as of curing, epidemic cholera appears distinctly to be owing to the astringent influence by which it prevents the absorption of the cholera poison from the alimentary canal, the ordinary channel of its introduction; and, at the same time, limits the transudation of the contents of the bloodvessels into the bowels. Its efficacy in *painter's colic* is generally admitted. It is administered with water, in the proportion of about two fluidrachms in three pints of water, in the course of twenty-four hours. Its value as a prophylactic against cholera is not so well authenticated. If it is useful, as alleged, in curing *gravel* and *stone*, its utility is probably due to a tonic action upon the stomach. It has sometimes appeared to remove *tape-worms*, probably by its physical action upon these parasites.

As *antidotes* to poisoning by sulphuric acid, chalk, magnesia, carbonate of magnesia, and the alkaline carbonates, may be administered.

The *dose* of the strong acid is one or two drops dissolved in not less than four ounces of water; of the diluted acid, from ten to thirty drops may be given in the same way.

ACIDUM SULPHURICUM AROMATICUM, *U. S.*, *Br.*—AROMATIC SULPHURIC ACID.

Tinctura aromatica acida, P. G.; *Elixir vitrioli Mynsichti*.—*Elixir of vitriol*, E.; *Elixir vitriolique*, *Teinture (or Alcoolé) aromatique sulfurique*, Fr.; *Saure aromatische Tinctur*, *Mynsicht's Elixir*, G.

Preparation.—Take of Sulphuric Acid six troyounces; Ginger in moderately fine powder a troyounce; Cinnamon in moderately fine powder a troyounce and a half; Alcohol a sufficient quantity. Add the acid gradually to a pint of alcohol, and allow the liquid to cool. Mix the ginger and cinnamon, and, having packed them firmly in a percolator, pour alcohol gradually upon them until a pint of tincture is obtained. Lastly, mix the diluted acid and the tincture. *U. S.*

The British and German Pharmacopœias macerate the aromatics with the mixed acid and alcohol for a week, the latter authority using them in the proportion of two to fifty by weight; it is, therefore, much weaker in acid than either the United States or British preparation. The directions of the latter are to mix three fluidounces (or 2419 grains by weight) of sulphuric acid with two pints (imperial) of rectified spirit, add the coarse powder of two ounces of cinnamon and one and a quarter ounce of ginger, macerate for seven days, agitating frequently, and filter. Its specific gravity is 0.927, and 304.2 grains (6 fluidrachms) of it require for neutralization 830 grain-measures of the volumetric solution of soda, corresponding to 10.91 per cent. of sulphuric anhydrid.

When mixing sulphuric acid with alcohol, some sulphovinic acid is produced, the quantity of which increases with the age of the preparation. For the same amount of sulphur, this acid has only one-half the saturating power of sulphuric acid, the acidimetric test is, therefore, unreliable.

This preparation has a brown-red color.

Medical Uses.—This preparation is preferable to any other form of sulphuric acid for internal administration. It is peculiarly adapted for use in the treatment of *gastro-intestinal disorders* for which the simple acid is appropriate, and of the *colliquative sweats* of phthisis and other hectical affections. Dose from ten to twenty drops.

ACIDUM SULPHUROSUM, *U. S.*, *Br.*—SULPHUROUS ACID.

Acide sulfureux, Fr.; *Schweflige Säure*, G.

Formula of sulphurous anhydrid, SO_2. Molecular weight 64. The specific gravity of sulphurous acid is 1.035 *U. S.*, 1.04 *Br.*

Origin and Production.—It is met with in the exhalations of active volcanoes, and is produced on the burning of sulphur, and when concentrated sulphuric acid is heated with charcoal or with copper, mercury, or other metals. The officinal process is as follows:—

Preparation.—Take of Sulphuric Acid eight troyounces; Charcoal in coarse powder a troyounce; Distilled Water thirty-six fluidounces. Pour the acid upon the charcoal, previously introduced into a matrass, and shake them together. Connect the matrass with a washing bottle, and this, by means of a bent glass tube reaching nearly to the bottom of it, with a two-necked bottle containing the distilled water. To the other neck of this bottle attach another bent tube, and let it dip slightly into a solution of carbonate of soda. All the joints having been properly luted, apply heat to the matrass until gas ceases to be evolved, preventing the temperature of the distilled water from rising, by means of cold water applied to the bottle containing it. Lastly, pour the sulphurous acid into half-pint dark-colored bottles, which must be well stopped, and kept in a cool place. *U. S.*

In these directions neither the size of the wash bottle, nor the amount of water to be used for washing the gas is given; an eight-ounce bottle containing two ounces of water will be found to answer the purpose. The gas which is not absorbed by the distilled water must, to avoid inconvenience, be conveyed either into the open air, into a flue, or, as directed above, into an alkaline solution where it will be retained.

The process of the British Pharmacopœia is essentially the same; the gas evolved from 4 fluidounces of sulphuric acid and 1 ounce of wood-charcoal is washed by passing it through 2 ounces of water, and conducted into 20 fluidounces of distilled water.

The charcoal acts as a reducing agent upon the sulphuric acid, generating carbonic and sulphuric acids and water, thus: $C_2+4H_2SO_4=2CO_2+4SO_2+4H_2O$. The sulphurous acid gas is, therefore, contaminated with carbonic acid, which will likewise be retained by the distilled water to some extent. A purer acid is obtained by heating copper clippings with concentrated sulphuric acid, when sulphate of copper and sulphurous acid will be produced: $Cu_2+4H_2SO_4=2CuSO_4+2SO_2+4H_2O$. Double the quantity of sulphuric acid will be necessary to produce the same amount of sulphurous acid as is produced by the officinal process.

Properties and Tests.—Sulphurous acid gas is colorless, irrespirable, has a pungent and suffocating odor, and condenses to a liquid under a pressure of 4 or 5 atmospheres; this liquid boils briskly on coming into contact with ice. The officinal sulphurous acid is a nearly-concentrated solution of the gas in water, having the odor of burning sulphur. Exposed to light it acquires the property of precipitating sulphide of silver from nitrate of silver. Its specific gravity is 1.035 (*U. S.*), 1.04 (*Br.*). Chloride of barium yields no precipitate with it, or only a slight one; when evaporated, no residue is left. The gas remains with the water when the solution freezes, and at the boiling temperature some time must elapse before it is entirely expelled. 34.7 grains of it, mixed with an ounce of distilled water and a little mucilage of starch, do not acquire a permanent blue color with the volumetric solution of iodine until 1000 grain-measures of the latter have been added (*Br.*).

Sulphurous acid is a powerful deoxidizing agent, abstracting oxygen from many vegetable colors, and thereby bleaching them. In the presence of water and air it is oxidized to sulphuric acid; the officinal preparation should, therefore, be kept in well-filled stoppered bottles. Sulphurous acid displaces carbonic acid from its saline compounds, and yields salts which generally are sparingly soluble in water, except the alkaline sulphites; they are inodorous, and have a somewhat acrid taste.

Sulphurous acid gas$=SO_2$ consists of one measure of gaseous sulphur and two of oxygen, condensed into two measures.

Medical Uses.—Sulphurous acid is chiefly used for the purpose of destroying or preventing the development of those low forms of cryptogamic life which are supposed to be the essential element of certain diseases, and of the process of fermentation. *Favus* of the scalp and hairy portions of the face is treated by means of lotions containing one part of the acid to three of water, after the crusts have been removed by means of emollient poultices. It has also been used successfully in the cure of *scabies*. As a lotion for recent *wounds* it has been thought to allay pain, diminish suppuration, and promote cicatrization; and as a gargle it is recommended for ulcerated and gangrenous *pharyngitis*. It may be given internally to prevent the *flatulence* depending upon dyspeptic fermentation, but for this purpose the sulphites are preferable. This acid, as it is formed by burning sulphur, has been much used for *disinfecting* shops, hospital wards, etc., which have been occupied by the sick, or which are contaminated by foul odors.

The *dose* of sulphurous acid is from one to three fluidrachms largely diluted.

ACIDUM TANNICUM, *U. S.*, *Br.*—Tannic Acid.

Acidum gallo-tannicum, Tanninum.—*Tannin*, E.; *Acide tannique, Tannin*, Fr.; *Gerbsäure, Tannin*, G.

Formula $C_{14}H_{10}O_9$. Molecular weight 322.

Origin and Varieties.—Compounds having acid properties and an astringent taste, producing dark-colored solutions or precipitates with salts of iron, and precipitating gelatin and albumen from their solutions, are called by the generic name of tannins. They are conveniently arranged into two groups, according to the color produced with ferric salts, which is either dark green or dark blue. A large number of plants contain tannin of the latter group, differing, however, from the officinal tannic acid in not furnishing gallic or pyrogallic acid.

The tannin obtained from nutgalls is, for this reason, distinguished from the others by the prefix gallo. Gallotannic acid has been found in the officinal galls, in Chinese and Japanese galls, in the cups of the fruit of some oaks, and in the leaves of Italian sumach, Rhus coriaria, *Lin.*

Preparation.—Take of Nutgall in fine powder, Ether, each, a sufficient quantity. Expose the nutgall to a damp atmosphere for twenty-four hours, and then mix it with sufficient ether, previously washed with water, to form a soft paste. Set this aside, covered closely, for six hours; then, having quickly enveloped it in a close canvas cloth, express it powerfully between tinned plates, so as to obtain the liquid portion. Reduce the resulting cake to powder, and mix it with sufficient ether, shaken with one-sixteenth of its bulk of water, to form again a soft paste, and express as before. Mix the liquids, and allow the mixture to evaporate spontaneously until it assumes a syrupy consistence; then spread it on glass or tinned plates, and dry it quickly in a drying closet. Lastly, remove the residue from the plates with a spatula, and keep it in a well-stopped bottle. *U. S.*

The directions of the British Pharmacopœia are identical with the foregoing, except that the final evaporation is accomplished on earthen plates or dishes at a temperature not exceeding 100° C. (212° F.).

The process adopted by the Pharmacopœias is that proposed by Dominé in 1844, and based upon that of Leconnet, first published in 1836, the important modification being the exposure of the powdered galls to a damp atmosphere in order to supply the water requisite for rendering the tannin soluble in the ether, and the addition of water to the ether used for the second maceration. That water is absolutely necessary has been noticed by Pelouze (1834), who percolated powdered nutgalls with commercial ether containing water; the percolate separates into two slightly colored layers, the lower of which is a very concentrated solution of tannin. Dominé's plan brings about the same result in less time, and with much less ether, for which reasons it is well adapted for the preparation of tannin on a large scale.

Gallotannic acid is insoluble in absolute ether, but in the presence of a little water a definite compound appears to be formed of tannin and ether, or with water in addition thereto, which is insoluble in ether, but may be dissolved in water; the ether retained in this syrupy liquid is larger in quantity than would be dissolved by the same amount of water. The complete drying of the tannin is effected at a somewhat elevated temperature, by which the volatile ingredients of the syrupy liquid cause the latter to froth up, leaving the tannin behind in loose porous masses somewhat sponge-like in appearance.

Properties.—Tannic acid, thus prepared, has a yellowish-white color, frequently of a slight greenish tint. It has a strongly astringent taste, and is freely soluble in water, alcohol, and in six parts of glycerin; but remains pulverulent when in contact with anhydrous ether, which is free from alcohol. The solutions have an acid reaction. The aqueous solution is precipitated by mineral and some organic acids, tannin being less soluble in acidulated than in pure water. It yields precipitates with the alkaloids and many so-called neutral principles, with lime-water, most metallic salts, with starch, albumen, and gelatin. The latter precipitate is soluble in a solution of gelatin, but insoluble in water and aqueous solutions of certain salts (see Ichthyocolla); this tannate of gelatin is formed in the tanning of hides, and is an important constituent of leather. With solutions of ferric salts a bluish-black precipitate occurs, with a reduction to ferrous compounds. In the presence of alkalies, and in contact with air, solutions of tannin rapidly assume a brown color. On the application of heat, tannic acid is decomposed, and pyrogallic acid sublimes at 215° C. (419° F.), leaving metagallic acid behind, which is finally consumed without leaving any residue. The odor adhering to tannic acid may, according to Procter (1864), be removed by benzin, together with some coloring matter, tannin being insoluble therein.

Composition.—The impossibility of obtaining tannic acid in the crystallized state has rendered the determination of its composition very difficult. A brief review of the widely differing views held by various chemists will be found under *Acidum Gallicum.* The latest investigations on the subject appear to furnish conclusive proof that chemically pure tannin must be viewed as an anhydrid of gallic acid, and that one molecule of it represents two molecules of the latter, minus one of water. If this be the correct view, tannin must be regarded as *digallic acid*, and its relation to gallic acid will be analogous to the relations of the sulphuric, nitric, and phosphoric anhydrids to their respective hydrogen compounds. The formula of tannic acid will then be $(C_7H_6O_5)_2 - H_2O = (C_7H_5O_4)_2O = C_{14}H_{10}O_9$, which is the formula of Mulder (1848). The officinal acid is contaminated with an odorous principle, some coloring matter, and variable quantities of glucose, combined with tannin.

Impurities.—Tannic acid should burn from platinum foil without leaving any residue (mineral impurities), and be completely soluble in strong alcohol (dextrin insoluble) and in warm water (resin insoluble).

Pharmaceutical Uses.—Tannin is employed in the preparation of various proximate principles, such as digitalin.

Off. Prep.—Glyceritum (glycerinum) acidi tannici, *U. S.*, *Br.* Suppositoria, Trochisci, and Unguentum acidi tannici, *U. S.*

Physiological Action.—From experiments upon animals (rabbits) with very large doses, it appears that this acid renders the gastric mucous membrane pale and lustreless, and coagulates mucus. Injected into the bloodvessels it coagulates the albumen of the blood. To the former of these actions, as well as to its inherent astringency, must be attributed the dryness and sense of constriction which it produces in the mouth and fauces. When administered in moderate doses it causes constipation, at least at first, but the state is not made permanent by a continuance or even an increase of the dose; nor does it seem to derange the digestive function, as a general rule. Occasionally, however, it excites pain in the stomach and bowels, thirst, and eructation, and causes a coated tongue and tenesmus in defecation. The stools are generally without fecal odor. Tannic acid appears not to be absorbed and not to circulate as such, but to be converted into gallic acid. In this form alone is it found in the blood and urine. Indeed, it could not remain in the blood without coagulating it, as experiments on animals demonstrate. But as gallic acid is not an astringent, and as one of the best uses of tannic acid is to control internal hemorrhages, it is difficult, while admitting the conversion of the one acid into the other, to explain the therapeutic operation of the latter in the affections named. Several theories have been proposed for this purpose, but none are satisfactory.

Medical Uses.—The astringent property of this substance gives it some utility in relaxed states of the gastro-intestinal mucous membrane, such as exists in certain forms of *dyspepsia* (with excessive acid, mucous, or watery secretion, or with flatulence), but still more in chronic *diarrhœa, dysentery, lientery,* etc. The presence of fever usually contraindicates it. It is less used, although hardly less efficient, in chronic fluxes of other organs which it can influence only through the blood, as *chronic bronchitis, whooping-cough,* and *phthisis.* It often moderates or even suspends the *night sweats* of the last-named disease, and those of other hectical states. But it is in *hemorrhages* that tannic acid especially shows its power. Employed originally to restrain *menorrhagia,* it was afterwards used successfully in other forms of uterine hemorrhage, including those produced by organic diseases of the womb. The more passive forms are the most improved by it. In *hæmaturia,* even of organic origin, in passive hemorrhage from the *stomach* and *bowels,* and in some cases of *hæmoptyis,* and also of *hæmophilia,* it has displayed remarkable efficacy. Not only in forms of *albuminuria* with copious urination, but in those in which the secretion is scanty, or, perhaps, chiefly in these, it seems to have been useful.

It is very efficient as a direct or local hæmostatic when finely powdered and applied to the bleeding part. Its application is neither painful nor irritating. It is, therefore, a convenient application in *hemorrhage* from the nose, vagina, or rectum, from leech-bites, varicose veins, etc. Its constringing operation is of great value in producing the contraction of various soft tissues.[1] A solution of tannic acid in tincture of benzoin (one part to four) tends to repress the development of *variolous* pustules. Powdered tannin may be used as a snuff in chronic *coryza*, and in the treatment of nasal *polypi*. A watery solution is a useful application to sore *nipples*, and an ointment of tannin, or suppositories containing it, is a useful palliative in *anal fissure*, *hemorrhoids*, and *prolapsus ani*. A solution of from fifteen to sixty grains of tannin in about four fluidounces of water, injected into the bladder, has sometimes cured obstinate *vesical catarrh*. Aphthous *ulcers of the mouth*, *mercurial salivation*, *spongy gums*, and a relaxed condition of the mucous membrane of the *pharynx* are all benefited by this astringent. Introduced into a carious cavity it often allays *toothache*. In coryza and the other forms of chronic mucous inflammation mentioned, the glycerite of tannin has been used, but it is probably less efficient than the watery solution. Injections of a solution of tannic acid have been successfully used in *gleet* and in *leucorrhœa;* in the latter disease they are very useful, but less so than the more prolonged application of tampons or sponges saturated with the solution. The latter method is often efficient in curing *prolapsus of the uterus* due to relaxation of the vagina. Chronic inflammations of the *conjunctiva*, especially the granular form, and pannus, have been successfully treated by very finely powdered tannin; and injections of a solution of this substance into vascular *erectile tumors* have been followed by their permanent contraction. A dentifrice containing tannin and charcoal in equal proportions is very efficient in removing the discoloration of the *teeth* produced by preparations of iron.

The *dose* of tannic acid is from three to ten grains. It is best administered in pill, except in cases of hemorrhage, when it should be given dissolved in water sweetened and flavored. Externally it is employed in a watery solution containing from three to ten grains to the ounce. Its incorporation in an ointment or with glycerin impairs its astringent action.

ACIDUM TARTARICUM, *U. S.*, *Br.*—TARTARIC ACID.

Sal essentiale tartari.—Acide tartrique, Acide du tartre, Fr.; *Weinsäure, Weinsteinsäure,* G.

Formula $H_2C_4H_4O_6$. Molecular weight 150.

Origin.—It is met with either free or in combination with bases in grapes, sumach-berries, tamarinds, pineapples, and other acidulous fruits; also in other parts of many plants.

Preparation.—The British Pharmacopœia gives the following directions: Take of Acid Tartrate of Potassium forty-five ounces; Distilled Water a sufficiency; Prepared Chalk twelve and a half ounces; Chloride of Calcium thirteen and a half ounces; Sulphuric Acid thirteen fluidounces. Boil the acid tartrate of potassium with two gallons of the water, and add gradually the chalk, constantly stirring. When the effervescence has ceased add the chloride of calcium dissolved in two pints of the water. When the tartrate of calcium has subsided, pour off the liquid and wash the tartrate with distilled water until it is rendered tasteless. Pour the sulphuric acid, first diluted with three pints of the water, on the tartrate of calcium, mix thoroughly, boil for half an hour with repeated stirring, and filter through calico. Evaporate the filtrate at a gentle heat until it acquires the specific gravity 1.21, allow it to cool, and then separate and reject the crystals of sulphate of calcium which have formed. Again evaporate the clear liquor till a film forms on its surface, and allow it to cool and crystallize. Lastly, purify the crystals by solution, filtration if necessary, and recrystallization.

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[1] Styptic colloid, which consists of a saturated solution of tannin in alcohol to which ether and then gun-cotton is added to saturation, when applied to a part rapidly condenses and grows firm, so as to arrest the discharge of blood, serum, or pus. It is also used after the surfaces of wounds, fractures, etc., have been coäptated, for keeping their edges from being displaced.

This process is the one which in its main features is followed in preparing tartaric acid on the large scale. An excess of sulphuric acid is necessary for the decomposition of the tartrate of calcium to insure the complete removal of the calcium, since tartaric acid does not crystallize properly from a solution of acid tartrate of calcium. Boiling the precipitate with the sulphuric acid is avoided, and digestion for two or three days substituted. After concentration in the vacuum-pan, the liquid is heated with some wood-charcoal, or pure animal charcoal, to remove coloring matter, filtered, and crystallized. The last crystallizations are more or less colored, and, like the mother-liquor, are purified by digestion with wood-charcoal. Should the free sulphuric acid accumulate in the mother-liquor, its partial removal with milk of lime will be necessary. Where chloride of calcium cannot be used as a waste product for the decomposition of the tartrate of potassium, the cheaper sulphate of calcium is used for the purpose.

The rationale of this process is as follows: Acid tartrate of potassium yields with calcium carbonate insoluble calcium tartrate and soluble potassium tartrate. The solution of the latter reacts with the calcium chloride or sulphate, furnishing an additional quantity of insoluble calcium tartrate, and soluble potassium chloride or sulphate, which is removed by washing. The calcium tartrate, when digested with sulphuric acid, yields sparingly soluble sulphate of calcium which precipitates, and tartaric acid which, being freely soluble in water, remains in solution, and is recovered by crystallization.

Properties.—Tartaric acid crystallizes in colorless, oblique, rhombic prisms or tables, which are inodorous, and have a strongly but agreeably acid taste. They are soluble in a little less than their own weight of water, and dissolve freely in alcohol and wood spirit, but are insoluble in ether.

We have found (1863) the density of aqueous solutions of tartaric acid at 16° C. (60.8° F.) to be as follows:—

Tartaric acid, per cent.	Specific gravity.	Tartaric acid, per cent.	Specific gravity.	Tartaric acid, per cent.	Specific gravity.	Tartaric acid, per cent.	Specific gravity.
1	1.0044	15	1.071	30	1.153	45	1.240
2.5	1.0114	17.5	1.083	32.5	1.167	47.5	1.255
5	1.023	20	1.097	35	1.181	50	1.271
7.5	1.035	22.5	1.111	37.5	1.195	52.5	1.287
10	1.047	25	1.125	40	1.209	55	1.304
12.5	1.059	27.5	1.139	42.5	1.224	57.75	1.325

The crystals have the composition $H_2C_4H_4O_6$, and contain no water of crystallization. In American commerce, tartaric acid is usually found in the state of powder. It is a strong bibasic acid, and many of its salts crystallize readily. The aqueous solutions of tartaric acid and of its salts deviate the plane of polarized light to the right; hence the name of *dextrotartaric acid.* Some grapes contain naturally an acid isomeric with the foregoing, which is called *racemic, uvic, or paratartaric acid.* Its solutions do not affect polarized light;

but some of its salts crystallize in two distinct hemihedric forms, one of which contains the ordinary, or dextrotartaric acid, while the other contains *lævotartaric acid*, another isomeric form turning the plane of polarized light to the left. When dextrotartrate of cinchonia is heated to 170° C. (338° F.), it is converted into paratartrate; but at the same time a fourth isomeric modification is obtained, the calcium salt of which crystallizes after the calcium paratartrate. This new acid is *meso-* or *inactive tartaric acid*, so called, because its solutions have no effect upon polarized light, and the acid cannot be resolved into dextro- and lævotartaric acids under the same circumstances as racemic acid. Finally, a fifth isomeric acid may be obtained from tartaric acid by fusing it, which occurs between 170° and 180° C. (338° and 356° F.), when without loss in weight *metatartaric acid* is formed, whose solution has the same influence upon polarized light as that of the acid from which it was made; but it is deliquescent, and its salts dissolve more freely in water, and crystallize in forms different from the dextrotartrates. L. Pasteur has been engaged during the years 1847 to 1853 in investigating most of these facts.

The neutral tartrates, with the exception of those with an alkaline base, are nearly all insoluble, or slightly soluble in water, but dissolve in diluted nitric acid. Calcium tartrate is almost insoluble in water, but dissolves in chloride of ammonium, acetic acid, and cold potassa solution, being precipitated from the latter on boiling. Tartaric acid, added to the concentrated solution of a potassium salt, produces a precipitate of acid tartrate of potassium; a similar precipitate, which is rather more soluble in water, is produced with ammonium salts.

Impurities.—Tartaric acid, heated upon platinum foil, is decomposed and is finally consumed without leaving any residue (mineral impurities). It dissolves completely in about six parts of alcohol, some salts if present being left behind. Its solution in water is not precipitated or colored dark by hydrosulphuric acid (lead, copper, etc.), and is not precipitated by chloride of barium (sulphuric acid); the solution neutralized by ammonia, and acidulated by acetic acid is not precipitated by chloride of calcium (oxalic acid), or by oxalate of ammonium (calcium salts). 75 grains of tartaric acid dissolved in water require for neutralization 1000 grain-measures of the volumetric solution of soda, *Br.* If adulterated, a smaller quantity of the solution will be required for neutralization.

Off. Prep.—Ferri et ammonii tartras, Pulveres effervescentes, Pulveres effervescentes aperientes, *U. S.* Sodæ citrotartras effervescens, *Br.*

Physiological Action.—Given to dogs in large and concentrated doses it acts poisonously, quickening the pulse and respiration, and then causes debility, spasm, paralysis, and death, after which the blood remains liquid, but the stomach is not inflamed. It is in part secreted unchanged with the urine. It has been given to cats in large doses, without striking consequences. In man, an ounce of tartaric acid, dissolved in half a pint of warm water, is said to have acted like a corrosive poison, causing violent burning pain in the throat and stomach, followed by obstinate vomiting, and death at the end of nine days. Nearly the whole of the alimentary canal was found highly inflamed. But in another case six drachms of the acid were taken within twenty-four hours, without the least inconvenience. The alleged poisonous action in the first case is, therefore, open to doubt.

Medical Uses.—Tartaric acid is hardly ever used in medicine alone, but generally in combination with alkalies or their carbonates, or with carbonate of magnesium. It may be used to prepare whey, which is thought to be febrifuge and diuretic, and it is said to modify the unpleasant taste of the liquid preparations of cinchona, senna, and rhubarb. Associated with sugar, mucilage, and some flavoring extract, it serves to moisten the throat in *pharyngitis* and *pulmonary catarrh.* It is said to correct the *fetor of the feet*, to which some persons are subject, when it is strewn as a dry powder in the stockings.

ACIDUM VALERIANICUM, *U. S.*—VALERIANIC ACID.

Acidum valericum.—Acide valérianique, Acide valérique, Fr.; *Baldriansäure, Valeriansäure*, G.

Formula $HC_5H_9O_2$. Molecular weight 102.

Origin and Formation.—Valerianic acid has received its name from valerian root, from which it was obtained and recognized as a distinct acid by Grote (1830); it has been found in the flowers of Anthemis nobilis, in wormwood, angelica root, etc., and in dolphin oil, obtained from Delphinus globiceps by Chevreul (1817), who named it *delphinic acid;* it is found among the products of oxidation of a large number of organic substances, and is prepared for medicinal purposes almost exclusively by oxidizing amylic alcohol with bichromate of potassium and sulphuric acid.

Preparation.—Valerian root is distilled with water, the oil is removed from the acid distillate, the latter neutralized with soda, and evaporated to dryness. 5 parts of this residue are, according to Wittstein (1845), dissolved in 5 parts of water, and distilled with 4 parts of sulphuric acid diluted with 8 parts of water. The oily portion of the distillate is purified by fractional distillation. The yield is increased if bichromate of potassium and sulphuric acid is added to the water distilled with the root (Lefort, 1846).

In the preparation of valerianic acid from fusel oil, valerianate of sodium is prepared as the first step (for details see Sodii Valerianas), and this is then distilled with sulphuric acid. To obtain a concentrated acid, B. J. Crew (1860) manipulates as follows: 8 parts of sodium valerianate and 3 parts of water are mixed, and 3½ parts of sulphuric acid gradually added to the mixture. Sulphate of sodium is formed, and the liberated valerianic acid rises as an oily layer to the surface. The latter is separated and repeatedly agitated with small portions of oil of vitriol, to deprive it of water, which cannot be separated by distillation. When the specific gravity of the oily layer has been reduced to below 0.950, it is distilled, and that portion of the distillate having the specific gravity 0.940 and more is collected by itself, to be dehydrated by sulphuric acid as before. The remaining portion of the distillate, rather more than half the quantity of the whole, will have the required specific gravity 0.935. The weaker but heavier acid comes over first, and may be readily brought to the specific gravity 0.945 by oil of vitriol, when it is again ready for fractional distillation (F. C. Musgiller, 1868).

Properties.—Valerianic acid is a colorless, thin, oily liquid, of a disagreeable odor resembling that of valerian and of old cheese, and has a sour, acrid, unpleasant taste, producing upon the lips and tongue the sensation of burning; diluted with water the taste is less disagreeable, with a sweet after-taste. It is soluble in thirty parts of cold water, and, by agitation with a small quantity of that liquid, takes up about twenty per cent. of its weight, without losing its oily consistence. It mixes in all proportions with alcohol and ether. The specific gravity is 0.935, which increases if the acid becomes more hydrated. The boiling point of the officinal acid is 175° C. (347° F.); Musgiller ascertained that an acid of 0.933 specific gravity boils between 177.2° and 178.9° C. (351° and 354° F.); if of greater density, the boiling point is lower.

Valerianic acids, as obtained from different sources, differ to some extent in their specific gravities, boiling points, behavior to polarized light, and the solubility, in water, of their barium and silver salts: there are evidently several modifications of the normal acid.

The Composition of valerianic acid is $HC_5H_9O_2$; it bears to amylic alcohol, $C_5H_{12}O$, the same relation as acetic acid does to ordinary alcohol (see Acetum). Hydrogen being eliminated from the alcohol in the form of water, under the influence of oxidizing agents, the remaining molecule is oxidized to the acid. $C_5H_{12}O+O_2$ yields $HC_5H_9O_2+H_2O$.

The *neutral salts* of valerianic acid, when perfectly dry, are inodorous; in the presence of moisture, and still more in contact with carbonic acid, they have the odor of the acid; their taste is decidedly sweet. Most of the salts are soluble in water, several dissolve also in alcohol; from these solutions, valerianic acid is liberated by nearly all the mineral and organic acids, even by acetic acid.

Impurities.—The solubility of valerianic acid in not less than 26 and not over 30 times its weight of water, affords a ready means of discovering the presence of impurities which are freely soluble or insoluble in water, the former rendering the valerianic acid soluble in less water, the latter floating upon its aqueous solution (fixed oils, apple oil). Apple oil or amyl valerianate is always formed in preparing the acid from fusel oil, and unless the crude acid had been treated with warm soda or potassa solution, will contaminate valerianic acid; on treating it in the manner indicated, the apple oil will be decomposed and amylic alcohol float upon the solution. Butyric acid if present will, according to Laroque and Huraut, produce with concentrated solution of acetate of copper pale blue scales of copper butyrate, while pure valerianic acid mixed with the same solution yields a mixture which is transparent for several minutes, then separates oily drops of copper valerianate, which are gradually converted into a greenish-blue crystalline powder. A solution of valerianic acid in fifty parts of hot water, on being saturated with hydrated carbonate of zinc, yields a liquid which, when filtered, and evaporated to ten parts and cooled, affords white pearly crystals of valerianate of zinc. The mother-water, drained from these crystals, should not yield, by further evaporation and cooling, a salt crystallizing in six-sided tables, and very soluble in water. *U. S.* This is intended to discover the presence of acetic acid; but valerianate of zinc being less soluble in hot than in cold water, the concentrated liquid should be filtered while hot; this filtrate when cold treated with solution of crystallized ferric chloride, or of subsulphate of iron, yields a precipitate of valerianate of iron, and the filtrate will have a brown-red color from ferric acetate. Admixtures of hydrochloric or sulphuric acid are detected in the aqueous solution of valerianic acid, after adding some nitric acid, by the nitrates of silver and of barium.

Off. Prep.—Ammonii valerianas; Quiniæ valerianas. *U. S.*

Physiological Action and Medical Uses.—According to Reissner's experiments on animals, it coagulates albumen, blood serum, and milk, and is slightly irritating to the integuments. Its odor is not imparted to the urine or the blood, but may be perceived in the peritoneal cavity. It quickens but weakens the heart's action and the respiration, produces debility and then paralysis of the limbs, and spasms before death; after which, if it takes place rapidly, the gastric mucous membrane is pale, but if slowly, this membrane and that of the intestine are inflamed, the kidneys congested, and the urine is turbid and bloody. The acid is not used in medicine except in combination, but it is very doubtful if it gives any special properties to the bases with which it is associated, unless it does so in valerianate of ammonium.

ACONITI FOLIA, *U. S.*, *Br.*—ACONITE LEAVES.

Herba aconiti.—*Feuilles d'aconit, Coqueluchon*, Fr.; *Eisenhutblätter, Sturmhutblätter*, G.

ACONITI RADIX, *U. S.*, *Br.*—ACONITE ROOT.

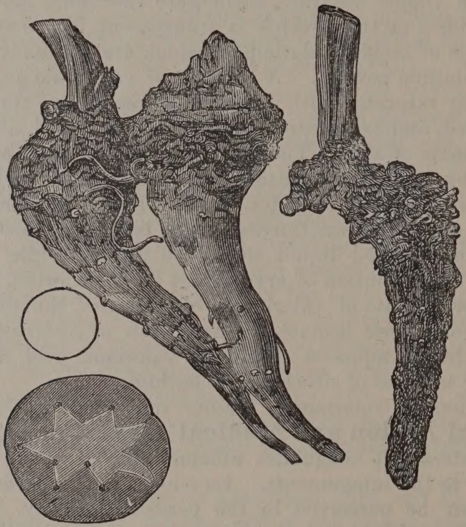
Tubera aconiti, P. G.—*Racine d'aconit*, Fr.; *Eisenhutknollen*, G.

The leaves and tuberous roots of Aconitum Napellus, *Lin.*, s. Ac. variabile, *Hayne*, s. Ac. vulgare, *D. C.* Bentley and Trimen, Med. Plants, 5, 6, and 7.

Nat. Ord.—Ranunculaceæ, Helleboreæ.

Origin.—The plant, which attains a height of 3 to 4 feet and is very variable in appearance, as indicated by one of its specific names, is met with throughout the greater portion of Asia and Europe, mostly in mountainous regions. It grows in the Himalaya Mountains at an altitude of from 10,000 to 16,000 feet, and from there north and west in Siberia and in Europe south to the Alps and Pyrenees. It is frequently cultivated for ornament and for medicinal use.

Fig. 5.



Tubers of Aconitum napellus, Lin., with a transverse section.

Description. 1. ACONITE ROOT.—The subterraneous portion of the plant consists of a tuber, which is contracted below into a conical root; from a lateral bud of the tuber a short rhizome is produced, developing at its end again into a tuber, bearing a bud at its top from which the stem for the succeeding year will be produced. This second tuber is fully developed in the fall of the first year and withers a year afterwards, by which time it has produced fruit and developed another, the third, tuber. The parent tuber and its offspring are often met with among the commercial article still united by the short rhizome, or if detached, showing the scar and often a portion of this branch. As met with in commerce it is of a conical shape, two to three inches in length, and about an inch in thickness at the crown; the numerous rootlets are mostly broken off, giving the tuber a tuberculated appearance from the remnants of the radicles. At the top it is crowned with a short portion of the stem or with the terminal bud. It is of a dark-brown color externally, and longitudinally wrinkled; internally it is compact and whitish if of latest growth, or brownish, porous, and often hollow if of the previous year's growth. The transverse section shows a thick bark, inclosing a star-shaped six to eight-rayed pith, having a vascular bundle in each ray. The radish-like odor of the fresh root disappears on drying; the taste is at first sweetish, then acrid and burning, with a persistent sense of numbness.

Admixtures.—The tubers of allied blue flowering species of aconitum are sometimes dug up and mixed with the officinal. The tubers of Aconitum cammarum, *Jacquin* (s. Ac. variegatum, *Lin.*) are globular-ovate, smaller than the preceding, the central pith about five-rayed and the rays rounded. Those of Aconitum Stoerckianum, *Reichenbach* (s. Ac. cammarum, *Lin.*, s. Ac. napellus, *Stoerck*), are often three to five attached to each other, of a slender conical shape, and with the pith roundish pentagonal in outline. The root of Imperatoria ostruthium, *Lin.*, or European masterwort, resembles aconite tubers in shape, but has an aromatic odor and pungent taste, and exhibits upon transverse section numerous oil cells arranged in several circles.

2. ACONITE LEAVES.—They are smooth, petiolate, two to three inches in length, nearly orbicular in outline, somewhat heart-shaped at the base and divided to the base, the lower into five, the upper into three segments, each of which is again three or sometimes five-cleft, the last divisions being linear-lanceolate, often toothed, show a prominent rib beneath and a furrow above, which extends into the petiole, this being of about the length of the leaf. The texture of aconite leaves is somewhat leathery, their color rather bright-green and somewhat shining above, and paler beneath. In the dry state they have a slight herbaceous odor, and a taste which soon becomes bitter and acrid, producing tingling upon the tongue.

The leaves of Aconitum Stoerckianum, *Reichenb.*, are similar in appearance, but the segments are broader; those of Ac. cammarum, *Jacq.*, are less deeply incised and have nearly rhomboid segments.

Other Species of Aconite.—BISH OR BIKH ROOT, also called Nepaul aconite root, obtained from Aconitum ferox, *Wallich*, s. A. virosum, *Don*, and perhaps from other species of aconitum indigenous to the Himalayas, is occasionally met with in commerce. It is conical in shape, two to four inches long, about one inch and over in its upper diameter, longitudinally wrinkled, externally of a brownish-black color, internally whitish and somewhat spongy, or compact and of a resinous somewhat translucent appearance upon the smooth and short fracture. Its taste is intensely acrid.

ACONITUM HETEROPHYLLUM, *Wallich.*—The conical roots of this Himalayan species have a bitter taste without acridity, and are used in India, under the name of *atis*, for their tonic and antiperiodic properties.

ACONITUM LYCOCTONUM, *Lin.*—Von Schroff (1875) has recently again called attention to the fact that the aconite leaves which are used in Lapland as a pot-herb, are from a blue flowering variety of this species, the *Ac. septentrionale* of Koelle, which contains only a very minute quantity of bitter alkaloid in the leaves, though more in the root.

ACON. ANTHORA, *Lin.*—A white flowering species of Europe, has bitter roots, which were formerly used as a tonic, and, according to Hooker, the roots of the allied *Acon. multifidum*, as also those of *Acon. rotundifolium*, indigenous to India, are eatable.

Constituents.—The important medicinal constituent of both aconite root and leaves is the acrid alkaloid *aconitia*, associated with the bitter alkaloid *napellina*, which are probably combined with aconitic acid. Napellina was discovered by Hübschmann (1857) and subsequently (1867) found by him to be identical with *acolyctina*, one of the alkaloids obtained by him from Aconitum lycoctonum, *Lin.*, which plant contains a second alkaloid *lycoctonina*, but no aconitia. The acrid alkaloid of bikh tubers differs in some respects from aconitia, and has been named *pseudaconitia.* T. & H. Smith obtained (1864) from aconite root, by almost neutralizing the acid solution of crude aconitia with carbonate of sodium, a non-poisonous alkaloid, which readily crystallizes from its solutions, and bears in its behavior such a close resemblance to narcotina, that it is probably identical with it; the name of *aconella* has been proposed for it. Groves failed (1866) to obtain it.

Aconite leaves contain also albumen, gum, chlorophyll, extractive matter, and salts. In aconite tubers, resin, fat, mannite, cane- and grape-sugar have been found.

Aconitic acid, $H_3C_6H_3O_6$, has been obtained also from Delphinium consolida, Equisetum fluviatile, and by the decomposition of citric acid, by heating it rapidly in a retort until oily streaks make their appearance in the neck, when the residue is exhausted with ether to free it from the undecomposed citric acid. By this process citric acid is deprived of one molecule of water; $C_6H_8O_7$ (citric acid) yields H_2O and $H_3C_6H_3O_6$. Aconitic acid crystallizes in colorless laminæ, or warts, which are easily soluble in water, alcohol, and ether, and which fuse at 140° C. (284° F.). Aconitate of calcium$=Ca_3(C_6H_3O_6)_2 6H_2O$, dissolves with difficulty in water, after it has been obtained in the crystalline state.

Hager obtained (1863) between 0.64 and 1.25 per cent., Hottot (1864) only 0.06 per cent. of aconitia from commercial aconite root; Procter (1863) 0.42 from American, and 0.20 from commercial German aconite root.

Nepaul aconite contains an alkaloid which was at first supposed to be identical with aconitia, but was afterwards described under various names, like acraconitia (Ludwig, 1869), napellina (Wiggers, 1857), and nepalina (Flückiger, 1869). The name *pseudaconitia* appears now to be more generally employed for this substance, which, according to Groves (1870–1874), exists in two modifications, one crystalline, but yielding uncrystallizable salts, the other amorphous; the latter becomes sticky in boiling water, while the former coheres and becomes plastic only if treated with boiling water immediately after having been precipitated by ammonia. Another alkaloid, resembling Hübschmann's napellina, but probably differing from it, is likewise met with in bikh-root. These alkaloids appear to be closely analogous to aconitia in their elementary composition, and must, probably, be regarded as polymeres (Groves, 1874). Duquesnel (1871), and Patrouillard (1872) regarded pseudaconitia and aconitia as identical, differing from each other merely in the amount of other inert constituents contained in them. C. R. A. Wright (1875, 1878), however, proved the former to have the composition $C_{36}H_{49}NO_{12}$, and when acted upon by alcoholic solution of soda at 100° C. (212° F.) observed it to be decomposed into *dimethyl-protocatechuic acid*, $C_9H_{10}O_4$, and an uncrystallizable base, *pseudaconina*, $C_{27}H_{41}NO_9$, which prevents also the crystallization of pseudaconitia; the latter is closely related to the opium alkaloids narceia and narcotina, which give rise to derivatives of dimethyl-protocatechuic acid. The same author is inclined to regard Hübschmann's lycoctonina as merely a mixture of these two alkaloids, pseudaconina predominating.

Off. Prep.—Of the leaves: Extractum aconiti, *U. S.*, *Br.* *Of the root:* Aconitia, *U. S.*, *Br.* Emplast. aconiti, *U. S.* Liniment. aconiti, *Br.* Tinctura aconiti (radicis), *U. S.*, *Br.*

Physiological Action.—The operation of aconite and that of its alkaloid aconitia are so nearly identical in nature that both may be described in the same article. Experiments upon fish, serpents, earth-worms, frogs, birds, etc., show that in all these animals it causes loss of sensibility and paralysis terminating in death. The same general effects are exhibited by dogs, but in some instances it is evident that general sensibility is obtunded, if not suspended, even while locomotion is unimpaired. The first effects of a poisonous dose are staggering and weakness of the limbs, then disordered breathing, paralysis of the limbs, general anæsthesia, blindness, imperfect respiration, spasms, and death. Associated with these phenomena are slow pulse and breathing, and lowered temperature, followed by rapidity and irregularity of the action of the heart and lungs. After death the stomach is not inflamed, and the vessels of the cerebral meninges are gorged with blood. Upon *man* the following effects have been noted: After a dose of five minims of the tincture, there is felt a tingling, numb sensation in the lips and tongue, and in the tips of the fingers, with a sense of muscular weakness and depression; the pulse falls in frequency and force, and the breathing is somewhat slower. A dose of ten minims produces the same symptoms greatly intensified and more prolonged. Beyond this dose the effects become poisonous; besides tingling of the skin, there may be lancinating pains in the joints; there is vertigo with dimness of vision, alarming debility, and a pulse of between 30 and 40 in a minute, which afterwards grows frequent and irregular. The skin is cool and moist, nausea and vomiting occur, and the sickness and depression may last for several days. In poisonous doses, which have not proved fatal, the preceding symptoms occur in an intensified degree, but consciousness may not be lost. If the dose is a fatal one, there is complete loss of sight, hearing, and speech, yet consciousness may be retained; the pupils are dilated, the muscles are tremulous or convulsed, the pulse is imperceptible at the wrist, and may be even in the axilla, the skin is cold, and death takes place by syncope. No characteristic lesions are found after death. Large doses of aconite are said to leave behind them general debility, tremulousness, photophobia, feverishness, impaired digestion, and sometimes a tendency to jaundice. The mechanism of the phenomena which have been detailed has been differently explained by various experimenters, who have tended to obscure by their analytical exposition what the mere description seemed to render intelligible.

Medical Uses.—Aconite has been proclaimed by not a few writers of authority as a potent remedy for *rheumatism*, and it may be admitted to possess some value as a sedative of arterial action, and thereby as an indirect anodyne; but it is in no proper sense a remedy for the disease. Indeed, it falls so far short of alkalies in the articular, and of iodide of potassium in the muscular variety of rheumatism, that its practical value is next to nothing, and it does not enter into the catalogue of remedies which are prescribed for the disease by judicious practitioners. It is of still less utility in *gout* than in rheumatism. But in both affections it may be employed as a topical application for mitigating pain. So far as the internal use of aconite in *neuralgia* is concerned, a somewhat analogous judgment may be given. Undoubtedly it sometimes palliates the severe suffering of this disease affecting the nerves of the face or of the chest, especially when it is at the same time applied, in the form of a strong tincture, or of aconitia, over the superficial and painful nervous branches. But in the greater number of cases of neuralgia, not the direct effect of external causes, the affection depends upon states of the system which must be remedied by quinia, arsenic, iron, etc.; and in which the sole indication for aconite is fulfilled by its local application. It is sometimes very efficient in relieving *toothache* when introduced into a carious cavity. But the risk of poisoning in such cases outweighs the advantages of the medicine. The same reflection is suggested by its use in *palpitation* of the heart, whether nervous, or arising from organic disease of that viscus; in *dysentery*, *amenorrhœa*, etc. In traumatic *tetanus* a like consideration should forbid its use, in spite of certain cases in which it seems to have been advantageous.

The statements which have been made respecting the virtues of aconite in purely inflammatory affections and fevers, e. g., *pneumonia*, *rheumatism*, *erysipelas*, *typhoid fever*, *puerperal fever*, and *traumatic fever*, have not been supported by concurrent experience. They seem to rest upon the same error which led to the employment on the one hand of digitalis, and, on the other, of white and green hellebore in such affections, and which consisted in mistaking a lowering of the pulse-rate for a cure of the disease which caused its increase. It should constantly be borne in mind, in reference to the two last-mentioned medicines, and still more in regard to aconite, that the lowering effect upon the pulse is brought about at the expense of the muscular tonicity of the heart.

The treatment of *poisoning* by aconite consists in evacuating the stomach with mechanical emetics and the stomach-pump, and sustaining vitality by means of the galvanic battery, and by the administration of diffusible stimulants, including alcoholic liquids, coffee, and external heat. Oxygen has apparently tended to revive failing life. Strychnia is regarded as indicated physiologically; and digitalis, or, preferably, digitalin, may be given for its sustaining operation upon the heart. To assist in preventing syncope the patient's head should be kept low. According to Harley, death results from asphyxia, and progressive collapse of the lung; the former being due to the spasmodic closure of the respiratory passages, and paralysis of the muscles of inspiration, and notably of the diaphragm.

Dose.—Of the powdered leaves or root, one or two grains is a minimum dose; but it is seldom employed in this form. The extract and tincture of aconite are preferable for internal administration; and for the local effects of the medicine, either the tincture, aconite plaster, or aconitia may be employed. It must not be forgotten that alarming symptoms have been produced by a dose of three drops of the saturated tincture of aconite root.

ACONITIA, *U. S.*, *Br.*—ACONITIA.

Aconitina, *Aconitinum.*—*Aconitin*, E.; *Aconitine*, Fr.; *Aconitin*, G.
Formula $C_{33}H_{43}NO_{12}$. Molecular weight 645.

Preparation.—Take of Aconite Root in moderately fine powder forty-eight troyounces; Diluted Sulphuric Acid a fluidounce and a half; Alcohol, Stronger Water of Ammonia, Stronger Ether, Distilled Water, each, a sufficient quantity. Digest the powder in eight pints of alcohol, in a close vessel, at the temperature of 120°, for twenty-four hours. Introduce the mixture into a cylindrical percolator, and gradually pour alcohol upon it until twenty-four pints of liquid have slowly passed. Distil off the alcohol from the filtered liquid until this is reduced to the measure of a pint. Then add to the concentrated liquid a pint of distilled water, to which has been added the diluted sulphuric acid, and mix thoroughly. Remove from the liquid the fixed oil and resin, which separate on standing, and evaporate it to four fluidounces. When the liquid has cooled, pour it into a glass-stoppered pint bottle, and wash it, by agitation and decantation, with six fluidounces of stronger ether, to remove the remainder of the fixed oil and resin. Now add stronger water of ammonia until, after agitation, it remains in slight excess. Next, treat the resulting mixture with six fluidounces of stronger ether, and, having closed the bottle, agitate briskly for a few minutes. Allow the liquid to stand until it separates into two layers, the lighter being an ethereal solution of aconitia. Decant this carefully, and treat what remains, twice successively, with the same quantity of stronger ether, decanting each time as before. Mix the several ethereal solutions in a porcelain capsule, and allow the mixture to evaporate spontaneously to dryness. Lastly, reduce the dry residue to powder, and keep it in a well-stopped bottle. *U. S.*

This process was proposed by Prof. Procter (1861) as a modification of that previously suggested by Headland, and is nearly identical with that of Liégeois and Hottot (1864) adopted by the French Codex, except that by the latter the root is exhausted with alcohol acidulated with sulphuric acid, that magnesia is used in place of ammonia, to liberate the alkaloid from its combination with sulphuric acid, and that the impure alkaloid obtained on evaporating the ether is further purified. The British Pharmacopœia directs the distillation and evaporation of the alcoholic tincture of the root, until all the alcohol has been dissipated; the residual extract is thoroughly mixed with twice its weight of boiling water and the solution allowed to cool, when it is filtered; this liquid is treated with ammonia in slight excess, and the mixture gently heated over a water-bath, whereby the precipitate unites, forming a mass which is readily separated by a filter and, after drying and powdering, exhausted by ether. On the evaporation of the ether, aconitia is obtained of about the same purity as by the process of the U. S. Pharmacopœia.

In these processes the aconitates of aconitia and napellina are taken up from the root by alcohol, together with coloring matter, resin, and fixed oil; the last-named two constituents become insoluble in the aqueous liquid remaining after the evaporation of the alcohol, and are removed by filtration, while the two alkaloids remain dissolved in the water as aconitates in the British process or as sulphates in the French and United States processes. By treating this solution with ether, for which petroleum benzin may be substituted, the remainder of the fixed oil is removed, and ammonia, magnesia, or similar bases now separate the two alkaloids, which, together with some coloring matter, are dissolved by the ether and left behind on evaporating that liquid.

Purification of Aconitia.—The impure aconitia thus obtained is dissolved in warm distilled water acidulated with sulphuric acid, and the solution, when cold, is precipitated by the cautious addition of ammonia diluted with four times its bulk of distilled water; the precipitate is washed on a filter with a small quantity of cold distilled water, and dried by slight pressure between folds of filtering paper. (*Br.*) Napellina being more soluble in water and alcohol than aconitia, remains, with most of the coloring matter, in the mother-liquor from which the aconitia is precipitated by ammonia. Since napellina is less soluble in ether than aconitia, most of it may be removed by treating the crude aconitia with a quantity of ether insufficient for its complete solution.

According to the French Codex the crude alkaloid is dissolved in diluted sulphuric acid; the solution is decolorized by animal charcoal, precipitated by ammonia, and heated to boiling. The precipitate is collected upon a filter, washed with some water, dried, and again dissolved in ether. The clear ethereal solution is evaporated to dryness and the residue dissolved in a very small quantity of diluted sulphuric acid. Ammonia is now added drop by drop, and the first portion of the precipitate, which consists of impure aconitia, is removed by filtration. On the subsequent addition of ammonia, pure aconitia is precipitated, which is collected on a filter, and dried at a low temperature.

C. R. A. Wright (1876) agrees with Duquesnel that mineral acids and heat used in preparing the alkaloid tend to render it partly amorphous. He uses tartaric acid in alcohol for its extraction, evaporates at a very low temperature, removes the resin and fat by filtering and by petroleum benzin, and precipitates the alkaloid by potassium carbonate; the precipitate is treated with ether, the solution agitated with aqueous tartaric acid, and again decomposed by an alkaline carbonate. After repeating this treatment several times, pure crystallized aconitia is obtained.

Properties.—Aconitia is a white amorphous powder; as obtained by the process of the U. S. Pharmacopœia, it is always yellowish. Mr. T. B. Groves' researches on the aconite alkaloids, which have been reported to the British Pharmaceutical Conference (1866 to 1874), render it probable that aconitia obtained by any one of the above processes is never chemically pure, but still contains variable proportions of the bitter, and probably inert, alkaloid napellina. Pure aconitia occurs in two modifications, a crystalline and amorphous, both of which, when precipitated with ammonia and heated to boiling, do not fuse, but become quite brittle. Amorphous aconitia dissolves in 1000 parts, crystallized nitrate of aconitia in 520 parts of water containing 1¼ per cent. of ammonia; the latter solution gradually heated becomes turbid, and when near the boiling point separates microscopic crystals of aconitia, while the ammoniacal solution containing the amorphous alkaloid becomes clear again near the boiling point of the liquid. The ammoniacal solutions of both modifications speedily decompose, the amorphous aconitia being somewhat more stable. Pure aconitia gives no characteristic color reactions with acids or oxidizing agents.

C. R. A. Wright (1875 to 1877) corroborated these statements, and found the physiologically active and crystallizable aconitia to have the composition above given, and, when heated with water to 140° or 150° C. (284° or 302° F.), to be decomposed into benzoic acid and an amorphous alkaloid, *aconina*, $C_{26}H_{39}NO_{11}$, which is bitter, not acrid, is more or less largely contained in commercial aconitia and is identical with acolyctina and napellina, mentioned above (see pages 93, 94).

Aconitia of the different Pharmacopœias has a bitter, acrid taste accompanied by a sense of numbness, is insoluble in petroleum benzin (Dragendorff), soluble in 150 parts of cold, and 50 of boiling, water, and in much less alcohol, ether, benzol, and chloroform. It melts with heat and burns with a smoky flame, leaving no residue when burned with free access of air. It has a strong alkaline reaction and neutralizes acids, from which solutions it is precipitated by caustic alkalies, but not by carbonate of ammonium, or by bicarbonate of sodium. Sulphuric acid produces with it a brown color.

The purity of officinal aconitia is proven by these reactions. Pseudaconitia may be distinguished from it by requiring about 230 parts of chloroform, 100 parts of boiling ether, and 1500 to 2600 parts of diluted ammonia of 1¼ per cent. strength, for solution.

Liégeois and Hottot found that aconitia precipitated by ammonia from cold solutions, contains 25 per cent. of water, which is given off at 85° C. (185° F.), and Hager (1875) has directed attention to this as a source of the variable strength of commercial aconitia. According to Wright, however, the process adopted for its preparation is evidently of primary importance.

Off. Prep.—Unguentum aconitiæ, *Br.*

Physiological Action.—Its action upon the system, as shown by experiments upon animals and upon man, as well as by cases of poisoning in man, is identical with that of aconite. In some of the latter experiments the doses varied from $\frac{1}{25}$ to $\frac{1}{4}$ gr., and the larger ones developed alarming symptoms. When applied to the skin, in an ointment, or in alcoholic solution, it produces itching and prickling, followed by anæsthesia of the part, without redness or heat.

Medical Uses.—The internal employment of this alkaloid in medicine is rarely resorted to, on account of its dangerous activity as a poison. It has, however, been administered advantageously for the cure of *neuralgia*, in the dose of $\frac{1}{125}$ gr. Its efficiency is, however, much greater in the form of an ointment, which may contain two, or from that to five, grains in a drachm of lard; or in the form of a solution made by dissolving one grain of aconitia in two fluidrachms of alcohol. Either preparation should be applied with a soft brush, or with the finger protected by a glove.

ACTÆA SPICATA, *Lin.*—BANEBERRY ROOT.

Radix Christophorianæ.—*Racine de Saint-Christophe*, Fr.; *Christophswurz*, *Wolfswurz*, G.

Nat. Ord.—Ranunculaceæ, Cimicifugeæ.

Origin.—The plant is a native of Central and Northern Europe, and a variety with red berries (A. rubra, *Bigelow*) is indigenous to the Northern

United States and Canada. The leaves are twice or thrice ternately compound with ovate or oblong, sharply cleft or toothed leaflets. The whitish flowers are in short, dense racemes. The fruit of the European variety is glossy black. Another American species, *A. alba*, Bigel., is taller, and has longer racemes and white berries.

Description.—The rhizome and rootlets closely resemble the corresponding parts of Cimicifuga, but are shorter, thinner, and of a blackish-gray color. When dry, they are nearly inodorous; their taste is bitter, afterwards acrid and sweetish. The constituents are similar to those of cimicifuga.

Physiological Action and Medical Uses.—A. spicata, or baneberry, and A. alba and rubra are sometimes used in domestic medicine, where they flourish—the first in Europe, the others in this country. They are probably very analogous, if not identical, in their mode of action, which is that of an irritant emeto-cathartic. The berries of the European species are said to occasion violent and even fatal delirium, as well as gastro-intestinal disorder. They destroy the life of hens and ducks; but sheep, asses, and goats devour the green leaves without injury. The powder and decoction are used to kill fleas and lice. The fresh root of the plant has been used in veterinary medicine, and was formerly regarded as a remedy for "asthma." Whatever virtues belong to either of these species probably exist more perfectly in cimicifuga.

ADANSONIA DIGITATA, *Lin.*—BAOBAB.

Baobab, E., Fr., G.

Nat. Ord.—Sterculiaceæ, Bombaceæ.

Description.—The tree is indigenous to tropical Africa, and has been introduced and naturalized in various parts of the East and West Indies. It is remarkable for its enormous size, the trunk being about 15 feet high up to the branches, but attaining a circumference of 70 feet and more, and being divided into branches 50 to 70 feet long. It has a smooth, gray bark; palmate leaves, with 5 to 7 obovate or elliptic, rather acute and somewhat dentate leaflets, which are about 5 inches long. The flowers are about 4 inches long and wide, have 5 thickish, obovate, white petals, and numerous stamens, with the lower half of the filaments united into a tube, and produce a roundish, oblong fruit, about 10 to 12 inches long, and containing about 50 blackish, subreniform seeds, which are covered with a whitish, acidulous pulp. The bark, leaves, and flowers have a mucilaginous taste. The fruit is known as *monkey bread* (*Pain de singes*, Fr.; *Affenbrot*, G.), *Ethiopian sour-gourd*, and in Southern Africa as *cream of tartar fruit*. The pulp surrounding the seeds appears to contain pectin and several organic acids.

Medical Uses.—The bark of the baobab does not appear to affect any of the functions, except perhaps by increasing the appetite. The natives of Senegal are said to use it for its emollient qualities, and to mix the powder of the leaves with their food. It at first attracted attention in consequence of its alleged power of curing *intermittent* fever, but no confirmation of the original assertion is accessible, and it is quite improbable that a mucilaginous plant should possess such a virtue. A decoction is made with an ounce of baobab bark and a quart of water reduced by boiling to a pint and a half.

ADEPS, *U.S.*—LARD.

Adeps præparatus, Br.; *Adeps suillus*, P. G.; *Axungia*, *Axungia porci s. porcina.—Prepared lard*, *Hog's lard*, E.; *Axonge*, *Graisse de porc*, Fr.; *Schweineschmalz*, G.

The prepared or purified fat of the hog, Sus scrofa, *Lin.*

ADEPS BENZOATUS, *Br.*—BENZOATED LARD.

Adeps benzoinatus, *Unguentum benzoini*, U.S.; *Axungia balsamica s. benzoinata s. benzoata.—Benzoinated lard*, *Ointment of benzoin*, E.; *Axonge (graisse) benzoinée s. balsamique*, Fr.; *Benzoinirtes Schmalz*, G.

Hog's lard impregnated with benzoic acid and the odorous principle of benzoin.

Preparation.—For medicinal purposes, the fat attached to the mesentery, omentum, and kidneys of the hog killed during the winter or spring, should be selected, as this has a higher fusing point than if obtained during the summer or from other parts of the body. It is that portion which is ordinarily called the "leaves," and should be as free from blood as possible. Hogs which have been fed on corn and similar amylaceous food appear to yield a more solid lard than hogs fed on the refuse of the kitchen. The British Pharmacopœia gives the following directions for preparing lard: Take of the internal fat of the abdomen of the hog, perfectly fresh, fourteen pounds. Remove as much of the membranes as possible, cut the fat into small pieces, put it into a suitable vessel with about four gallons of cold water, and, while a current of water is running through the vessel, break up the masses of fat with the hands, exposing every part to the water, so that whatever is soluble may be thus dissolved and carried away. Afterwards collect the washed fat on a sieve or in a cloth; drain away as much as possible of the water, liquefy the fat at a heat not exceeding 212°, and strain through flannel, pressing the residue while hot; then put it into a pan heated by steam, and keep it at a temperature a little but not much above 212°, stirring it continually until it becomes clear and entirely free from water; finally strain it through flannel. *Br.*

Perfumers obtain it inodorous, or nearly so, by adding to every pound of the fused lard about fifteen grains of powdered alum and thirty grains of table salt, and continuing the heat until a scum rises, which is to be carefully removed, and the fat is uniform in appearance; it is then allowed to cool, and worked upon a slab or in a mortar, while a slow stream of clear water passes over it whereby the salts are completely removed. The fat is then remelted and the heat maintained, until the water has completely separated or evaporated.

As met with in commerce, lard often has a rancid odor and is then unfit for medicinal use. Salt is often added to prevent it from becoming rancid, and should be carefully removed by fusing the lard and stirring it in hot water, and afterwards washing it until the fat is tasteless or nitrate of silver ceases to produce a precipitate with the washings. Carbonate of potassium is used to impart an artificial whiteness to commercial lard and to incorporate with it considerable proportions of water; such lard is to be purified by remelting and washing with water. Adulterations with mucilaginous jellies are removed in the same manner.

Properties.—Lard is a soft white fat, entirely free from rancid odor, and of sweetish insipid taste. It dissolves completely in ether and volatile oils, has a density of about 0.935, and fuses near 35° C. (95° F.). In contact with the air, particularly when exposed to the light, it speedily oxidizes and becomes rancid, acquiring a disagreeable odor and acrid taste; this change is accelerated by the presence of alkalies.

Constituents.—Lard is a mixture of olein, palmitin, and stearin, the last two fats being obtainable to the amount of 30 to 40 per cent., by subjecting the lard to pressure near the freezing point of water. The expressed liquid is known in commerce as *lard oil*, and is extensively used for various purposes; it furnishes a cheap adulterant for some of the more costly non-drying oils. The solid portion is called *stearin*, and is employed for making candles, soap, etc. When melted lard is allowed to cool slowly, a portion of the solid fats separates in granules; hence lard and all its preparations should be constantly stirred while cooling, to obtain them of uniform smoothness.

Preservation and Tests.—Lard should be preserved in glass, porcelain, or other well-glazed vessels, which must be entirely impervious to fat; the vessels should be well filled and protected from the access of air and light. The adulterations mentioned above are detected by *ether*, which should dissolve lard completely, and by boiling with *distilled water*, which should not acquire an alkaline reaction, and, after separating the fat, the liquid should not form a precipitate with nitrate of silver or assume a blue color on the addition of compound solution of iodine.

Preparation of Ointment of Benzoin or Benzoated Lard.—Take of Tincture of Benzoin two fluidounces; Lard sixteen troyounces. Melt the lard by means of a water-bath, add the tincture of benzoin, constantly stirring, and, when the alcohol has evaporated, remove the ointment from the water-bath, and stir while cooling. *U. S.*

Take of prepared Lard one pound; Benzoin reduced to coarse powder one hundred and sixty grains. Melt the lard by the heat of a water-bath, add the benzoin, and, frequently stirring them together, continue the application of heat for two hours; finally, remove the residual benzoin by straining. *Br.*

Fixed oils dissolve the benzoic acid and odorous principles contained in benzoin. When following the process of the U. S. Pharmacopœia it is advisable to strain the lard after the alcohol has evaporated, whereby the resins of benzoin are removed, and irritation is prevented, if the benzoated lard is applied to tender surfaces (Wilder, 1873).

Pure benzoic acid has no preservative influence on lard; that property appears to be due solely to the balsamic principle of benzoin and similar bodies. Hence the rancidity of lard may be prevented by impregnating it with the balsamic principles of Storax, Peru or Tolu balsam, in the proportion of one part of balsam to one hundred parts of lard: the latter constitutes the so-called *balsamic lard* (Procter, 1863). In a similar manner *populinated lard* is obtained, by digesting two parts of poplar buds, one part of water, and six parts of lard, until the moisture has evaporated, when the undissolved matter is removed by straining (Dorvault). Groves found (1866) that volatile oils generally preserve fats from rancidity to some extent, and that the oils of cloves, allspice, and sassafras are best adapted for this purpose, in the proportion of four drops to one ounce of fat.

Pharmaceutical Uses and Preparations.—Lard is used as an ingredient in ointments, cerates, and sometimes also in plasters as a substitute for olive or other oil. The base of the following ointments is lard only: Ung. acidi tannici, *U. S.;* Ung. aconitiæ, *Br.;* Ung. antimonii, *U. S.;* Ung. atropiæ, *Br.;* Ung. belladonnæ, *U. S.*, *Br.;* Ung. creasoti, Ung. gallæ, Ung. hydrarg. nitratis, *U. S.;* Ung. hydrargyri subchloridi, *Br.;* Ung. iodinii (iodi), *U. S.*, *Br.;* Ung. iodinii comp., *U. S.;* Ung. potassæ sulphuratæ, *Br.;* Ung. potassii iodidi, *U. S.*, *Br.;* Ung. stramonii, Ung. sulphuris, *U. S.;* Ung. sulphuris iodidi, *U. S.*, *Br.;* Ung. tabaci, *U. S.;* Ung. veratriæ, *U. S.*, *Br.*

The following ointments are made with benzoated lard (ointment) for their base: Ung. gallæ, Ung. plumbi acetatis, Ung. sulphuris, *Br.;* Ung. zinci (oxidi), *U. S.*, *Br.* Benzoated lard enters also into the suppositories of the British Pharmacopœia.

Lard is also an ingredient in the following: Ceratum, *U. S.;* Ceratum (emplastrum) cantharidis, *U. S.*, *Br.;* Cerat. extr. canthar., Cerat. resinæ, *U. S.;* Unguentum (simplex), Ung. hydrargyri, *U. S.*, *Br.;* Ung. mezerei, *U. S.;* Ung. sabinæ, Ung. terebenthinæ, *Br.*

Physiological Action and Medical Uses.—Lard is used in medicine chiefly on account of the property it possesses in common with all unctuous substances of facilitating manual and mechanical operations by its lubricating qualities, and on account, also, of the same common property of protecting exposed tender surfaces from the action of the air. Like other fats and oils it is difficult of digestion, and therefore is sometimes used as a laxative for children, and for its protective power in *diarrhœa*, *dysentery*, etc. Enemata of melted fresh lard are extremely soothing in acute dysentery. It has been proposed as a substitute for cod-liver oil in the treatment of *phthisis*, but its indigestible nature unfits it for this purpose. It has been employed externally in the same disease by inunction of the chest, and probably with the advantage of protecting the lungs from the external impression of cold. In the treatment of bronchial and laryngeal *catarrh* in children, and indeed of all pulmonary affections of early life, this simple application is valuable, not only for the reason assigned, but because it seems, when the cough is dry and urgent, to render expectoration freer. The same may be said of its use in *coryza*, in which the ointment should be applied upon the bridge of the nose. In *scarlet fever* inunction of the whole body protects the skin from the atmosphere, and thereby lessens the burning and itching, and both directly and indirectly lowers the temperature and the pulse rate. It also tends to prevent a sudden chill on exposure to the air, and hence diminishes very much the occurrence of scarlatinous *dropsy*. But with this end in view the application must be continued for some time after the acute febrile symptoms have disappeared. It is thought that the anginose symptoms of scarlet fever may be moderated by keeping the neck enveloped in well-greased flannel cloths; but of this the evidence is slender. In *measles* it is probable that the bronchitis may be moderated by similar applications upon the chest. The best form in which lard can be used for the above purposes is simple ointment. The strongest objections to its use are the necessity of soiling much body and bed clothing, and the repugnance which is generally manifested by patients to its frequent repetition. Benzoated lard is preferable to prepared lard or simple ointment when a mild stimulant action is desired besides the protective influence.

ADIANTUM.—MAIDENHAIR.

Herba capillorum veneris.—*Capillaire*, Fr.; *Frauenhaar*, *Venushaar*, G.

The frond of Adiantum capillus Veneris, *Lin.*, and A. pedatum, *Lin.*

Nat. Ord.—Filices.

Origin.—The first species is indigenous to southern Europe, and grows in moist rocky places; the second is common in rich moist woods of North America.

Description.—The European maidenhair has a polished, blackish-brown stipe about a foot high, tri- or bipinnate below, pinnate above; the leaflets are short-stalked, irregular, roundish wedge-shaped, oblique at the base, obtusely lobed and with linear marginal fruit dots. The American species has the stipe forked at the summit, each branch recurved and with 6 or 7 pinnate branches; the leaflets are triangular oblong, on the lower margin entire, the upper margin cleft and fruit-bearing; otherwise resembling the preceding. Both have a faintly astringent, sweetish, and slightly bitter taste; the American maidenhair has also a faint aromatic odor.

A *syrup* is employed in Europe which is prepared by making an infusion with 1 part of the drug and 10 parts of boiling water, and dissolving in the strained liquid 19 parts of sugar.

Other species indigenous to Mexico and South America are employed there for similar purposes. *Asplenium Adiantum nigrum*, Lin., was formerly known in Europe as *black maidenhair*, and *Aspl. ruta muraria*, Lin., as *white maidenhair;* the latter is also a native of the United States.

Medical Uses.—The indigenous species of maidenhair is reputed to be useful in the same affection for which its European congener has so long been celebrated, viz., in *pulmonary catarrh;* and a syrup made with the latter species is, in France, an ordinary flavoring addition to expectorant mixtures. It is demulcent and slightly stimulant.

ÆTHER, *U. S.*, *Br.*—ETHER.

Æther sulphuricus, Naphtha vitrioli.—*Sulphuric ether*, E.; *Ether hydrique s. vinique s. sulfurique*, Fr.; *Æther, Schwefeläther*, G.

Ether of the specific gravity 0.750 (*U. S.*), 0.735 (*Br.*), 0.728 (*P. G.*), 0.720–0.725 (*Cod. Fr.*).

ÆTHER FORTIOR, *U. S.*—STRONGER ETHER.

Æther purus, Br.—*Pure ether*, E.; *Ether hydrique pur*, Fr.; *Reiner Æther*, G.

Formula $(C_2H_5)_2O$. Molecular weight 74.

Preparation.—Take of Stronger Alcohol six pints; Sulphuric Acid thirty-six troyounces; Potassa three hundred and sixty grains; Distilled Water three fluidounces. To two pints of the alcohol, contained in a six-pint tubulated retort, gradually add the acid, stirring constantly during the addition. By means of a cork fitted to the tubulure, adapt a long funnel-shaped tube, with the lower end drawn out so as to form a narrow orifice, and reaching nearly to the bottom of the retort, and also a thermometer tube, graduated from 127° to 149° C. (260° to 300° F.), with its bulb reaching to the middle of the liquid. Having placed the retort on a sand-bath, connect it with a Liebig's condenser, and this with a well-cooled receiver. Then raise the heat quickly until the liquid boils, and attains a temperature between 130° and 138° C. (266° and 280° F.). By means of a flexible tube, connected with the stopcock of an elevated vessel containing the remainder of the alcohol, introduce that liquid into the retort, through the funnel-shaped tube, in a continuous stream; the quantity supplied being so regulated, that the temperature of the boiling liquid shall continue between the degrees mentioned. After all the alcohol has been added, proceed with the distillation until the temperature rises to 141° C. (286° F.), when the process should be discontinued. To the distilled liquid add the potassa, previously dissolved in the distilled water, and shake them occasionally together. At the end of twenty-four hours, pour off the supernatant liquid, introduce it into a retort, and, with a gentle heat, distil into a well-cooled receiver three pints, or until the liquid attains the specific gravity 0.750. Lastly, keep the ether in a well-stopped bottle. *U. S.*

Take of Rectified Spirit fifty fluidounces; Sulphuric Acid ten fluidounces; Chloride of Calcium ten ounces; Slaked Lime one-half ounce; Distilled Water thirteen fluidounces. Mix the sulphuric acid with twelve fluidounces of the spirit in a glass matrass capable of containing at least two pints, and, not allowing the mixture to cool, connect the matrass, by means of a bent glass tube, with a Liebig's condenser, and distil with a heat sufficient to maintain the liquid in brisk ebullition. As soon as the ethereal fluid begins to pass over, supply fresh spirit through a tube into the matrass in a continuous stream, and in such quantity as to equal the volume of the fluid which distils over. For this purpose use a tube furnished with a stopcock to regulate the supply, connecting one end of the tube with a vessel containing the spirit raised above the level of the matrass, and passing the other end through a cork fitted into the matrass. When the whole of the spirit has been added, and forty-two fluidounces have distilled over, the process may be stopped. Dissolve the chloride of calcium in the water, add the lime, and agitate the mixture in a bottle with the impure ether. Leave the mixture at rest for ten minutes, pour off the light supernatant fluid, and distil it with a gentle heat until a glass bead of specific gravity 0.735, placed in the receiver, begins to float. The ether and spirit retained by the chloride of calcium and by the residue of each rectification, may be recovered by distillation and used in a subsequent operation. *Br.*

Etherification.—When alcohol and sulphuric acid are mixed, one molecule of each compound unites to form sulphovinic acid and water. $C_2H_6O + H_2SO_4$ yields $C_2H_5HSO_4$ (sulphovinic acid) $+ H_2O$. On the application of heat and in the presence of a fresh portion of alcohol, a further reaction takes place whereby sulphuric acid is reproduced and ether formed, the latter distilling over. $C_2H_5HSO_4 + C_2H_6O$ yields H_2SO_4 and $(C_2H_5)_2O$. The apparent result of the entire reaction, it will be noticed, consists in the abstraction of one molecule of water from two molecules of alcohol, the remaining elements forming one molecule of ether, while the sulphuric acid remains free, merely determining by its affinity for water the decomposition of the alcohol. The incorrectness of such an explanation of etherification is readily demonstrated by the different products of decomposition obtained in case the supply of alcohol is insufficient or the sulphuric acid is used in excess, when oil of wine, sulphurous acid, olefiant and other gases are generated (see Oleum æthereum).

By calculation upon the above equation for the production of sulphovinic acid, it will be found that two parts of sulphuric acid require nearly one part of stronger, and subsequently the same weight of alcohol to again decompose all the sulphovinic acid with the production of ether. However, if the whole amount of the alcohol is added at once, a considerable portion of it will distil over before the temperature of etherification has been attained. In practice, the addition of about ten per cent. of the second part of alcohol has been found most advantageous, making the proportion of acid and alcohol 9 parts of the former to 5 parts of the latter. This proportion has been adopted in the British Pharmacopœia; in the United States authority a somewhat larger amount, about six parts, of alcohol is directed for nine parts of sulphuric acid. If the quantity of alcohol is increased beyond the proportions given, the boiling point of the mixture will be lowered and a proportionate amount of alcohol will distil over with the ether. On the other hand, a reduction of the alcohol below the proportions indicated will result in an increase of the boiling temperature, and the production of a larger or smaller amount of the decomposition-products mentioned above.

As the ether distils over, a sufficient amount of alcohol is admitted into the retort so as to maintain the original proportion of the two liquids. This part of the process requires careful attention, and is determined either by comparing the bulk of the alcohol with that of the distilled ether, or more practically by keeping the boiling point of the liquid in the retort between the limits given in the United States process. If the boiling point should rise above 138° C. (280° F.), the supply of alcohol is insufficient, and if the temperature should fall below 130° C. (266° F.), alcohol has been added too freely and the excess must be removed by cutting off its flow, either partly or entirely, until the proper temperature has again been reached.

Since, in the formation of ether, sulphuric acid is continually regenerated, its power of etherification is theoretically unlimited; practically, however, it ceases when about five or six times its weight of alcohol have been subjected to its influence. The main cause for this limit is found in the water, which, in the course of the process, accumulates in the retort and weakens the sulphuric acid. In the beginning of the distillation, a considerable proportion of the liberated water comes over with the ether, so that the distillate separates into two layers. As the acid in the retort becomes weaker, a larger proportion of alcohol evaporates with the ethereal and aqueous vapors, so that after some time the distillate will be found to be a clear and uniform mixture of ether, alcohol, and water. The two Pharmacopœias do not direct the preparation of ether to be pushed to the utmost limit of the etherizing power of the sulphuric acid, but when about double its weight of alcohol has been used, the process is discontinued.

The crude ether obtained by the Pharmacopœia process consists of ether, alcohol, and water; but contains, besides these, variable proportions of other decomposition-products, among which sulphurous acid, oil of wine, and occasionally acetic acid are found. The acids are removed by agitating the crude product with an alkali—potassa or lime—in the presence of water, the latter serving also the purpose of abstracting much of the alcohol from the ethereal liquid. To avoid the loss of too large a quantity of ether, the U. S. Pharmacopœia employs a small quantity of water, while the British Pharmacopœia uses instead a larger proportion of a nearly concentrated solution of calcium chloride, which dissolves the alcohol, but only a small quantity of ether. When the aqueous liquid after sufficient agitation has subsided, the ether is drawn off and rectified until the distillate has the proper specific gravity, which is conveniently ascertained, according to the British Pharmacopœia, by keeping in the receiver a glass bead of the proper density, which will begin to float as soon as the density of the distillate is the same. This rectification is best performed by placing the retort in a water-bath, the heat of which is carefully regulated, so that the ebullition never becomes violent, in which case the vapors are apt to escape condensation and to become ignited. The condenser should be capacious and well cooled whenever ether is distilled.

Older Theories.—The oldest view of chemists was that sulphuric acid, by its greater affinity, abstracts water from the alcohol and leaves ether. Berzelius explained the action of sulphuric acid upon alcohol by catalytic force. Liebig regarded sulphovinic acid as a double sulphate of water and ethylic oxide (ether), which is decomposed by heat, with the liberation of ether. Rose explained this decomposition by water displacing the ether from the compound mentioned. Graham ascribed the result to the polymerizing power of sulphuric or sulphovinic acid, whereby alcohol $= C_2H_2 + HO$ (old notation), is converted into ether $= C_4H_4 + HO$. According to Robiquet (1854), carbylic sulphate $= C_2H_42SO_3$, and water are first formed, and these, with alcohol, yield ether and sulphuric acid, thus, $C_2H_42SO_3 + 2H_2O + C_2H_6O = C_4H_{10}O + 2H_2SO_4$. The theory explained at the beginning of this article was first advanced by Williamson (1850 to 1854), and is supported by the discovery of ethers containing two distinct alcohol radicals.

STRONGER ETHER.—Take of Ether, Water, each three pints; Chloride of Calcium in fine powder, Lime in fine powder, each a troyounce. Shake the ether and the water thoroughly together, and, when the water has subsided, separate the supernatant ether. Agitate this well with the chloride of calcium and the lime in a well-stopped bottle, and allow the mixture to stand for twenty-four hours. Then decant the ether into a retort, and, having adapted thereto a Liebig's condenser, distil a pint and a half of stronger ether into a receiver refrigerated with ice-cold water. Lastly, keep the liquid in a well-stopped bottle. By continuing the distillation, a portion of weaker ether may be obtained (*U.S.*).

Take of Ether and Distilled Water, each two pints; Lime recently burned one-quarter of an ounce; Chloride of Calcium four ounces. Put the ether with one pint of the water into a bottle, and shake them together; allow them to remain at rest for a few minutes, and, when the two liquids have separated, decant off the supernatant ether; mix this with the remainder of the water, and again, after separation, decant as before. Put now the washed ether together with the lime and chloride of calcium into a retort to which a receiver is closely attached, let them stand for twenty-four hours, then distil with the aid of a gentle heat (*Br.*).

The object of these processes is the removal of alcohol by agitating the ether with water, the last portions of which, together with nearly the whole of the remaining alcohol, are afterwards separated by the calcium chloride and lime, the latter of which should be used unslaked. The distillation may be continued as long as ether of the proper specific gravity is obtained. The weaker ether, recovered by continuing the distillation, may be reserved for a subsequent operation.

Properties. 1. ABSOLUTE ETHER.—It is a colorless, very limpid, not solidifiable liquid, of a strong refractive power, and having a specific gravity of 0.710 at 20° C. (68° F., Richter), to 0.712 at 25° C. (77° F., Gay-Lussac). It has a peculiar penetrating odor, and a sweetish, pungent taste. It boils at 34° to 35° C. (93° to 95° F.), the vapors having a specific gravity of 2.58, and volatilizes very rapidly at ordinary temperature, thereby producing a considerable diminution of temperature. It is easily ignited, and burns with a bright flame, yielding water and carbonic acid. Its vapor mixed with a large quantity of air, if ignited, explodes with great violence. In consequence of this property, and of the great density of its vapor, great care should be exercised in handling ether or manipulating with it in the vicinity of a flame. It dissolves phosphorus, sulphur, iodine, bromine, some metallic sulphides, chlorides, bromides, and iodides, bromoform, iodoform, chloroform, alcohols, fats, volatile oils, many resins, most alkaloids, and some organic acids. When shaken with an equal bulk of water, it loses one-fourteenth of its volume, which is dissolved by the water, a little of this liquid being dissolved by the ether (*Boullay*).

2. STRONGER OR OFFICINAL PURE ETHER.—Its density does not exceed 0.720 (*Br.*). It has a specific gravity not exceeding 0.728. It is extremely inflammable, and does not redden litmus. Shaken with an equal bulk of water, it loses from one-tenth to one-eighth of its volume. It boils actively in a test-tube, half-filled with it, and inclosed in the hand, on the addition of small pieces of glass. Half a fluidounce of the liquid, evaporated from a porcelain plate by causing it to flow to and fro over the surface, yields a faintly aromatic odor as the last portions pass off, and leaves the surface without taste or smell, but covered with a deposit of moisture (*U. S.*).

3. OFFICINAL ETHER.—Its specific gravity is 0.750 (0.735, *Br.*). It evaporates without residue, does not redden litmus, and when shaken with an equal bulk of water loses one-fifth to one-fourth of its volume.

Hager gives the following table showing the percentage by weight of ether of the specific gravity 0.7185, contained in the alcoholic distillates, obtained in the rectification of ether. Temperature 17.5° C. (68.5° F.).

Per ct. ether.	Specific gravity.	Per ct. ether.	Specific gravity.	Per ct. ether.	Specific gravity.	Per ct. ether.	Specific gravity.	Per ct. ether.	Specific gravity.
99	0.7198	89	0.7290	79	0.7397	69	0.7516	59	0.7640
98	0.7206	88	0.7300	78	0.7408	68	0.7528	58	0.7653
97	0.7215	87	0.7310	77	0.7420	67	0.7540	57	0.7666
96	0.7224	86	0.7320	76	0.7432	66	0.7552	56	0.7680
95	0.7233	85	0.7331	75	0.7444	65	0.7564	55	0.7693
94	0.7242	84	0.7342	74	0.7456	64	0.7576	54	0.7707
93	0.7251	83	0.7353	73	0.7468	63	0.7588	53	0.7721
92	0.7260	82	0.7364	72	0.7480	62	0.7601	52	0.7735
91	0.7270	81	0.7375	71	0.7492	61	0.7614	51	0.7750
90	0.7280	80	0.7386	70	0.7504	60	0.7627	50	0.7764

According to the same author 100 measures of water dissolve the following measures of ether of the densities stated: 8 meas. ether, sp. gr. 0.719–0.721; 10 meas. ether, sp. gr. 0.724–0.726; 13 meas. ether, sp. gr. 0.729–0.731; 16 meas. ether, sp. gr. 0.733–0.735; 20 meas. ether, sp. gr. 0.738–0.741; 23 meas. ether, sp. gr. 0.743–0.746; 26 meas. ether, sp. gr. 0.748–0.750.

The purity of the officinal ethers is determined by their properties, which must agree with those given above.

Pharmaceutical Uses and Preparations.—Ether, or pure ether, is used as a solvent for the removal of inert matter in preparing Digitalinum, Extract. ergotæ liquidum, Ext. stramonii, *Br.*, and Tinct. opii deodorata, *U. S.;* and as a solvent for obtaining Acid. tannicum, and the officinal Oleoresinæ (Extracta ætherea), *U. S.*, *Br.* It is also an ingredient in Collodium, Collodium flexile, *U. S.*, *Br.;* Collodium cum cantharide, *U. S.;* Liquor epispasticus, *Br.;* Oleum æthereum, *U. S.;* Spiritus ætheris, *Br.;* Spir. ætheris compositus, *U. S.*

Physiological Action.—Plants confined in an atmosphere of ethereal vapor lose their irritability, their color, and then their life. Insects are rapidly benumbed, apparently die, and, if the exposure is prolonged, die in reality. In birds and quadrupeds an excited intoxication is followed by oppression of the cerebral functions, anæsthesia with loss of muscular co-ordination, muscular relaxation, and complete insensibility, during which the urine and feces may escape; the capillaries are everywhere distended with blue or venous blood, respiration is suspended, and finally death takes place by arrest of the heart. In this series of phenomena, cerebration is first impaired, then anæsthesia precedes loss of motility, and last of all the movements of the respiratory muscles and those of the heart cease.

When a compound nerve-trunk is etherized in any part of its course, it loses its sensibility at all points beyond that of the application, although it may retain its motor power; but a prolonged application destroys this also. Introduced into the rectum, especially in the form of vapor, ether produces the same phenomena as when given by the stomach, or inhaled. The odor and taste of ether impregnate the flesh of animals for several days after they have inhaled it fully; and in the nervous centres is found a deficiency, and in the liver an excess, of fatty elements.

On man the primary impression of ether, even when smelled, is that of an agreeable nervous stimulant. On the skin it excites coolness if allowed to evaporate, but occasions irritation if retained. When swallowed it creates burning heat in the throat, œsophagus, and stomach, and a rapid intoxication like that of alcohol, but more intense and of shorter duration. When inhaled pure it excites at first cough and dyspnœa, but presently a prickling of the hands and feet, and exhilaration of spirits, with a peculiar perception of lightness, while the senses all become perverted or blunted: that of touch much less so than the sense of pain, so that severe injuries may be received without their being felt, and brief operations may at this stage be advantageously performed. The muscular system gradually becomes relaxed, while the consciousness is growing more perverted or obscured. Meanwhile the pulse and respiration are generally quickened, the skin becomes warm and moist, and the pupils are contracted, but, as complete unconsciousness and anæsthesia supervene, general relaxation is more or less rapidly displayed, the pupils are dilated, the respiration is slow and deep, the pulse infrequent and feeble, the skin cool and moist, and sometimes cyanotic. This state continues only for a few moments after the vapor ceases to be inhaled; consciousness returns almost suddenly, but numbness and weakness remain for some time longer. Of occasional after-effects may be mentioned congestion of the brain or lungs, various hysterical phenomena, and more rarely epileptiform or tetanoid symptoms, but these effects are exceedingly rare when the ether is pure, and skilfully given. In appropriate cases, and properly administered, we believe pure sulphuric ether to be beyond all comparison the safest of anæsthetic agents employed in general surgery, and that when these conditions have been observed there is not a single authenticated example of its having destroyed life.

Medical Uses.—The inhalation of the vapor of ether has in a great measure supplanted its earlier administration in a liquid form, but the latter should not be neglected. It may be given to alleviate nervous *headache*, and the pain of flatulent, renal, and hepatic *colic*, spasmodic *vomiting*, and *asthma*, and to prevent or subdue the paroxysms of *hysteria*. Even puerperal *mania* has been held in check by ethereal enemata. It is occasionally indicated as an adjuvant to alcohol in the *typhoid state* of febrile affections, particularly when some temporary exhaustion calls for a transient but vigorous stimulation. In the treatment of *tape-worm* a full dose of ether to stupefy the parasite so as to facilitate its expulsion by means of castor oil, given directly afterwards, is sometimes successful; and so are enemata of ether in destroying *ascarides* of the rectum. Ether has been used for a long time in conjunction with oil of turpentine, and also of castor oil, with a view of removing *biliary calculi* by dissolving them. The efficacy of the treatment, if real, may depend in part upon the local anæsthetic action of the medicine, but some authorities entitled to respect maintain the reality of its solvent operation also. Whatever view of the mode of action may be entertained, it is certain that ether very frequently removes the symptoms of biliary calculi. The difficulty of digesting cod-liver oil and other forms of fatty food in pulmonary *phthisis* has been supposed to depend upon a deficiency of pancreatic juice, and the crude condition in which such food is brought into contact with that secretion. It is claimed that ether, by emulsifying the oil, and also stimulating the stomach and duodenum and thereby increasing the flow of pancreatic juice, renders the aliment much more assimilable than it would otherwise be. It is also claimed that in practice these views have received the confirmation of experience, and that by the use of ether after taking the food in question, it is fully and easily digested, and that the objects of its administration, the increase of the patients' weight and the abatement of the pulmonary symptoms, are secured. The scientific adaptation of the medicine to the purpose in view is very complete, but, like other remedies proposed on similar grounds, and by their proposers regarded as fulfilling their object, this one does not appear to have been found successful. On the contrary, the unpleasant taste of ether, whether given separately or combined with the oil, and the offensive eructations to which it gives rise, render a continued use of it difficult if not impossible, and evidence is wanting to confirm the results at one time attributed to it.

Besides being taken internally, ether in its liquid form is applied externally to produce anæsthesia, or by the cold it occasions in evaporating to cause a contraction of the tissues. With the former object it is familiarly used to relieve the pain of neuralgic *headache*, and also when applied over the superficial portions of nerves to palliate *neuralgia*. It affords prompt relief in *toothache* from carious cavities, especially when associated with camphor, and also in *earache* when applied on cotton with oil, or in the form of vapor. In some cases of *deafness* due to a rheumatic condition of the auditory canal it is said to have been curative. In irritative congestion of the retina, and *photophobia* generally, a little ether allowed to evaporate from cotton-wool, so placed in the hollow of the hand as to cover the eye at the distance of an inch or two, affords decided relief. The refrigerant action of ether is best shown in some cases of *hernia* strangulated by a mere excess of blood in the tumor; it contracts the tissues, expels the blood, and permits the reduction of the bowel.

Ethereal inhalation is employed to produce anæsthesia, and thereby, according to its degree, to relieve pain, relax muscular tension and spasm, or produce unconsciousness. In *surgery*, it permits the performance of operations which would without it be inexpedient or impracticable, both by abolishing the sense of pain and preventing the struggles of the patient, and hence it has probably diminished the mortality of grave surgical operations. Age is no contraindication to its use; but it should rarely be employed when there is disease of the lungs, brain, or heart, or when the sensations of the patient are needful to guide the surgeon's hand. Operations upon the fauces and nasal passages involving the flow of blood are embarrassed, and may be rendered dangerous, by anæsthesia; it is unfavorable to success whenever the voluntary muscular action of the patient is required; it is unnecessary when the duration of an operation is short, or its severity is insignificant. In general, the severer the operation the less danger of accident is there from inhaling ether; the greater number of cases with alarming symptoms have occurred where the operation was trivial, as in the extraction of teeth, the opening of abscesses, etc. In *obstetrics* the inhalation of ether robs the throes of *labor* of their acutest pain, and hence lessens the exhaustion of the patient, and in tedious and complicated labors, in cases of great tenderness or rigidity of the maternal organs, of unusual susceptibility to pain and great nervous irritability, in labors requiring manual or instrumental interference, and in *puerperal convulsions*, anæsthesia by ether has long been and continues to be a precious remedy. It does not involve any risk of injury either to child or mother if judiciously employed, while by lessening the rigidity of the os uteri and perineum without impairing the strength of the expulsive efforts, it facilitates and shortens labor. It is the best palliative for after-pains. For all of the purposes mentioned except those which involve operations on the interior of the uterus, it is unnecessary to produce the narcotic degree of anæsthesia.

The diseases which call for anæsthesia include all painful and spasmodic affections, *e. g.*, *neuralgia*, *dysmenorrhœa*, *gout in the stomach*, *biliary* and *nephritic colic*, *tetanus*, *chorea*, *hysteria*, puerperal and other reflex *convulsions*, *whooping-cough*, *spasmodic croup*, *laryngismus stridulus*, *delirium tremens*, *mania*, etc. In all of these it eliminates one or the other, or both, of the symptoms which tend to exhaust the patient, by repressing their organic causes.

Local anæsthesia may be produced by projecting upon the skin a stream of atomized pure ether, or of ether and chloroform. The former is preferable from the rapidity of its action and the complete congelation it produces, so that a variety of surgical *operations* may be performed by its aid without inflicting pain. Among them are not only such minor ones as opening abscesses, the evulsion of nails, the excision of nævi, hemorrhoids and other small tumors, and the amputation of fingers, the incision of carbuncles, fistulæ, etc.; but this method has also been applied to the removal of large tumors of the skin, breast, etc., to amputations, ovariotomy, Cæsarean section, etc. The latter uses indicate rather the extreme limits of its application than its practical utility. Local anæsthesia of the lumbo-sacral region by ethereal vapor has been used to mitigate the throes of labor; of the hypogastric region to arrest uterine hemorrhage and promote contraction of the uterus; to facilitate the reduction of *hernia* and of *paraphimosis;* to relieve the pain of neuralgia by a direct action; and the spasms of *chorea* and other spasmodic affections by its application to the spine.

Administration.—The average dose of sulphuric ether is a fluidrachm. It may be administered upon powdered sugar and rapidly swallowed with a mouthful of water. Smaller doses may be given by incorporating it with syrup or spermaceti, and diluting the mixture with water or mucilage which should be made cold by ice if possible. It has also been administered in gelatine capsules. Ethereal inhalation should not be used while the stomach contains food. It is most conveniently employed by means of a sponge saturated with ether and inclosed in a cone made of a napkin or of coarse paper and large enough to cover the nose and mouth of the patient. Or if the napkin alone be employed, the ether may be poured freely upon its internal surface. The capital precept in etherization is to produce anæsthesia as rapidly as possible, by overwhelming the patient with as much of the vapor as he can possibly inhale. Care must be taken not to allow the contact of flame with the ethereal vapor.

ÆTHER ACETICUS, *Br. Add.*—ACETIC ETHER.

Naphtha aceti.—Ether acètique, Naphte acètique, Fr.; *Essigäther, Essignaphtha,* G.

Formula $C_2H_5C_2H_3O_2$. Molecular weight 88.

Preparation.—It may be obtained by distilling a mixture of eight parts of dry acetate of sodium, five parts of rectified spirit, and ten parts of sulphuric acid, adding the distilled product to half its weight of chloride of calcium, in a stoppered bottle; letting them remain together for twenty-four hours, and then decanting and rectifying the ethereal liquid. *Br. Add.*

The first step in this process is to dehydrate the crystallized acetate of sodium by exposing it to a temperature gradually increased to about 110° C. (230° F.), until it ceases to lose weight; the water which is thus expelled is nearly 10 per cent. of the weight of the crystallized salt. The remaining operation may be performed in two ways, so that the distillation of the ether may be effected either at once or after some time. If the first is desired, the dry coarsely-powdered salt is introduced into a retort of sufficient size, which is connected with a good condenser; the alcohol is then added through a funnel tube inserted in the tubulure, and afterwards the sulphuric acid in small quantities. If the latter is added too rapidly, the mixture will become too hot and much alcohol will distil over; should this occur, it is to be returned to the retort. The mixture may then at once be distilled from a water-bath.

It is sometimes desirable to proceed in another way, by first forming sulphovinic acid. The sulphuric acid is gradually added to the alcohol contained in a flask, and the mixture digested for some time, care being taken to avoid the loss of alcohol, when it may be poured upon the sodium acetate contained in the retort. The distillation of acetic ether will commence at once, and should be continued until a dry mass remains behind.

The distillate contains, besides acetic ether, water, some alcohol, and acetic acid. To remove the latter, some carbonate of calcium or prepared chalk is added in slight excess and agitated with the liquid until effervescence ceases; acetate of calcium is thus formed, which dissolves in the liquid. Dry chloride of calcium, broken into small pieces, is now added gradually, to prevent the liquid from becoming heated. It will combine with the water, forming a dense solution, which also contains the calcium acetate and nearly all the alcohol of the distillate. After repeated agitation, the acetic ether is allowed to separate, when it is removed from the watery liquid and rectified from a clean retort or flask which is placed in a water-bath kept at a temperature of about 90° C. (194° F.).

In both the above manipulations sulphovinic acid is first formed (see page 104), one molecule of which reacts with one molecule of sodium acetate, producing acid sulphate of sodium and acetic ether, according to the equation $C_2H_5HSO_4 + NaC_2H_3O_2 = NaHSO_4 + C_2H_5C_2H_3O_2$ (acetic ether).

The weights of the different ingredients given above are very nearly the theoretical proportions. An excess of sodium acetate would cause the first distillate to be contaminated with free acetic acid, while an excess of sulphuric acid and alcohol would result in the production of ethyl oxide (ether). Any other acetate in an equivalent proportion may be substituted for the sodium acetate.

In acetic ether the basylous H of acetic acid is replaced by the basylous radical C_2H_5, forming a compound having the above formula.

Properties and Tests.—Acetic ether is a colorless, limpid, volatile liquid having an agreeable refreshing ethereal odor. It has the specific gravity 0.90 (0.91, *Br.*), and boils at 74° C. (165.2° F.). It is very inflammable, though less so than ether, and burns with a yellowish-white flame and the odor of acetic acid vapors. It dissolves in all proportions of alcohol and ether, and in 11 or 12 parts of water at 15.5° C. (60° F.). It has a neutral reaction to test-paper, but if kept in contact with the air, and particularly in the presence of water, free acetic acid is formed. Solutions of potassa, soda, and other oxides decompose it gradually or rapidly, if heated, into acetic acid and alcohol. It dissolves a little phosphorus and sulphur, and is a good solvent for volatile and fixed oils, many resins, cantharidin, and other organic compounds.

The *purity* of acetic ether is determined by its neutral reaction, its specific gravity, its volatility without residue, and its solubility in the quantity of water given above. If soluble in less water, the presence of too large a proportion of alcohol is to be inferred.

Physiological Action and Medical Uses.—According to Dr. H. C. Wood, in pigeons and rabbits it produces perfect unconsciousness, without as much previous struggling as when sulphuric ether is used, and has the advantage over that compound of being less inflammable. On the other hand, its volatility is less. On account of its pungency and agreeable odor, and its stimulant and antispasmodic qualities, it is used for several of the minor purposes of sulphuric ether, and especially to stimulate the nasal passages in cases of *syncope* and *nervous agitation.* Its vapor may also be inhaled under similar circumstances, and to allay *laryngeal and bronchial irritation* and *nervous cough.* It may be given internally for the relief of *colic* and *flatulence*, in the dose of thirty minims or more, properly diluted. Externally, it may be applied in all the cases in which sulphuric ether is appropriate.

ÆTHER FORMICICUS.—Formic Ether.

Ether formique, Fr.; *Ameisenæther*, G.
Formula $C_2H_5CHO_2$. Molecular weight 74.

Preparation.—It was first obtained by Bucholz (1782), and is conveniently prepared, according to Kopp, by mixing in a retort eight parts of dry sodium formiate with seven parts of alcohol of 88 per cent., and adding eleven parts of strong sulphuric acid. On the addition of the acid, enough heat is usually produced to volatilize the ether. The distillate, if acid, is agitated with an equal bulk of water, containing lime or magnesia in suspension, and after separation rectified from chloride of calcium.

Properties.—Formic ether is a colorless, thin, inflammable liquid, of a strong, agreeable odor suggesting that of peach-kernels, and a pungent taste. Its density at 17° C. (62.8° F.) is .918; its boiling point at 53° C. (127.4° F.). It dissolves in 9 parts of water and in all proportions in alcohol, methylic alcohol, ether, fixed and volatile oils.

Physiological Action.—Byasson made experiments with this compound upon dogs, rats, and guinea-pigs. He regarded it as readily undergoing decomposition into alcohol and alkaline formiates through the alkali of the blood. When inhaled it lowers the temperature as much as $3\frac{1}{2}$° C., induces signs of asphyxia, but not so marked as those caused by chloroform, and causes muscular relaxation and anæsthesia. The effects persist for several hours. Hypodermic injections of 1–2 c. c. in guinea-pigs and rats, and of 4–6 c. c. in dogs, produce a less degree of asphyxia, but more somnolence, lowering of temperature, and a diminution but not a complete suppression of sensibility. In man six or eight grams occasion no other symptom than drowsiness. The urine contains formic acid.

ÆTHER HYDRIODICUS.—Hydriodic Ether.

Iodide of ethyl, E.; *Ether hydriodique, Iodure d'éthyle*, Fr.; *Jodwasserstoff-äther, Jodäthyl*, G.

Formula C_2H_5I. Molecular weight 156.

Preparation.—This ether was prepared by its discoverer, Gay-Lussac (1815), by distilling a mixture of absolute alcohol and concentrated hydriodic acid, and separating the ether from the distillate by means of water. Much better results are obtained by distilling a mixture of alcohol, phosphorus, and iodine, as proposed by Serullas (1827); and the substitution of amorphous for ordinary phosphorus, first used by Personne (1861), affords still greater advantages. Rieth and Beilstein (1863) obtained the best results by macerating for twenty-four hours a mixture of 10 parts of amorphous phosphorus, 50 parts of alcohol, specific gravity .83, and 100 parts of iodine, the latter added in small quantities; the mixture is then distilled, the distillate decolorized by a little solution of soda, and freed from water by rectification over chloride of calcium. The residue in the retort from the first distillation consists of phosphoric acid, the reaction occurring according to the following equation: $5I_2+P_2+10C_2H_6O$ yields $10C_2H_5I+2H_3PO_4+2H_2O$.

Properties.—Hydriodic ether is a colorless, non-inflammable liquid, having a peculiar penetrating odor. It is freely soluble in alcohol, nearly insoluble in water, does not react upon litmus, boils at 70° C. (158° F.), and has at 15° C. (59° F.) the specific gravity 1.93. Exposed to air and light, it liberates iodine, and is gradually colored red and brown; the presence of metallic mercury prevents the coloration, but not the decomposition. Iodine is also liberated by chlorine gas, nitric acid, and strong sulphuric acid.

Medical Action and Uses.—Hydriodic ether has been used by inhalation to bring the system speedily under the influence of iodine, and especially in chronic *bronchitis* and pulmonary *phthisis*. It, doubtless, contributes to diminish the bronchial secretions. Ten or fifteen drops may be inhaled several times a day from a handkerchief or an appropriate respirator.

ÆTHER HYDROBROMICUS.—Hydrobromic Ether.

Bromide of ethyl, E.; *Ether hydrobromique* (*bromhydrique*), *Bromure d'éthyle*, Fr.; *Bromæthyl, Bromwasserstoff-æther*, G.

Formula C_2H_5Br. Molecular weight 109.

Preparation.—Serullas (1827), the discoverer of this ether, recommended its preparation by the action of bromine upon alcohol in the presence of phosphorus. Personne (1861) replaced the latter by amorphous phosphorus. Prof. Remington (1877) suggests the following modification of Personne's process: thirty-three parts by weight of absolute alcohol are introduced into a flask or retort, which is placed in ice; when thoroughly cooled, six parts of amorphous phosphorus are added, and afterwards twenty-six parts of bromine dropped in, with the precaution of avoiding too great an elevation of temperature. The mixture is allowed to stand twenty-four hours, and then distilled; the distillate is washed with water, and if acid, with a little alkali; and finally rectified over chloride of calcium. The residue in the retort is phosphoric acid; the reaction is analogous to that produced in preparing hydriodic ether.

Properties.—Hydrobromic ether is a colorless, very volatile liquid, of a strong ethereal odor, and a sweetish and warm taste. It has the density 1.419 at 15° C. (59° F.), boils at 40.7° C. (105.2° F.), burns with some difficulty with a green, non-sooty flame, is sparingly soluble in water, and dissolves in all proportions in alcohol and ether.

Physiological Action.—Hydrobromic ether is said to exhibit the same qualities as hydrochloric ether, when its vapors are inhaled, and to produce anæsthetic effects in animals without excitement or suffering. It does not appear to have been employed in medicine or surgery.

ÆTHER METHYLICUS.—Methylic Ether.

Oxyde of methyl, Hydrate of methylene, E.; *Æther méthylique, Oxyde de méthyl*, Fr.; *Methylæther, Holzæther, Formæther*, G.

Formula $(CH_3)_2O$. Molecular weight 46.

Preparation.—Dumas and Peligot, who discovered this ether in 1835, direct the preparing of it by distilling a mixture of one part of methylic alcohol and four parts of sulphuric acid, and purifying the gas by prolonged contact with caustic potassa, whereby carbonic and sulphurous acids are removed, and *methyl-sulphuric ether*, which has a garlic-like odor, is decomposed. Kane recommended the purification of the gas by passing it through milk of lime.

Properties.—Methylic ether is a colorless, inflammable gas, heavier than air, of an ethereal odor, and aromatic taste. It is soluble in water and strong sulphuric acid, and more freely in wood-spirit, alcohol, and ether. A solution in the latter liquid, saturated at 0° C. (32° F.), has been recommended by Dr. B. W. Richardson, under the designation of *methyl-ethylic ether*. It should be kept in well-corked bottles in a cool place.

Physiological Action and Medical Uses.—Being gaseous, and only feebly held in solution by alcohol, it is more readily absorbed than this liquid into the blood. Its anæsthetic operation is somewhat peculiar. A pigeon under a bell-glass filled with the vapor of this ether, or made to inhale it from a kind of respirator, falls into a quiet sleep without agitation or convulsion. Dr. Richardson, experimenting upon himself, observed that there was no preliminary spasm excited by it in the larynx or elsewhere, no rigidity, lividity, or other change of color. The pulse rose to 96; the anæsthesia was perfect, and was not preceded by convulsion, or followed by nausea. In some further experiments (upon guinea-pigs) the anæsthesia was carried as far as possible, and the respiration ceased several minutes before the heart stopped. After death the lungs were not congested; but the pulmonary veins, and both sides of the heart were filled with fluid blood, which was dark on the left side. In death by bichloride of methylene, the blood in the same cavity is light red. The repletion of the heart contrasts with the emptiness of its cavities in death by chloroform. According to Richardson it is a safe anæsthetic, yet is objectionable because it rapidly volatilizes from its solution, and its odor is more unpleasant than that of ether, chloroform, or bichloride of methylene.

ÆTHYLENI BICHLORIDUM.—Bichloride of Ethylene.

Æthylenum chloratum, P. G.; *Elaylum chloratum, Liquor Hollandicus.—Dutch liquid*, E.; *Liqueur des Hollandais, Huile du gas oléfiant*, Fr.; *Æthylen-chlorid, Elaylchlorid*, G.

Formula $C_2H_4Cl_2$, or, according to Regnault, $C_2H_3Cl.HCl$. Molecular weight 99.

Preparation.—Olefiant gas and Dutch liquid were discovered by Dieman, Troostwyk, Bondt, and Lauwernburgh (1795). The latter is produced on bringing the former in contact with chlorine gas. One part of strong alcohol is mixed with 3 or 4 parts of sulphuric acid, and sufficient sand to form a thick mixture, which is heated, and the gas passed successively through sulphuric acid, solution of potassa and sulphuric acid, whereby it is deprived of alcohol, ether, sulphurous and carbonic acids. The gas thus purified is conducted into a retort containing a mixture of 2 parts of black oxide of manganese, 3 of common salt, 4 of water, and 5 of sulphuric acid. The retort is at first very moderately warmed, and afterwards heated, until the liquid distils. The distillate is washed with water and rectified over chloride of calcium.

Properties.—It is a colorless, thin, oily liquid, having an ethereal odor resembling that of chloroform, and a sweetish ethereal taste; it has the specific gravity 1.270, boils at 85° C. (185° F.), is sparingly soluble in water, and freely soluble in alcohol and ether. It is inflammable, and burns with a yellowish flame, having a green border and giving off vapors containing muriatic acid. When agitated with water, the latter does not acquire an acid reaction to litmus paper, and when agitated with sulphuric acid, the mixture is not blackened.

Allied Compounds.—By the action of chlorine upon Dutch liquid, a number of chlorinated compounds may be obtained, which are isomeric with the chlorinated compounds produced under similar circumstances from *chloride of ethyl* or, as it is frequently termed, *muriatic* (*hydrochloric*) *ether.*

CHLORIDE OF ETHYL, C_2H_5Cl (molecular weight 64.5), is obtained by passing dry chlorine gas into cold strong alcohol, distilling at a very moderate heat, washing the distillate with water and a weak alkaline solution, and rectifying. It is a thin, colorless, inflammable liquid, having an ethereal odor and a sweetish aromatic, afterwards somewhat alliaceous taste. It dissolves in about 50 parts of water, boils at 11° C. (51.8° F.), and at 0° C. (32° F.) has the density .9214. If chlorine, not in excess, acts upon it,

MONOCHLORINATED HYDROCHLORIC ETHER, C_2H_4ClCl, is produced. It is isomeric with bichloride of ethylene, which it resembles in odor, but its density is only 1.174, and it boils at 64° C. (147.2° F.).

On continuing the action of chlorine, the following isomeric compounds are obtained from

	Ethyl chloride.	*Ethylene chloride.*
$C_2H_3Cl_3$.	Sp. gr. 1.372; boiling point 75° C. (167° F.).	Sp. gr. 1.422; boiling point 115° C. (239° F.).
$C_2H_2Cl_4$.	" 1.530; " " 102° C. (215.8° F.).	" 1.576; " " 135° C. (275° F.).
C_2HCl_5.	" 1.644; " " 146° C. (295° F.).	" 1.663; " " 154° C. (309.6 F.).
C_2Cl_6.	Prisms; fuse at 160° C. (320° F.), boil at 182° C. (360° F.); odor aromatic, camphoraceous.	

Physiological Action and Medical Uses.—When bichloride of ethylene was tested by Simpson, he found that although it was capable of producing anæsthesia without excitement of the pulse or subsequent headache, yet it caused so great irritation of the throat that few persons could persevere in breathing it long enough to induce the anæsthetic state. Other experimenters have reached the same conclusions, but it is generally agreed that the liquid does not tend to induce the dangerous collapse which constitutes the chief objection to chloroform. As a local anæsthetic this preparation has been applied to the seat of pain in *neuralgia*, and other limited painful parts such as occur in *cancer*, etc.

Chloride of ethyl, formerly known as muriatic ether, appears to be almost identical in its effects with sulphuric ether. Its extreme volatility, however, renders it unmanageable in practice, and even dangerous if used near a flame. It is sometimes dissolved in an equal bulk of alcohol, and dispensed as alcoholic muriatic ether, for the same purposes to which Hoffmann's anodyne is applied. It may be given in the dose of from ten to thirty drops in sweetened water, or in a little wine or spirit and water.

AGARICUS ALBUS.—WHITE AGARIC.

Fungus laricis, P. G.; *Boletus laricis.—Purging agaric*, E.; *Agaric blanc*, *Agaric purgatif*, Fr.; *Lärchenschwamm*, G.

Polyporus officinalis, *Fries*, s. Boletus laricis, *Lin.*

Nat. Ord.—Fungi.

Origin.—This fungus grows on old trunks of the European larch in Central and Southern Europe, and on *Larix sibirica*, Ledebour, in the northern section of Asia, whence it is brought into commerce. It is without a stalk, hoof-shaped or irregularly conical, externally grayish or yellowish; the hymenium on the lower side is in the form of small yellowish pores.

Description.—Agaric occurs in commerce in irregular pieces, which are deprived of the outer rind, and of the size of a fist, and frequently much larger. It is white, light, somewhat spongy, very friable, but not readily pulverizable, has a faint odor and a sweetish, afterwards acrid and lastingly bitter taste.

Substitution.—We have noticed (1875) a white insipid fungus, mixed with powdered agaric, to impart a bitter taste, sold in place of the medicinal drug. The substitute appeared to be a species of *Agaricus*, with a lamellate hymenium, the greater part of which had been removed. Another occasional substitute, according to Wiggers, is the cap of *Polyporus igniarius* dusted over with the powder of white agaric.

Constituents.—White agaric has been analyzed by Bucholz (1808), Bouillon-Lagrange, Trommsdorff, and Bley (1834); the boletic acid of the latter, according to Bolley and Dessaignes (1853), is identical with *fumaric acid*. The latter is obtained from several other fungi; also citric and malic acids, the mixture of which he considers to be Braconnot's *fungic acid*. Martius and Will (1846) separated *laricin*, $C_{14}H_{48}O_2$, in the form of a white, amorphous, bitter powder, soluble in alcohol and oil of turpentine, and forming a jelly with hot water. Fleury (1870) has obtained *agaric acid*, which crystallizes in needles, is freely soluble in strong alcohol, less so in ether, and almost insoluble in water. On exhausting agaric with boiling alcohol, Masing (1870) observed the separation, on cooling, of a slowly crystallizing fusible body, which dissolves readily in alkalies, but is less soluble in alcohol than agaric acid. The same author denies the presence of benzoic acid, observed by Bouillon-Lagrange; by the process of the latter he obtained an amorphous resin. The resins were further examined by Masing (1875); two are insoluble in cold alcohol and crystallizable; one of these is soluble in chloroform, and has a faintly bitter taste. The resin soluble in cold alcohol is brownish-red, intensely bitter, and readily soluble in chloroform, acetic acid, benzol, and amylic alcohol. Many fungi contain mannite, others mycose; which of the two is present in agaric has not been ascertained. The *agaricin* of Schoonbroodt (1864) has at first an insipid, afterwards sweet, bitter, and acrid taste, is insoluble in ether and sparingly soluble in water. It is obtained as a white crystalline powder by exhausting the alcoholic extract of white agaric with 50 per cent. alcohol, evaporating the solution, and crystallizing from alcohol containing a portion of ether.

Medical Action and Uses.—The ancients used agaric as a purgative in large doses, and as an astringent in small doses. In the former way, it is said to have produced watery stools and colic, with nausea and vomiting in some cases; and in the latter it was employed to check *diarrhœa*, and restrain *sweating*. It is for the last-mentioned purposes that it is now occasionally used, as well as to diminish excessive *bronchial secretion*. These three indications are often associated in pulmonary consumption, and in it, undoubtedly, it is one of the best palliatives hat can be used of the symptoms mentioned. It is said, also, to hasten the drying up of the *milk* in weaning. Agaric may be given in pill, in the dose of two or three grains, and repeated hourly, or less frequently, according to the urgency of the case. Prepared agaric is useful as an application to leech-bites and similar wounds, to arrest hemorrhage; and formed into cylinders it serves for moxas.

AGAVE.—American Aloe.

Century plant, E.; *Maguey*, E., Fr.; *Agave*, G.

Agave Americana, *Lin.* *Nat. Ord.*—Amaryllidaceæ.

Description.—The plant is indigenous to the tropical portion of America, has been introduced and naturalized in Southern Florida, and is frequently met with in cultivation in all parts of the globe, having spontaneously appeared in the warmer portions thereof. The leaves are all radical, curving backwards, about six feet long, thick and fleshy, lanceolate in shape, and at the apex and margins armed with sharp spines. The plant flowers in its native localities, usually in about ten years, but attains a considerable age before flowering in temperate climates, hence the name century plant; the rapidly growing flowering scape reaches a height of 30 to 40 feet.

Agave mexicana, *Lam.*, and A. vivipara, *Lin.*, are closely allied Mexican species.

Uses.—A translucent gum is obtained from it, known as *gum maguey*, which is partly soluble in water, the solution containing malate of calcium, besides a substance resembling arabin. The fibres of the leaves are strong and valuable for cordage. The juice of the plant, *aguamiel*, or honey-water, is saccharine, and is evaporated to the consistence of honey or wax, frequently fermented to yield a vinous acidulous beverage, which in Mexico is called *pulqué*, and by distillation, a kind of brandy known as *mezcal* or *aguardiente de maguey*. The roots are regarded as possessing alterative properties. For papers on the uses of Agave, the reader is referred to *Amer. Journ. Pharm.*, 1875, p. 78, and 1876, p. 301.

Agave Virginica, Lin., of the Southern United States, produces a scape about 4 or 5 feet high. Its roots are very bitter.

Medical Action and Uses.—The fresh juice of this plant is acidulous or acrid, and is said to be laxative and diuretic. A nearly allied species furnishes a juice from which, as above stated, the Mexican alcoholic drink *pulqué* is prepared; and in the Southern States of this country *A. Virginica* has a very bitter root, with which a tincture is made for the relief of *colic* and as an antidote to the *rattlesnake's bite*. This plant is known as *rattlesnake's master*.

AGRIMONIA.—Agrimony.

Herba agrimoniæ.—*Aigremoine, Eupatoire des Grecs*, Fr.; *Odermennig, Leberklette*, G.

Agrimonia eupatoria, *Lin.* *Nat. Ord.*—Rosaceæ, Roseæ.

Description.—An herbaceous perennial, about 2 feet high, indigenous to Europe and North America, and growing along roadsides and the border of woods. The root is fibrous, several-headed, and brown; the stem almost simple; the leaves about 5 inches long below, pinnate, with 4 to 8 pairs of elliptic-oblong, coarsely-toothed leaflets intermixed with several pairs of minute ones; the stipules semi-cordate, clasping, and coarsely serrate. The yellow flowers are rather small, in slender spicate racemes, and have a persistent top-shaped calyx, which is covered with hooked bristles. The plant flowers from June to September. It has a very faint aromatic odor, and a bitterish, mildly astringent taste, which is stronger in the root.

The closely allied *Agr. parviflora*, Ait., indigenous to the United States, is distinguished by smaller flowers and by crowded lanceolate leaflets, of which there are 11 to 19 pairs, intermixed with smaller ones.

Constituents.—H. K. Bowman (1869) determined agrimony to contain 4.75 per cent. of tannin; the other constituents are unknown.

Medical Action and Uses.—Common agrimony is astringent and stimulant, and is chiefly employed in popular medicine, in gargles for *sore throat*, as a wash for *ulcers* in man and beast, and internally for the cure of *intermittent fever*, *chronic fluxes* of the bowels, bladder, vagina, etc., and for passive *hemorrhages*. It is said to be used instead of Chinese tea by the peasantry of the north of France. It may be given in an infusion made with from one to four drachms in a pint of water. Externally, it may be employed in fomentations, poultices, injections, or gargles, and in the latter form with the addition of honey, vinegar, borax, or chlorate of potassium.

AILANTHUS.—TREE OF HEAVEN.

Chinese sumach, E.; *Götterbaum*, G.

Nat. Ord.—Simarubaceæ.

Description.—Three species are medicinally employed, of which two are natives of India and one, indigenous to China, is much cultivated in the United States and Europe as an ornamental tree. The latter is AILANTHUS GLANDULOSA, *Desf.* It is of rapid growth, producing a straight trunk, which is covered with a nearly smooth brown-gray, internally yellowish fibrous bark. The leaves are three or four feet long, oddly pinnate, with about fifteen pairs of leaflets, which are shortly petiolate, oblong or ovate-lanceolate with a few teeth near the base. The greenish polygamous flowers are in terminal panicles, and exhale an odor which is disagreeable to many persons. The pistillate flowers produce three to five linear-oblong, one-seeded samaras. This tree is known in France as *vernis des japon*, which name is also used for Rhus vernix, *Lin.*

The leaves are the favorite food of the silk-worm, *Bombyx cynthia;* the barks of the trunk and of the root have been employed medicinally; both have a persistently bitter taste.

AIL. EXCELSA, *Roxb.*, is a similar tree, with larger and broader leaflets. The bark, which is used as a tonic and febrifuge in India, is of a reddish or orange color internally, and has a very bitter taste.

AIL. MALABARICA, *D. C.*, has obliquely oblong and entire leaflets, and obtusely winged fruits. When incised, the bark yields a gum resin which has an aromatic odor, and is used as incense in India and medicinally in dysentery.

Constituents.—An analysis by Alonzo Lilly (1861) of the bark of the first species determined the presence of tannin and a trace of volatile oil, besides the widely distributed vegetable principles; the bitter principle was not isolated. The bark of the second species was analyzed by Marayan Daji (1870), who found the bitter taste to be due to the calcium salt of *ailanthic acid*, which like the lead salt is yellow, and soluble in water. The acid is uncrystallizable, freely soluble in water, insoluble in other solvents, of a waxy consistence, and reddish-brown color.

Medical Action and Uses.—The infusion, decoction, and tincture of the bark are said (Daji) to be useful in *anorexia*, *dyspepsia*, and atonic conditions generally of the digestive organs, such as those for which gentian, quassia, etc., are prescribed. The acid is said to provoke the secretion of bile when it is deficient. Ailanthus has been used in the treatment of *tæniæ* in dogs, and also in man, under the form of a powder of the bark or leaves, and also as a watery or an alcoholic extract of the bark, a resin and an oleo-resin. It has caused the expulsion of these parasites when given in substance in the dose of eight grains; or four grains of the watery extract; or three grains of the oleoresin. The resin alone is nearly inert. The extract occasions slight colic and moderate purging, and does not exhaust or depress like pomegranate or kousso.

AKAZGA.

Boundou; Ikaja; Quai.

Description.—This shrubby plant is indigenous to the equatorial region of Western Africa, and appears to be a hitherto unknown species of *Strychnos.* It is about six feet high, with a stem nearly an inch in diameter. The dense hard wood is covered with a firmly adhering bark having sometimes numerous yellow tubercles, of a yellowish-orange or in some parts light-red color, with a light-brown inner surface, and characterized by a continuous layer, three or four cells deep, of indurated parenchyma. The leaves are opposite, oval-acuminate in shape, and attain a length of three to six and even twelve inches. The seeds are subglobular, downy, about five-eighths of an inch in diameter, and contain albumen, with a central cavity into which the embryo with its five-ribbed cotyledons projects. The bark has a strongly bitter, faintly aromatic taste, and a distinct bitterness is also perceived in the other parts of the plant.

Constituents.—Thomas R. Fraser (1867) has obtained an alkaloid *akazgia* which crystallizes from its alcoholic solution, is readily soluble in chloroform, carbon bisulphide, benzol and ordinary ether, is colored brown by concentrated mineral acids, and dissolves in dilute acids yielding colorless salts, which are rather less persistently bitter than strychnia salts, and are precipitated by the bicarbonates of potassium and sodium; the precipitates occurring with the usual reagents for alkaloids are not crystalline.

Physiological Action.—It appears from the narrative of Professor Fraser, of Edinburgh, who carefully investigated the nature and action of akazga, that it is used as an ordeal in West Africa. "The supposed witch is obliged to drink a certain quantity of the infusion prepared from the bark, and to step over a number of akazga sticks placed parallel to one another at the distance of two feet. If this can be done, the person is pronounced innocent; if guilty, difficulty is experienced in stepping over the sticks; they appear like large logs, to surmount which suitable efforts are made, and these are rendered more and more difficult by spasmodic muscular twitches, until the victim staggers and ultimately falls in tetanic convulsions. . . In those cases in which the trial is successfully undergone, a copious flow of urine is described as occurring, and by this means the poison is supposed to be removed." The physiological action of the alcoholic extract of akazga, and that of the alkaloid akazgia, correspond to those of nux vomica and strychnia. Each grain of the alkaloid is equal to about seven grains of the extract or fifty grains of the dried bark, in physiological effects, which consist essentially in tetanic convulsions. As yet no therapeutical applications appear to have been made of akazga or its alkaloid.

ALBUMEN OVI, *Br.*

Egg albumen, White of egg, E.; *Blanc d'œuf,* Fr.; *Eiwiss,* G.

The liquid white of the egg of Gallus Banckiva var. domesticus, *Temminck.* (See Ovum, Egg.)

Medical Uses.—It forms insoluble and inert compounds with corrosive sublimate and sulphate of copper, and is therefore a convenient and efficient antidote in *poisoning* by these substances. Agitated with powdered alum it coagulates, and thus forms a convenient and very grateful poultice for local *erythemas, burns, contusions, excoriations, bites* and *stings* of insects, etc.; and confined in a thin bag it is a popular and useful application for acute inflammations of the *conjunctiva.*

ALCOHOL, *U. S.*—ALCOHOL.

Spiritus, P. G.; *Spiritus rectificatus*, Br.; *Spiritus vini rectificatissimus, Alcohol vini.—Rectified spirit*, E.; *Alcool*, Fr.; *Weingeist*, G.

Spirit of the specific gravity 0.835 *U. S.*, 0.838 *Br.*, 0.830 to 0.834 *P. G.*

ALCOHOL DILUTUM, *U. S.*—DILUTED ALCOHOL.

Spiritus tenuior, Br.; *Spiritus dilutus*, P. G.; *Spiritus vini rectificatus.—Proof spirit*, E.; *Alcool dilué*, Fr.; *Verdünnter Spiritus*, G.

Spirit of the specific gravity 0.941 *U. S.*, 0.920 *Br.*, 0.892 to 0.893 *P. G.*

ALCOHOL FORTIUS, *U. S.*—STRONGER ALCOHOL.

Alcool forte, Fr.; *Starker alcohol*, G.

Spirit of the specific gravity 0.817 *U. S.*

Formula C_2H_5HO. Molecular weight 46.

Fermentation.—Alcohol is formed only by the fermentation of saccharine liquids. Under the name of *fermentation*, various processes of decomposition are embraced, apparently depending upon the mere presence of a certain substance or compound, called the *ferment*, which does not enter into chemical composition with the fermenting substance or its products, and is capable of producing a large, if not unlimited quantity of the latter. The several varieties of fermentation are distinguished from each other by the products obtained. Accordingly we speak of *saccharine* fermentation, when starch is converted into dextrin and sugar by diastase; of *lactic* fermentation when milk-sugar is transformed into lactic acid by casein; of *butyric* fermentation, when milk-sugar and lactic acid yield butyric acid in the presence of the same compound; of *mucic* fermentation, when cane-sugar is changed into mucus and mannite by protein compounds; of *alcoholic* or *vinous* fermentation when grape sugar is split into alcohol and carbonic acid under the influence of yeast, and of *acetic* fermentation when alcohol is oxidized to acetic acid, for which process some investigators consider the appearance of mycoderma aceti as a ferment necessary. The decomposition of the numerous class of organic compounds, known as glucosides, by the action of emulsin, myrosin and similar protein compounds, and the action of ptyalin upon starch, of pancreatin upon fat, and of pepsin upon albumen, etc., are other instances of fermentation, induced and completed by the substances named which are the ferments.

The exact manner in which these ferments act has not yet been determined, and with respect even to the vinous fermentation is still a subject of controversy, notwithstanding the numerous experiments performed with the view of solving the problem. It is, however, now generally conceded, that under ordinary circumstances, the ferment of alcoholic fermentation is of vegetable origin, and is due to the so-called yeast-cells or yeast-plant, *Torula cerevisiæ*, the sporules of which are widely diffused in the air, and are thus easily supplied to all liquids capable of vinous fermentation; hence, if these spores are destroyed by boiling the liquid, and if their further supply is arrested by admitting only air which has been filtered, or passed through sulphuric acid, vinous fermentation does not take place.

According to Pasteur's patient investigations, extending through many years, alcohol and the other compounds formed during fermentation, are not merely decomposition-products of sugar, but result from the growth and multiplication of the yeast-plant, the existence of which depends upon the presence of sugar and protein, and by whose cells the new compounds are generated.

The formation of alcohol from sugar is expressed by the equation: $C_6H_{12}O_6$

(grape-sugar) yields $2CO_2+2C_2H_6O$ (alcohol); but the process does not appear to be so simple, since small quantities of succinic acid (about 0.6 per cent.), glycerin (3 per cent.), and cellulose (1 per cent.), are always formed, according to Pasteur. Amylic and other homologous alcohols are likewise produced in vinous fermentation.

Berthelot observed that mannite, glycerin, milk-sugar and other carbohydrates yield alcohol very slowly when in contact with water, chalk and casein.

Preparation.—Nearly all the ordinary alcohol is obtained from starchy substances, such as corn, rye, potatoes, etc., which require to be *mashed*, during which process the starch is converted into sugar (dextrose and lævulose, so named from their behavior to polarized light, and whose mixture is called *invert sugar*) by the gluten contained in grain, or by the diastase of the malt added with this object in view; this being accomplished, fermentation will speedily set in on the addition of yeast, if the temperature is kept at 22° C. (71.6° F.), or within the limits of 18° and 28° C. (64.4° and 82.4° F.). At a lower temperature, fermentation proceeds slowly, and at a higher temperature mucilage and lactic acid are apt to be formed. If too large a quantity of sugar is present, the fermentation will be arrested after some time, in consequence of the destruction of the vitality of the yeast-plant by the alcohol formed. A very favorable proportion is one part of sugar to four of water.

On subjecting the fermented liquid to distillation, a weak spirit is obtained which requires rectification, and contains small quantities of homologous alcohols or ethers, varying with the source from which the spirit has been obtained. *Potato spirit* contains amylic alcohol; *whiskey*, obtained from grain, contains, besides amylic alcohol, some œnanthic and other ethers; *brandy*, the distillate of wine, owes its odor to œnanthic and perhaps propylic and allied ethers; *rum*, from fermented molasses, to butyric ether; and *arrack*, from fermented rice, to an unknown compound. The odor of *gin* is imparted by distilling spirit with juniper berries; that of the so-called *kirsch*, or *kirschwasser*, by the seeds of cherries or plums added before fermentation; in this case it is due to hydrocyanic acid and oil of bitter almonds.

The *purification* of spirit is effected by percolating it through recently burned and granulated charcoal, by which the fusel oil is retained; this process is called *leaching*, and is most effectually accomplished if the spirit has been previously diluted. Distillation with various chemicals, with the view of destroying the fusel oil, has been suggested, and small quantities of manganates and permanganates have been used with success (manganate of sodium for Atwood's alcohol). Usually, however, the purification and concentration of the spirit are effected in one operation by distilling it and passing the vapors through a series of condensers kept at different temperatures, or through an upright column, in the lower part of which the fusel oil and water are condensed at a temperature at which the alcohol is not liquefied, but this is recovered subsequently in an ordinary condenser. The apparatus is constructed so as to permit an uninterrupted distillation, until the water finally has accumulated in the still.

The spirit, as obtained by the different processes of distillation, contains water, the first distillate being stronger, the later portions weaker in alcohol; the strongest spirit obtainable from an ordinary still with a single condenser has the specific gravity 0.825; with a system of condensers alcohol of the density 0.815 to 0.817 is obtainable. The last portions of water can be removed only by treating the alcohol with a substance having great affinity for water, for which purpose chloride of calcium and other deliquescent salts, anhydrous sulphate of copper, burned lime, etc., have been proposed. If chloride of calcium is used, the distillation must be slow and repeated two or three times. Lime is better adapted for the purpose, if broken into pieces and digested with the alcohol for a day or two, or boiled with it for an hour, previous to distillation. The distillate, the first part of which is weaker than the subsequent portions, contains lime which has been mechanically carried over, and will be left in the retort if the alcohol is again rectified with the addition of a little tartaric acid. For some practical observations on the rectification of alcohol by means of lime, the reader is referred to the *Amer. Journ. of Pharmacy*, 1872, p. 111, and 1874, p. 184.

Properties.—Spirit containing 50 per cent. by volume of absolute alcohol and water, and having the specific gravity 0.936 at 15.55° C. (60° F.), has been adopted as the standard *proof spirit* of the United States custom-house and internal revenue service. *Second proof* is 52½ per cent. alcohol, specific gravity 0.931. *Third proof* 55½ per cent. alcohol, specific gravity 0.925. *Fourth proof* 58 per cent. alcohol, specific gravity 0.920. The British proof spirit has the specific gravity 0.920.

When alcohol is mixed with water, an elevation of the temperature is observed, and when the mixture has cooled to the ordinary temperature the volume will be found diminished. This contraction is greatest on mixing 55 measures of absolute alcohol with 45 measures of water, which will yield 96.23 measures of weaker alcohol, showing a loss of volume equal to 3.77 per cent.

The strength of alcoholic liquids is conveniently determined by their specific gravities. A modification of the hydrometer, called the alcoholometer, has been constructed by which the percentage strength by volume may be directly ascertained. As the density increases appreciably with a diminution of temperature, and decreases in about the same ratio with an elevation of temperature, alcoholometers are constructed with reference to a standard temperature, which is either 15° C. or 60° F.; every degree of variation indicates a difference of $\frac{4}{10}$ for the former, and $\frac{2}{10}$ for the latter scale, which must be added if the alcohol tested was below, or subtracted if it was above the standard temperature.

The following table, by Thomson, gives the percentage of absolute alcohol by weight for alcohol of different specific gravities; temperature 15.55° C. (60° F.).

Per cent. by weight.	Specific gravity.	Per cent. by weight.	Specific gravity.	Per cent. by weight.	Specific gravity.	Per cent. by weight.	Specific gravity.
1	9995	26	965	51	915	76	857
2	998	27	963	52	912	77	855
3	997	28	962	53	910	78	853
4	995	29	960	54	908	79	851
5	994	30	958	55	906	80	848
6	992	31	957	56	904	81	846
7	991	32	955	57	903	82	843
8	990	33	953	58	900	83	840
9	989	34	951	59	898	84	838
10	988	35	949	60	896	85	835
11	987	36	947	61	893	86	832
12	986	37	945	62	891	87	830
13	984	38	943	63	889	88	827
14	982	39	941	64	886	89	825
15	981	40	939	65	883	90	822
16	979	41	937	66	880	91	820
17	978	42	935	67	879	92	817
18	977	43	933	68	875	93	815
19	975	44	930	69	874	94	812
20	974	45	928	70	871	95	809
21	973	46	926	71	870	96	807
22	972	47	924	72	867	97	804
23	970	48	922	73	865	98	801
24	968	49	920	74	863	99	798
25	967	50	917	75	860	100	796

The following table gives the percentage by volume of alcohol of different densities at the temperature of 15.55° C. (60° F.).

Per cent. by volume.	Specific gravity.	Per cent. by volume.	Specific gravity.	Per cent. by volume.	Specific gravity.	Per cent. by volume.	Specific gravity.
5	993	30	966	55	925	80	865
10	989	35	959	60	914	85	850
15	984	40	952	65	903	90	835
20	977	45	944	70	891	95	817
25	971	50	935	75	878	100	796

1. Absolute Alcohol.—This is a colorless limpid liquid, which does not congeal, but acquires an oily consistence when cooled to —90° C. (—130° F.). It has a refreshing odor and a very pungent taste. Its specific gravity at 15.55° C. (60° F.) is 0.794 (.796 as given in the above table is rather too high), and it boils at 78.4° C. (173° F.). It is entirely volatilized by heat, and does not cause anhydrous sulphate of copper to assume a blue color when left in contact with it. It dissolves iodine, bromine, some phosphorus and sulphur, the alkalies, and alkaline earths, the chlorides, iodides and nitrates of many metals, many organic acids, and nearly all alkaloids, resins, volatile oils, camphor and fixed oils. With water and ether it unites in all proportions. On mixing alcohol with water, the temperature rises somewhat and the mixture assumes, for a short time, an opalescent appearance from the dissolved air, which is expelled in numerous minute bubbles, after which it becomes perfectly transparent. It is readily inflammable, and burns with a non-luminous blue flame and without smoke.

2. Stronger Alcohol.—This has nearly the same properties as absolute alcohol, but its specific gravity is 0.817. If mixed with a few drops of solution of nitrate of silver and exposed to a bright light, it either remains unchanged or lets fall a very scanty dark precipitate of oxide of silver, whereby the presence of a little fusel oil is indicated; the larger the proportion of this admixture, the more rapid and copious will the precipitate be.

3. Alcohol.—*Rectified spirit and highly rectified spirit* vary between 87 and 84 per cent. by weight, or between 92 and 89 per cent. by volume in the alcohol strength, as ordered by the United States, British, and German Pharmacopœias; but for most pharmaceutical preparations they may be substituted for each other. They differ from stronger alcohol mainly in dissolving a smaller quantity of castor oil, oil of turpentine, some resins, and other fixed and volatile oils. Diluted with 20 parts of distilled water, alcohol should yield little or no foreign odor, proving the absence of an undue proportion of fusel oil. The limit test of the British Pharmacopœia for this impurity is that four fluidounces with thirty grain measures of the volumetric solution of nitrate of silver, exposed for twenty-four hours to bright light and then decanted from the black powder which has formed, undergoes no further change when again exposed to light with more of the test.

For use in the arts and for various laboratory purposes, *methylated spirit* is not subject to taxation in Great Britain. It is a mixture of 90 per cent. of alcohol and 10 per cent. of wood-spirit or methylic alcohol, which addition renders it unfit for internal administration.

4. Diluted Alcohol.—This is made by mixing officinal alcohol with an equal measure of distilled water; its specific gravity is 0.941.

The French Codex gives for every preparation the volumetric strength of the alcohol to be employed.

Composition.—Alcohol has the empirical formula C_2H_6O, and is the hydrate of the univalent radical *ethyl*, C_2H_5; its rational formula is, therefore, C_2H_5HO. It is the most common, and may be regarded as the type of a homologous series of alcohols, which are nominally distinguished by prefixing the name of the radical contained in them; hence, *ethylic alcohol* for the alcohol under consideration. Under the influence of oxidizing agents, the alcohols first part with two atoms of hydrogen, being converted into *aldehyds*, and by combining afterwards with one atom of oxygen are converted into a monobasic acid, in this case, *acetic acid*. The ethers derived from these alcohols contain one molecule of the radical in place of the single atom of hydrogen in the above formula; the following will explain this relation:—

Ethyl.	Ethyl oxide (ether).	Ethyl hydrate (alcohol).	Aldehyd.	Acid (acetic).
C_2H_5	$(C_2H_5)_2O$	C_2H_5HO	C_2H_4O	$C_2H_4O_2$

Tests.—The purity of the different officinal alcohols is determined by their odor, specific gravity, miscibility with water, complete volatility, and their behavior to nitrate of silver.

Pharmaceutical Uses and Preparation.—Alcohol is employed on account of its solvent properties in the manufacture of alkaloids and other proximate principles of resins, numerous extracts, some plasters and chemicals, and is a permanent ingredient of all tinctures, spirits, most fluid extracts, some mixtures, liniments, solutions, a few infusions, syrups, wines, etc.

Physiological Action.—Alcohol applied to the roots or the stems of plants destroys their life. It is poisonous to every animal, producing local or general anæsthesia, according to the mode of its employment. Applied to the trunk of a nerve, it paralyzes all of its branches, and to the brain, it impairs sensation and voluntary motion. Injected into the veins, in a concentrated state, it coagulates the blood, and diluted, it causes intoxication. The latter effect is seen in all animals that have taken alcohol into the stomach, and, according to the dose, excitement, stupor, or death. After death, the stomach is more or less injected, the vessels of the brain are congested, and those of the portal system have been found to contain alcohol. When animals are kept for a long time intoxicated, they present the same characteristics as human drunkards, and the same lesions are found in them after death. The chief difference is that after a short experience their instinct teaches them to refuse the poison which the intelligence of man does not prevent his craving though it destroy him.

In man, the local action of alcohol produces cold, if the liquid can evaporate, but irritation if it cannot escape. Applied to a raw surface, it excites a severe smarting pain, and coagulates the blood. Taken internally, in small quantities appropriately diluted, it excites a sense of warmth in the stomach, and, if the person is very susceptible, an almost instantaneous glow throughout the body, with increased frequency and force of the heart and pulse, a livelier flow of ideas which are, according to the temperament of the individual, gay or gloomy, and actions which, in like manner, may be playful or malevolent. In larger and intoxicating doses, alcohol occasions such symptoms for a shorter time, but speedily induces a state of impaired perception and motor power, which is followed by one of total insensibility and unconsciousness, in which the phenomena are those of congestion of the brain, and usually of the whole capillary vascular system, although the latter sometimes gives way to coldness and pallor. In this condition death has frequently occurred after an excessive draught of distilled liquor. After death, all the large vascular organs are engorged with blood, which, in some cases, has furnished alcohol by distillation. Habitual excesses, according to the form and quantity of the alcohol consumed, tend to increase fat and diminish muscular tissue, and to render the capillary bloodvessels everywhere turgid, giving to the skin, especially of the face, a puffy and purplish look. The digestion becomes impaired, the nervous system unsteady, the gait loses its elasticity, the hands grow tremulous, the senses dull, and the mind torpid; the sleep is broken, dreamy, and unrefreshing. After unusual excesses delirium tremens is apt to occur, and habitual drunkenness, sooner or later, in many cases, induces a state of chronic imbecility, with partial paralysis. Fatty heart, cirrhosed liver, and granular kidneys are frequently associated lesions, producing fatal dropsy, especially if distilled liquors have been employed, while gout is the more usual result of intemperance in wine.

Experiments and observations made to determine the mode of action of alcohol in the economy have too generally referred to excessive doses rather than to such as are employed in dietetics and in medicine. Hence, a dispute has arisen whether alcohol raises or depresses the animal temperature, when it is of daily experience that moderate doses augment the heat, and excessive doses diminish it. In febrile disease it is quite possible that the dose, which in health would have been excessive, and even destructive of life, may, by limiting heat production, tend to preserve the tissues upon which life depends. If, as is altogether probable, this effect is due to a power in alcohol of stimulating the exhausted nervous system, and thereby exciting the distended capillary blood-vessels to contract, it is evident that less blood will reach the tissues, that less heat will be developed, and less waste of tissue result. This diminished waste is represented by the smaller amount of carbonic acid exhaled by the lungs and of urea secreted by the kidneys. It is probable, also, that it reduces febrile temperature by lessening the oxidizing power of the red corpuscles. The use of alcohol in every age, and by every nation in the world, demonstrates that it satisfies a natural instinct, that it literally refreshes the system exhausted by physical or mental labor, and that it not only quickens the appetite for food and aids in its digestion, but that it spares the digestive organs by limiting the amount of solid food which would otherwise be required. But, in accomplishing this salutary end, it does not act as a mere condiment. It is also food, in this sense, at least, that it offers itself in the blood as a substitute for the tissues which would otherwise be destroyed. "Alcohol," says Moleschott, "is the savings bank of the tissues. He who eats little and drinks alcohol in moderation, retains as much in his blood and tissues as he who eats more and drinks no alcohol." It is certain that of any amount of alcohol ingested not in excess of what the system requires, only a minute fraction can be recovered from any of the secretions; the remainder undergoes metamorphosis, and is eliminated in a new form. The doctrine that alcohol is food is probably true, not only in the sense just expressed, but in the more literal sense of its favoring the formation of fatty products, especially by its increasing the amount of adipose tissue, and also by its tendency to produce fatty liver and kidney, gall stones, and atheroma.

Medical Uses.—In the form of distilled spirits, alcohol is the universal and familiar remedy for *debility* of every kind, whether it be due to exhaustion produced by *shock* or *fatigue*, or shown by *syncope* arising from a nervously feeble or an exhausted heart, to wasting chronic disease, or to the tissue destruction of acute febrile affections. In *typhus fever* and the *typhoid state* of numerous diseases, including *pyæmia*, the usefulness and appropriateness of the medicine is demonstrated, not only by its diminishing the frequency and increasing the strength of the pulse, and by the decline of the symptoms which denote capillary stasis, but also by the very large quantities of it which may be taken without producing intoxicating effects. This tolerance may be added to the facts already stated, to confirm the doctrine that alcohol is consumed in the body and subserves the purposes of food. The special conditions which call for the use of alcohol are the following: constitutional *debility* and especially that which is due to advanced life; a compressible, slow, or irregular *pulse*, with a feeble impulse and first sound of the *heart;* a tendency to *syncope;* a sluggish capillary circulation, and a *dry tongue;* wandering *delirium*, *stupor*, *tremor*, or *subsultus*, and involuntary dejections. In the fevers above mentioned, there is both loss of power and nervous disorder (adynamia and ataxia); in some other diseases there is adynamia alone, or, as it is more specifically termed, asthenia, diseases in which the spinal nervous system appears exhausted, and debility and even paralysis of the muscles, both voluntary and involuntary, may occur. These accidents happen in the fevers already mentioned, and also, but less frequently, in the eruptive fevers, in *relapsing fever* and in *diphtheria*, in all of which the first threatening of their approach should be met with alcoholic and other stimulants. It should always, in acute febrile disease, be administered in divided doses, and its effect upon the symptoms noted. If it moderates such as have been enumerated, it may be regarded as useful, and may be continued in doses varied by its effects. The essential point in its administration is that it should never be allowed to produce intoxication, even by abnormally exciting, and still less by stupefying. It is absolutely contra-indicated in febrile diseases with scanty and albuminous urine of low specific gravity.

The same rule should govern the use of alcohol in *pulmonary consumption.* If it improves digestion, increases the weight and strength, reduces the fever, and lessens the cough, expectoration, and sweating, it may be regarded as exerting its most favorable influence. But unfortunately these salutary effects cannot be confidently anticipated; too often it increases fever, diminishes appetite, and impairs digestion. Two conditions appear to be essential to its utility; first, that the phthisis shall be primary and chronic, and not the consequence of a previous pleurisy or lobar pneumonia, and secondly, that the patient shall use muscular exercise in the open air proportioned to his strength. Under these circumstances it is the best adjuvant of cod-liver oil, which, indeed, so far as alcohol is a nutrient, it resembles in its mode of action. In *delirium tremens* alcohol in the form of malt liquor, wine, or distilled liquors is a direct antidote to this peculiar effect of intemperance. As the morning dram steadies the tremulous hand and tottering gait of the sot, so alcohol reduces to co-ordination the distracted ideas, perceptions, and movements of the victim of delirium tremens, and the more certainly, speedily, and with a smaller dose, in proportion as it is aided in its operation by physical fatigue produced by walking. It must not be forgotten that this delirium is usually the result of an abrupt cessation of the habit of drinking, either by the stomach giving out, or by some suddenly depressing influence, such as a surgical injury. In poisoning by venomous *serpents* and by *narcotics*, alcohol is often used to sustain life until the elimination of the poison has been accomplished. The full effects of this liquid have proved sufficient for the cure of *traumatic tetanus;* its slightly stimulant effects, on the other hand, have been resorted to for preventing *epileptiform* attacks, and by the same mechanism doubtless it prevents and even arrests reflex *convulsions*, such as occur during *dentition*, the *vomiting of pregnancy*, and the paroxysms of *neuralgia*, when thus administered in small doses.

As an external application alcohol, in its natural or artificial form, has from all antiquity been used as a dressing for *wounds*. Recent observations attest its excellence in arresting hemorrhage, coagulating the albumen of exuded plasma, preventing the putrefaction of discharges, and promoting cicatrization. It is an efficient dressing for atonic *ulcers* and *gangrenous* lesions; tends to prevent and heal fissure of the *nipples* and excoriation of the *feet* by walking, and is the best of all applications to recent *bruises* and *sprains* and superficial inflammations, and as a vehicle for other agents fitted for this purpose, for stimulating *paralyzed limbs*, etc.

In the treatment of alcoholic poisoning, the stomach should first be emptied by means of a mustard emetic, administered by the stomach-pump if necessary. Cold water may be dashed against the breast and spine, and applied to the head, while various mechanical expedients should be employed to keep the patient awake. In some cases, even of dead-drunkenness, a few drops of water of ammonia instilled into the throat, or held under the patient's nostrils, will suffice to terminate the attack.

ALCOHOL AMYLICUM, *U. S.*, *Br.*—AMYLIC ALCOHOL.

Fusel oil, E.; *Alcool amylique, Huile de grain*, Fr.; *Amylalcohol, Fuselöl*, G.
Formula $C_5H_{11}HO$. Molecular weight 88.

A peculiar alcohol obtained from fermented grain or potatoes, by continuing the process of distillation after the ordinary spirit has ceased to come over, *U. S.*

Preparation.—During the alcoholic fermentation of grain and potatoes, variable quantities of amylic alcohol are produced, the great bulk of which passes over with the last portions of the first distillation, which are milky, and contain, besides amylic, some ethylic alcohol and water. The portion remaining in solution with the distilled spirit is obtained in purifying the latter either by the process of distillation or leaching (see page 120). Commercial amylic alcohol contains variable quantities, between 20 and 30 per cent., of ordinary (ethylic) alcohol, of which it cannot be completely deprived by fractional distillation and washing with water. Distillation over chloride of calcium, after previous washing with water, removes most of the alcohol, a portion of which will, however, again pass over with the distillate. An effectual and economical method has been proposed by B. Hirsch (1861), who advises crude amylic alcohol to be repeatedly agitated with concentrated aqueous solutions of table salt, until a diminution of its volume is no longer noticed; it still contains a little alcohol, from which it is freed by distilling it with three or four times its volume of water.

Properties and Tests.—It is a colorless, thin, oily liquid, having a penetrating and oppressive odor and a burning acrid taste. It congeals at —25° (—13° F.), crystallizing in laminæ. It boils at 132° C. (269.6° F.), and evaporates without leaving any residue. Its specific gravity is 0.818. It is very sparingly soluble in water, to which it imparts its odor and taste. It unites in all proportions with alcohol, ether, glacial acetic acid, fixed and volatile oils. It dissolves iodine freely, a little phosphorus, camphor, many resins, and most alkaloids, yielding the latter again, on agitation, to water acidulated with sulphuric acid. In contact with sulphuric acid it acquires a deep red color, and reacts violently with concentrated nitric acid. Exposed to air in contact with platinum black it is slowly oxidized, yielding valerianic acid. It takes fire with difficulty, burning with a bright flame.

The *purity* of amylic alcohol is ascertained by its specific gravity, its volatility without residue, and by its not diminishing in volume when agitated with an equal bulk of solution of calcium or sodium chloride.

Composition.—Amylic alcohol is *amyl hydrate* $C_5H_{11}HO$, and yields a series of compounds homologous with those of ethylic alcohol, namely, amylic ether $(C_5H_{11})_2O$; amylaldehyd or valeraldehyd $C_5H_{10}O$, and valerianic acid $C_5H_{10}O_2$.

Pharmaceutical Uses.—Amylic alcohol is the source of valerianic acid, and may be used as a solvent in the manufacture of alkaloids and other proximate principles.

Physiological Action and Medical Uses.—The adulteration of alcoholic drinks with fusel oil has been supposed to explain the rapid and peculiar intoxication they produce, and the dyspeptic and nervous disorders following their habitual use. It is certain that the oil itself will produce, even in small doses, tension and pain in the head, and in large doses insensibility or a profound and death-like sleep. In small doses, on the other hand, it acts as a direct nervous stimulant, and has been employed for the purpose of controlling the nervous weakness and irritability which habitual drunkards are subject to. We have known it to be habitually prescribed by skilful physicians for the relief, apparently, of some of the symptoms of chronic *phthisis*, but without apparent benefit.

ALCOHOL METHYLICUM.—METHYLIC ALCOHOL.

Spiritus pyroxylicus rectificatus.—Pyroligneous (*pyroxylic*) *spirit or alcohol; Wood naphtha*, E.; *Alcool méthylique, formique, de bois; Esprit de bois, pyroligneux*, Fr.; *Holzgeist, Methylalkohol*, G.

Formula CH_4O. Molecular weight 32.

Preparation.—Methylic alcohol was first observed by P. Taylor (1812), but not correctly characterized until investigated by Dumas and Peligot (1835). It is contained in the aqueous portion of the distillate resulting from the destructive distillation of wood, together with acetic acid, acetone, aldehyd, empyreumatic oils, and other compounds. On the addition of chalk, acetate of calcium is produced, and the portion distilling below the boiling point of water furnishes the crude methylic alcohol. To obtain it pure, calcium chloride is dissolved in it to saturation, whereby a crystallizable compound, $CaCl_2.4CH_4O$, is formed, which is not decomposed by the heat of a water-bath, but yields acetone, lignone, and other impurities in the distillate. The residue is afterwards diluted with water and heated, when dilute methylic alcohol passes over, which is left in contact with burnt lime and then rectified.

Properties.—Pure wood-spirit is colorless, limpid, of a peculiar odor reminding of alcohol and acetic ether, and a warm taste. Its density at 20° C. (68° F.) is .798; it boils at about 65° C. (149° F.); burns with a pale blue, scarcely luminous flame; is soluble in all proportions in water, alcohol, and ether; dissolves volatile oils, fats, many resins, and particularly chloride of calcium, whereby, as well as by its boiling point, it is readily distinguished from *acetone*. It is easily oxidized by solution of permanganate of potassium in the cold, while the color of the latter is more slowly altered by ethylic alcohol. For determining the presence of one or both of these alcohols, Riche and Bardy (1875) proposed a process depending upon the differently-colored solutions obtained by the limited oxidation of ethyl- and methylanilina. Berthelot (1876) proposed to mix the alcohol with twice its bulk of concentrated sulphuric acid, when methylic alcohol will yield methylic ether, and ethylic alcohol ethylene gas, which is almost insoluble in water and sulphuric acid, but is readily absorbed by bromine.

Physiological Action and Medical Uses.—The commercial mixture of pyroxylic spirit and alcohol derives its special qualities from the first-mentioned ingredient. It is stated that the vapors from it diffused in the air give rise to headache, dizziness, nausea, and loss of appetite. It was at one time employed as a stimulant in *pulmonary consumption, chronic catarrh, dyspepsia*, and *verminous affections;* but is now entirely disused.

ALDEHYD.—ALDEHYD.

Acetic aldehyd, E.; *Aldéhyde acétique* (*vinique*), Fr.; *Aldehyd*, G.

Formula C_2H_4O. Molecular weight 44.

Formation and Preparation.—Aldehyd is formed by the oxidation of alcohol and many of its derivatives; it is found among the products of the dry distillation of wood and sugar, and on distilling various protein and other compounds with binoxide of manganese and sulphuric acid. A simple, though not the most economical process, proposed by Liebig, is as follows: A mixture of 3 parts of 80 per cent. alcohol and 2 parts of nitric acid, spec. grav. 1.25, is distilled, and the distillate rectified from the water-bath. This second distillate consists mainly of nitrous ether and aldehyd, and on being saturated with gaseous ammonia separates the former as a layer floating upon an aqueous solution of aldehyd ammonia. The latter is mixed with somewhat diluted sulphuric acid, and the mixture distilled from a water-bath; the distillate requires to be rectified over chloride of calcium.

Properties.—It is a colorless, thin, neutral, and very inflammable liquid, having a peculiar ethereal, rather suffocating odor, and the spec. grav. .805 at 0° C. (32° F.). It boils at about 21° C. (69.8° F.), dissolves in all proportions of water, alcohol, and ether, forms with ammonia a very soluble crystallizable compound, yields with alcoholic solution of potassa a yellow resin (*aldehyd resin*), and in contact with air is converted into acetic acid.

Physiological Action.—According to Lussana and Albertoni, aldehyd possesses more powerfully antiputrescent properties than alcohol, a watery solution containing only three per cent. of it preventing the putrefaction of meat and of urine. From 45 to 75 grains dissolved in water and injected into the veins of a moderate-sized dog almost instantaneously arrest respiration and induce coma. In smaller doses it intoxicates and anæsthetizes. Introduced into the stomach, it irritates that organ, and may even occasion gangrene. Being very volatile, it is readily inhaled; small quantities accelerating the respiration, but large ones arresting it, while the action of the heart continues almost at the normal rate. During the stage of asphyxia the temperature may fall even as much as 7° or 9° F. Animals forcibly resist attempts to make them inhale the vapors of aldehyd, but in about a minute sensibility and mobility are abolished. If the inhalation is prolonged the pupils dilate, respiration ceases, and the only sign of remaining life is the continued pulsation of the heart. Recovery takes place rapidly without vomiting or other unpleasant symptoms. Of thirty deeply-narcotized dogs only two died. The brain is rendered anæmic during the inhalation, as happens also in anæsthesia by chloroform and ether. Aldehyd has not, apparently, been used on man; but its property of arresting respiration, and its irritant action upon the lungs and stomach, are likely to prevent its employment as an anæsthetic.

ALETRIS.—Colic Root.

Starwort, Stargrass, Blazing star, E.; *Alétris farineux,* Fr.; *Mehlige Aletris,* G.

The rhizome of Aletris farinosa, *Lin.* *Nat. Ord.*—Hæmodoraceæ.

Origin.—The plant grows in grassy places and sandy woods in the United States, and flowers in July and August. It has a circular cluster of lanceolate, sessile, radical leaves, which are about 5 inches long, and spread, star-like, upon the ground, and from the centre of them rises the nearly naked scape, about 2 feet high, and bearing a spiked raceme of whitish flowers having a mealy appearance.

Description.—The rhizome is horizontal, about 1 or 1½ inches long, ⅛th inch thick at the lower end, and about ⅜th inch at the upper end, flattish or concave on the upper surface, and densely tufted with the fibrous or scaly remnants of the leaves; on the lower surface convex and beset with numerous simple rootlets 2 or 3 inches long, the older ones being wiry, and glossy blackish or brown, the recent ones softer and whitish. The rhizome consists of 4 to 6 rather indistinct joints, is brown-gray externally, white internally, breaks with a mealy fracture, with protruding scattered wood bundles, is inodorous, and has an amylaceous, afterwards persistently bitter taste.

Constituents.—The rhizome appears to be free from tannin, and to contain starch and a bitter principle which is more freely soluble in alcohol than in water.

Adulterations.—We have occasionally seen it adulterated with upright and horizontal rhizomes of other monocotyledonous plants, from which, however, it is easily distinguished.

Medical Action and Uses.—Star-grass belongs to the secondary list of the U. S. Pharmacopœia. This humble plant, if we may credit the published accounts of its virtues, is at once tonic, emetic, purgative, diuretic, carminative, sialagogue, and anti-rheumatic, besides being "the most powerful of uterine stimulants." It is probably little more than a simple bitter, and, as such, produces various effects according to its dose and mode of administration, in substance, in warm or cold infusion, in tincture, etc. The infusion is made with one ounce to a pint of water, and may be given in doses of a tablespoonful. The average dose of the powder is about ten grains.

ALISMA.—Water Plantain.

Plantain d'eau, Pain de grenouilles, Fr.; *Froschlöffel, Wasserwegerich,* G.

Alisma plantago, *Lin.* *Nat. Ord.*—Alismaceæ.

Origin.—The plant is indigenous to Europe and North America, grows in swampy places and on the edges of ponds and rivers, and flowers from July to September. The American plant is regarded as a variety, *Americanum.*

Description.—The rhizome consists of two or three united fleshy tuberous pieces, which vary in shape from oblong to subglobular, are externally of a blackish color, and beset with numerous radicles, internally white, and with scattered wood bundles, and in the fresh state of a disagreeable sharp odor and taste. The leaves are on long petioles, ovate oblong or lanceolate, acute, frequently with a heart-shaped base, five to nine nerved, light-green and of an acrid taste. The scape is about two feet high, three-edged, and bears a loose panicle of whitish perfect flowers, having six stamens and numerous pistils upon a flattish receptacle. The rhizome and leaves have been used medicinally.

Constituents.—Water plantain contains a butyraceous pungent volatile oil, of which Zuch (1818) obtained .6 per cent. Neljubin found in it also an acrid resin.

Medical Action and Uses.—A singular commentary on the virtues of this plant may be found in the statement that it was once regarded as an infallible cure for hydrophobia. Whatever powers it possesses are probably due to an acrid principle which exists in the fresh leaves, and is strong enough to irritate the skin. It has been supposed to be useful in *calculous* renal affections, in *dysentery, diarrhœa, chorea* and *epilepsy,* and as an application to recent *bruises, swellings,* and *sores.* It may be given in decoction.

ALKANNA.—Alkanet Root.

Orcanette, Fr.; *Alkannawurzel,* G.

The root of Alkanna (Anchusa, *Lin.*) tinctoria, *Tausch.* *Nat. Ord.*—Boraginaceæ.

Origin.—This perennial herb is a native of Western Asia and Southeastern Europe, is about a foot high, and has nearly sessile flowers with a whitish corolla tube, purplish throat, and blue margin.

Description.—The root is a foot or less in length, of the thickness of a finger, several headed, and often crowned with the remnants of white-hairy leaves. The loose bark, like the medullary rays, has a dark-purple color, and covers a harder, yellowish, very irregular and spongy wood. Alkanet root is nearly inodorous and tasteless.

Constituents.—The principal constituent is the red coloring matter which has been called *anchusin*, *alkannin*, and *anchusic acid*. To obtain it the root, previously exhausted with cold water, is treated with alcohol, the tincture slightly acidulated with muriatic acid, concentrated, and agitated with water and ether. On evaporation of the latter, the acid remains behind as a dark red-brown, brittle, resinous mass, which when carefully heated is sublimable in light floccules. It is readily soluble in alcohol, ether, fats, and most volatile oils, insoluble in water, and dissolves in alkalies with a blue color. On evaporating the tincture without previously acidulating it, the acid gradually changes to *alkanet green*, which dissolves in ether with a green color.

Uses.—Alkanet root is mainly employed for coloring oils and pomades. The oriental dyestuff *alhenna*, corrupted into alkanna, is obtained from the leaves of *Lawsonia alba*, Lam.

Allied Plants.—The root and herb of the *ox tongue* or *bugloss*, *Anchusa officinalis*, Lin., were formerly used in medicine; they have an insipid, mucilaginous taste. The root resembles alkanet in shape, but is externally blackish-brown, internally white.

Medical Uses.—Bugloss is said to have the same medicinal properties as borage (Borago officinalis), which are simply those of an emollient which becomes diaphoretic or diuretic according to the temperature and the quantity of the infusion administered. It is not used in this country.

ALKEKENGI.—WINTER CHERRY.

Alkékenge, *Coqueret*, Fr.; *Judenkirsche*, *Schlutte*, G.

The fruit of Physalis alkekengi, *Lin.*

Nat. Ord.—Solanaceæ.

Origin.—It is a perennial herb, indigenous to Middle and Southern Europe and to some extent cultivated and naturalized in this country under the name of *strawberry tomato*. It is more or less soft hairy, has a nearly simple stem, broadly ovate and pointed leaves, with a somewhat wedge-shaped base, and bell-shaped greenish-white unspotted flowers.

Description.—The fruit is spherical, of the size of a cherry, scarlet-red, shining, and remains inclosed in the inflated permanent calyx. It is two-celled, and contains numerous white flattish ovate seeds, attached to a central placenta. In the fresh state the fruit is very juicy and has a sweet and acidulous taste; it shrivels considerably on drying.

Constituents.—Dessaignes and Chautard (1852) found sugar and citric acid in the berries, and in the leaves and calyx an amorphous bitter principle, *physalin*, $C_{14}H_{16}O_5$, which is obtained as a whitish powder on agitating the cold aqueous infusion with chloroform, and is soluble in chloroform and alcohol, but sparingly so in ether, cold water, and diluted acids.

Allied Species. PHYSALIS VISCOSA, *Lin.*—A clammy pubescent North American plant, with ovate or oblong, slightly cordate and somewhat toothed leaves and purplish-brown flowers. The fruit is an orange or reddish berry, remaining in the inflated calyx.

PHYS. PENNSYLVANICA, *Lin.*—It resembles the preceding, but is not clammy, the leaves are usually entire, the corolla is veined in the centre, and the berry has a red color.

PHYS. PERUVIANA, *Lin.*, PH. PUBESCENS, *Lin.*, and NICANDRA PHYSALOIDES, *Gærtn.*, are indigenous to South America and employed for similar purposes. The last-named species is occasionally found wild in the United States, where it is known as *apple of Peru.*

Physiological Action and Medical Uses.—The herb is used in Europe as tonic, antiperiodic, and depurative, and the fruit as febrifuge and diuretic. Like many other bitter plants, this one is sometimes successful in arresting the paroxysms of *intermittent fever*, and is used for that purpose by the peasantry. The berries eaten when ripe and fresh, and when dried and used to prepare a decoction, and also their expressed juice, are regarded as having decided diuretic virtues, and are frequently employed in *jaundice*, *gravel*, *dysury*, *retention of urine*, and *dropsy*. It is recommended to give the fresh berries to the extent of several ounces a day; of the expressed juice two or three fluidounces; and an infusion of the dried berries, made with an ounce in a pint of hot water, to the extent of two or more pints a day. The powder of the plant is used in doses of a drachm or more.

ALLIUM, *U. S.*—GARLIC.

Bulbus allii.—*Ail*, Fr.; *Knoblauch*, G.

The bulb of Allium sativum, *Lin.* Used in the fresh state only.

Nat. Ord.—Liliaceæ.

Origin.—All the plants belonging to this genus are bulbous, resemble each other in their odor and taste, and contain similar, if not identical, volatile oils. The officinal species is indigenous to Southern Europe, but is cultivated for culinary purposes in other sections of Europe and North America. By cultivation and hybridization several varieties have been formed, one of which, of frequent occurrence here, was proved by R. P. Thomas (1860) to be a hybrid of A. sativum and A. porrum, *Lin.*, which is distinguished by its larger bulb, higher stem, and the absence of proliferous bulbs from the flowering heads.

Description.—Garlic is a subglobular compound bulb, surrounded by a few dry membranaceous scales, which cover the remnant of the upright stem, and the five to eight small bulbs or cloves arranged in a circle around its base. These bulblets are oblong in outline, compressed from both sides, wedge-shaped towards the stem, and rounded upon the back. They consist of a few thick fleshy scales and a short fleshy axis. Garlic has a peculiar pungent and disagreeable odor, and an acrid burning taste.

Constituents.—Besides the cellular tissue, garlic contains between 50 and 60 per cent. of water, 35 per cent. of mucilage, some albumen, and about $\frac{1}{4}$ per cent. of volatile oil, to which its odor and taste are due. In its crude state oil of garlic is of a dark brown-yellow color, heavier than water, of a very repulsive taste, and consists of oxide and sulphides of allyl. The rectified oil consists mainly of the sulphide $(C_3H_5)_2S$, is colorless, lighter than water, and may be obtained artificially by treating an alcoholic solution of potassium sulphide with allyl-iodide. It dissolves easily in alcohol and ether, and sparingly in water. Garlic, macerated in water or vinegar, yields its virtues to these liquids.

Preservation.—Garlic is best preserved in a dry place at a moderate temperature, in which it slowly parts with its water. A. P. Sharp proposed (1864) to put the fresh-cleaned cloves into a jar and add a small quantity of alcohol, about two ounces to a quart jar. The vitality of the bulbs is destroyed, and they retain their properties in the closed vessel for a long period, but change in color, acquiring a brownish, somewhat diaphanous appearance.

Off. Prep.—Syrupus allii, *U. S.*

Allied Species.—The following species of allium are more or less cultivated for culinary purposes; their bulbs and leaves possess a garlic-like, but mostly milder, odor, which is dependent upon similar volatile oils. Medicinally they appear to have the same properties, though in a milder degree :—

Allium cepa, *Lin.;* Onion, *E.;* Oignon, *Fr.;* Zwiebel, *G.*
Al. porrum, *Lin.;* Leek, *E.;* Porreau, *Fr.;* Lauch, *G.*
Al. ascalonicum, *Lin.;* Schallott, *E.;* Echallotte, *Fr.;* Schallotte, *G.*
Al. schœnoprasum, *Lin.;* Chives, *E.;* Civette, *Fr.;* Schnittlauch, *G.*

Physiological Action and Medical Uses.—Garlic, as well as leek and onion, is a stimulant to the part to which it is directly applied, and to the whole system. Its odorous element may be perceived in the breath and its taste in the mouth, when the bruised bulb has been applied to the skin. When eaten, its odor exhales from many parts of the body. It reddens skin, and may even vesicate it. Internally it stimulates the digestive organs; and is everywhere used, but principally in southern countries, as a condiment for various kinds of food. Excessive quantities of it produce nausea, vomiting, colic, and diarrhœa. The odor of garlic is popularly employed to revive persons from a *swoon*, or from *hysterical* insensibility. It is a vermifuge not to be neglected in the treatment of *lumbricoid worms*, when given by the mouth, and for destroying *ascarides* when administered by the rectum. Many cases of *dropsy*, particularly of anasarca produced by cold, have been cured by a diet of bread and raw onions. This regimen will sometimes produce copious diuresis. Bruised cloves of garlic and onion poultices are admirable remedies for chronic *bronchitis* in children. They should be applied over the whole front of the chest. Internally, garlic is a very useful agent in the same affection. Onion poultices are particularly applicable to *abscesses;* the core of a roasted onion relieves *earache* when introduced into the auditory canal. Onion and garlic cataplasms applied to the perineum relieve *strangury.* The *dose* of bruised or chopped garlic, or of the expressed juice, is about thirty grains.

ALNUS.—Alder Bark.

Ecorce d'aune, Fr.; *Erlenrinde*, G.

The bark of Alnus glutinosa, *Gærtn.*, s. Betula alnus, *Lin.*, and of Alnus serrulata, *Ait.*

Nat. Ord.—Betulaceæ.

Origin.—The first species is a tree about 30 feet high, indigenous to Europe and Northern Asia; the second is a native of the United States, and attains a height of about 10 feet. Both grow in moist localities.

Description.—The bark is in quills or curved pieces, about $\frac{1}{20}$ inch thick, smooth on both sides, of a brownish ash-gray color externally, the young bark with reddish-brown dots; brownish-orange on the inner surface, inodorous, and of an astringent, somewhat bitter taste. It is brittle, and breaks with an uneven, not splintery, fracture. The bark of the American species, which is called *black alder*, resembles the preceding, but is of a blackish-gray externally; has small suberous warts, which become somewhat confluent transversely, and is marked with few coarse longitudinal striæ upon the orange-brown inner surface.

Constituents.—Alder bark contains tannin, that of the black alder about 4 per cent., and the aments of the same species 1.5 per cent. (Bowman, 1869). These results were obtained by precipitation with gelatin; but, according to Stenhouse (1843), the tannin of the European alder bark is not precipitated either by gelatin or tartar emetic.

Medical Action and Uses.—The American species of alder is said to be "astringent and diuretic," which may be doubted, since diuretics are seldom astringent. Its astringency resides in the leaves, as well as in the bark, with both of which a decoction is prepared for the treatment of *diarrhœa* and *hæma-*

turia; and the former, when bruised, are applied to *contusions, sprains,* and *ulcers.* The inner bark is said to be emetic. The European species possesses almost identical virtues. Its decoction is used for the purposes above mentioned, and as a gargle in *sore throat,* as a mouth-wash in *ulceration* of the gums, etc., as an injection in *leucorrhœa,* etc.; and the bruised leaves are sometimes applied to the mamma to lessen the secretion of *milk,* or dissipate *indurations* during lactation. Internally, the bark has been used in *intermittent fever.*

ALOE BARBADENSIS, *U. S., Br.*—BARBADOES ALOES.

Hepatic aloes, E.; *Aloès hépatique des Barbades,* Fr.; *Barbadoes Aloe,* G.

The inspissated juice of the leaves of Aloe vulgaris, *Lamarck.* Bentley & Trimen, Med Plants, 282.

ALOE CAPENSIS, *U. S.*—CAPE ALOES.

Aloe, P. G.; *Aloe lucida.—Aloès du Cap, Aloès lucide,* Fr.; *Aloe, Capaloe,* G.

The inspissated juice of the leaves of Aloe spicata, *Thunberg,* and of other species of Aloe.

ALOE SOCOTRINA, *U. S.*—SOCOTRINE ALOES.

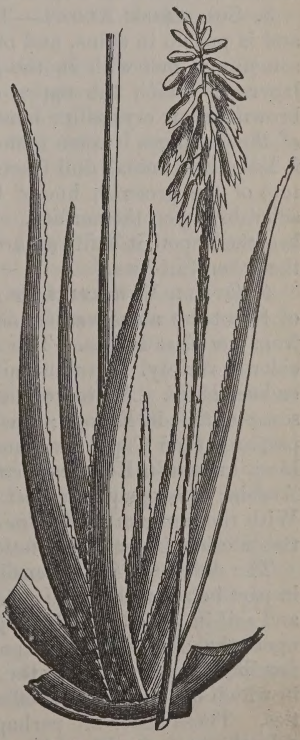
Aloe succotrina.—Aloès sucotrin s. socotrin, Fr.; *Socotora s. Socotrinische Aloe,* G.

The inspissated juice of the leaves of Aloe socotrina, *Lamarck.*

Nat. Ord.—Liliaceæ.

Origin.—In aspect, these plants resemble the so-called century plant or American aloe, Agave Americana, *Lin.* Of the above named species Aloe vulgaris is indigenous to India and Northeastern Africa, and has been naturalized along the shores of the Mediterranean and in the West Indian islands; in the latter locality, however, it is supposed to be indigenous. A. socotrina belongs to the east coast of Africa, near the southern shore of the Red Sea, to Socotora and the neighboring islands of the Indian Ocean. A. spicata is indigenous to the southern part of Africa, together with A. Africana, *Mill.,* A. linguæformis, *Lin.,* A. arborescens, *Mill.,* A. purpurascens, *Haw.,* A. ferox, *Lam.,* and other species, which are used in preparing some of the commercial aloes.

Fig. 6.



Aloe socotrina, *Lam.*

Preparation.—The large fleshy leaves of these plants contain in their central part an insipid, thick, mucilaginous juice, and a bitter yellow juice in distinct ducts situated near the surface. To obtain this bitter juice, the leaves are cut off near their base, and then placed in suitable vessels into which their cut ends project. The vessel used in Barbadoes and other West Indian islands is an inclined trough from which the juice flows into other vessels, where it is preserved until it can be evaporated. In the Cape Colony, a shallow ditch is dug into the ground and covered with a goat-skin, which, when nearly filled, is emptied at once into an iron kettle, and, without much attention, boiled down to the proper consistence. Greater care is bestowed upon the evaporation of the juice in Barbadoes and Curaçao, the impurities being removed during the evaporation, and when of sufficient consistence, the juice is poured into boxes or gourds, where it solidifies on cooling. Socotrine aloes, so named from the island of Socotora, is exported thence only occasionally. Most of the commercial article is probably obtained from the east coast of Africa. The juice appears to be inspissated by spontaneous evaporation. The importation of all kinds of aloes into the United States varies between 100,000 and 120,000 pounds.

Description. 1. BARBADOES ALOES.—It is usually imported in gourds, and has a deep-brown or orange-brown color, which in thin pieces has a decidedly yellow or reddish-yellow tinge; it is opaque in mass, translucent in thin splinters, and breaks with a smooth, scarcely conchoidal, waxy fracture. When breathed upon, it has a strong saffron-like odor, which is, however, distinct from that of Socotrine aloes.

Similar in appearance, but rather darker and more glossy, are *Curaçao* and *Bonare aloes;* their fracture is more conchoidal, and their odor less agreeable.

2. CAPE ALOES.—This is readily distinguished from the other kinds by its dark, blackish-brown color, which is frequently of an olive tint, its glossy appearance, and its large conchoidal fracture. It is transparent on the edges, with a red-brown color, and has a saffron-like, but disagreeable sourish odor. It affords a light greenish-brown powder. It is imported in cases, and varies more or less in the shade of color and in the brilliancy of its fracture.

3. SOCOTRINE ALOES.—This enters commerce mostly by way of Bombay, and is put up in skins, and of late years also in kegs and tin-lined boxes. It is sometimes met with in the liquid state, and separates then into two distinct layers, of which the upper one is transparent, while the lower consists of a brown-yellow crystalline mass. Even when quite hard externally, the interior of the packages is often found in a soft or semifluid state. When carefully dried it has a conchoidal, dull fracture, and is of a yellowish orange-brown color, destitute of the greenish hue of Cape aloes. On exposure, the color darkens considerably upon the surface. The powder is of a bright brownish-yellow. When breathed upon, it emits an aromatic saffron-like odor, more pleasant than that of the other varieties.

4. OTHER VARIETIES OF ALOES.—Under the name of *hepatic aloes*, a variety of Socotrine aloes was formerly known in Europe, which came into commerce from the East Indies. The name was afterwards applied to any opaque liver-colored variety. In the United States, this name is now used to designate Barbadoes aloes. A kind of hepatic aloes has for some years past been used to some extent in Europe; it comes from Southeastern Africa, is more carefully prepared than Cape aloes, and is the *Natal aloes* of recent writers. An inferior kind, known in European commerce as *Moka aloes*, comes from the interior of Arabia; it is opaque, almost black, of irregular fracture, and disagreeable odor. With the name of *Caballine* or *horse aloes*, European writers used to designate the inferior, impure, and fetid kinds of different origin.

The difference in the sensible properties of the different varieties of aloes must in part be referred to the species from which they are derived, and to the climate and soil in which the plants grow; and it must depend to a considerable extent upon the care bestowed upon obtaining the bitter juice free from the insipid mucilaginous contents of the cells of the interior parenchyma, upon the manner in which concentration is effected, and upon its freedom from accidental impurities. These latter are perhaps never absent, but are sometimes present to a considerable extent, although not readily observable on the examination of the aloes;

hence, the U. S. Pharmacopœia orders the purification of Socotrine aloes. The opaqueness of some sorts of aloes is due to the crystallization of one of the principles. The glossy and transparent kinds do not contain such a crystallized principle, but are nearly homogeneous. The odor of aloes is best observed when a sample is breathed upon; it resembles strongly saffron, associated with another odor, which is distinct for each kind. The taste of aloes is disagreeably bitter and very persistent.

Aloes dissolves almost completely in alcohol and in boiling water, the latter solution separating, on cooling, the so-called *resin of aloes*, which is taken up by alkalies and re-precipitated by acids.

Constituents.—The nature of the constituents of aloes and their chemical relation to each other is still unknown, none of the older analyses having thrown any light upon the composition, beyond establishing the degree of solubility of different samples in several menstrua and the behavior of these solutions with different reagents. T. & H. Smith, of Edinburgh, succeeded (1851) in isolating from Barbadoes aloes a crystalline principle, which was then named *aloin*, but is now called *barbaloin*, to distinguish it from the crystalline principles of other varieties, which are named *socaloin* and *nataloin*. The two first named principles may be obtained, according to Groves, who first prepared (1856) socaloin, but regarded it then as identical with barbaloin, by dissolving one part of aloes in ten parts of boiling water, decanting after cooling from the sediment, and acidulating slightly with muriatic acid. The clear liquid is then evaporated to about two parts and set aside in a cool place to crystallize. The crystals are purified by recrystallization from very dilute alcohol. Nataloin was obtained by Flückiger (1871) by triturating Natal aloes with an equal weight of alcohol at a temperature not exceeding 48° C. (118° F.), when the amorphous portion will be dissolved; the residuary crystalline mass, after washing with cold alcohol, is recrystallized from hot methylic or ethylic alcohol.

Barbaloin = $C_{17}H_{20}O_7$, occurs in small yellow prismatic needles, which dissolve sparingly in cold, but freely in warm water and alcohol. Bromine water produces in its solution a yellow precipitate of bromaloin, which crystallizes in needles. Heated with nitric acid, barbaloin yields chrysammic and picric acids. Barbaloin, added to a drop of nitric acid, produces a crimson color, which rapidly fades.

Nataloin = $C_{16}H_{18}O_7$, crystallizes best from methylic alcohol in thin pale-yellow rectangular scales, which dissolve at 15.5° C. (60° F.), in 35 parts of methylic alcohol, 50 of acetic ether, 230 of absolute alcohol, and 1236 of ether. It is sparingly soluble in hot and cold water, and in about 60 parts of alcohol. Nitric acid does not convert it into chrysammic acid, but yields oxalic and picric acids. Nataloin, added to a drop of nitric acid, produces a crimson color, which is more permanent than the similar color produced with barbaloin. If nataloin is added to a drop of sulphuric acid and the vapor of fuming nitric acid is passed over the surface, the orange-colored liquid will assume a fine green color, quickly changing to red and blue. (*Histed, Transact. Br. Phar. Conf.*, 1871, p. 580.)

Socaloin = $C_{15}H_{16}O_7$, crystallizes in small yellow needles, which dissolve in 30 parts of alcohol, 90 of water, 380 of ether, 9 of acetic ether, and freely in methylic alcohol. Cold nitric acid has little effect upon socaloin.

The above formulas for the three aloins are those of Sommaruga and Egger (1874), and if correct, would prove these principles to be homologous. Stenhouse's formula for crystallized barbaloin is $C_{34}H_{36}O_{14}.H_2O$; Tilden's formula for nataloin = $C_{25}H_{28}O_{11}$; Flückiger's formula for socaloin = $C_{34}H_{38}O_{15}+5H_2O$.

Kosmann did not succeed (1863) in obtaining a crystallizable body from Cape aloes; he assigns to the yellow amorphous portion, soluble in water and alcohol, the formula $C_{34}H_{22}O_{20}$, and states that the insoluble portion has nearly the same composition, and that both are glucosides.

Tilden and Rammell examined (1872) the so-called resin from Barbadoes and Socotrine aloes, and observed that by continued boiling a portion of it can be rendered permanently soluble in water. This and the insoluble portion are nearly alike in composition, and appear to differ from barbaloin merely by the elements of water and, for the insoluble resin, also, by containing less hydrogen. This view is somewhat supported by the change into an amorphous substance when aloin is boiled for a long time with water, or more rapidly in the presence of a little alkali, while small quantities of acid prevent this change. The amorphous aloetin or aloebitter of older investigators must have been aloin similarly modified.

The *quality* of aloes is ascertained from its physical characters and from its behavior to alcohol and water; it should be almost completely soluble in diluted alcohol.

Off. Prep.—Aloë purificata, *U. S.;* Enema aloes, Extract. aloes (Barbadensis and Socotrinæ), *Br.;* Pilulæ aloes, Pil. aloes et asafœtidæ, *U. S., Br.;* Pil. aloes et ferri, *Br.;* Pil. aloes et mastiches, *U. S.;* Pil. aloes et myrrhæ, Pil. cambogiæ comp., Pil. colocynthidis comp., Pil. colocynthidis et hyoscyami, *Br.;* Pil. rhei comp., *U. S., Br.;* Pulv. aloës et canellæ, *U. S.*; Tinct. aloes, *U. S., Br.;* Tinct. aloes et myrrhæ, *U. S.;* Tinct. benzoini comp., Vinum aloes, *U. S., Br.*

ALOE PURIFICATA, *U. S.*—PURIFIED ALOES.

Aloès depuré, Fr.; *Gereinigte Aloe*, G.

Preparation.—Take of Socotrine Aloes twenty-four troyounces; Stronger Alcohol four fluidounces. Heat the aloes, by means of a water-bath, until it is completely melted. Then add the alcohol, and, having stirred the mixture thoroughly, strain it through a fine sieve, which has just been dipped into boiling water. Evaporate the strained mixture by means of a water-bath, constantly stirring, until a thread of the liquid becomes brittle on cooling. Lastly, break the product when cold into pieces of a convenient size, and keep it in a well-stopped bottle. *U. S.*

The object of this process is to remove fragments of leaves, wood, stones, pieces of skin, and other extraneous matter, which are always found in larger or smaller proportion in Socotrine as well as in Cape aloes. If the heat is regulated by means of a water-bath, there is no danger of impairing the virtues of aloes by overheating. The melted aloes is rendered sufficiently fluid, by the addition of some alcohol, to pass without difficulty through the sieve, if this has been previously warmed. The impurities remain upon the sieve, and the strained liquid may be at once evaporated. If the operation has been carefully performed, purified aloes will yield a bright brownish-yellow powder.

Pharmaceutical Uses.—This preparation should always be dispensed when aloes in substance is ordered for internal use. The Pharmacopœia directs it to be used in extr. colocynthidis comp., pil. aloes et myrrhæ, and suppositoria aloes.

Physiological Action.—Aloes acts upon quadrupeds as a purgative. Given to dogs in the dose of sixty grains, it caused the liver to secrete a greater quantity of biliary matter in a given time, although the bile was rendered more watery. It was long ago known to have a purgative effect when applied in solution to the unbroken skin, and more recently when endermically used. Infants are purged by the milk of nurses using it. In doses of one or two grains it stimulates the appetite and improves the digestion; in doses of from three to six grains it occasions, after a delay of from twelve to twenty-four hours, a fecal and usually formed stool; in larger doses it excites more or less tormina, and tenesmus attends the evacuations. These have a peculiar smell, and are supposed by some to be bilious. At the same time slight feverishness is apt to occur, and according to some a sense of tension in the liver. Habitual use of the drug does not sensibly diminish its activity. It is presumed to act decidedly, if not chiefly, upon the lower bowels, since it causes an increase of the hemorrhoidal flux when it exists, and tends to bring on or to increase the menstrual flow. Genital irritation is sometimes manifested. The general belief that aloes tend to produce hemorrhoids is contradicted by the results of experience; these bodies probably arise from the constipation which aloes is given to relieve. The evident stimulation of the pelvic organs by aloes has led to its use as an abortifacient; but there is no case on record which conclusively proves it to be so. It is probable that aloin is two or three times as active as good aloes. Its cathartic action is said to be uniform, rather more speedy than that of crude aloes, and unattended by griping. One and a half grains will, in a strong adult, usually cause two or three copious evacuations. Two and a half grains are followed by powerful catharsis, producing five or six evacuations (Harley).

Medical Uses.—The salutary action of aloes upon the stomach, and its slow and moderate operation as a purgative, have led to its use in habitual *constipation;* and it enters into numberless compounds devised for the relief of this condition, especially as it presents itself in persons of sedentary habits, on the approach of old age, as an effect of repeated pregnancy, etc. It is said to be contraindicated by a plethoric, bilious, or hemorrhagic constitution, when the liver is congested, during pregnancy, and when hemorrhoids exist; but these statements are not justified by experience. As regards *hemorrhoids*, those which are attended with a mucous discharge are apt to be benefited by aloes. *Ascarides* of the rectum may often be destroyed by enemas of aloes, of which the best consists of aloes dissolved in the infusion of quassia. *Jaundice* from hepatic torpor or congestion may be successfully treated with purgative doses of aloes combined with blue pill. In simple *amenorrhœa* of the torpid sort, aloetic purgatives are very efficient, especially in the form of tincture, or the pill of aloes and myrrh, or of the powder of aloes and canella. Aloes and iron are equally valuable in cases of *menorrhagia* arising from debility; and enemas of aloes and soap have been found serviceable in curing atonic *uterine catarrh.* Aloetic laxatives will sometimes arrest *gleet.* The local applications of aloes are described in connection with the tinctures into which that substance enters.

Administration.—Aloes in pilular form is best administered alone, or simply associated with soap, or with an alkaline carbonate, to promote its solution. As a laxative, it may be given in the dose of from three to nine grains. Custom has, however, sanctioned its use in combination with mastic for this purpose. The tincture and the wine of aloes are occasionally used as purgatives. Its combinations with myrrh, with asafœtida, and with canella are especially adapted to the treatment of derangements of the catamenia, and with benzoin are used as internal and also as local stimulants. Aloin may be substituted for aloes in the various pills containing the latter, and in the proportion of from one-third to one-half of that of aloes. As a prescription for the relief of habitual constipation due to sluggishness of the bowels or torpor of the liver, the following formula has been recommended: ℞.—Aloin gr. $\frac{1}{4}$; Ferri sulph. exsic. gr. iss; Quiniæ sulph. gr. j; Capsici gr. $\frac{1}{4}$; Ext. nucis vomic. gr. ss; Ext. gentianæ q. s. ut ft. pil. To be taken two or three times a day (Craig).

ALSTONIA.—Dita Bark.

Écorce de dita, Fr.; *Ditarinde*, G.

The bark of Alstonia (Echites, *Lin.*) scholaris, *R. Br.* Bentley and Trimen, Med. Plants, 173.

Nat. Ord.—Apocynaceæ.

Origin.—Dita bark comes from a stately forest tree indigenous to the Philippines and other neighboring islands. The wood is soft and white, and the greenish-white flowers have, in the night, a strongly aromatic odor.

Description.—The bark is in thick curved pieces, usually about two or four inches long and half an inch broad. It is externally of a leather-color, has a scaly appearance from its longitudinal and transverse fissures, and is not unfrequently marked with small black spots. Internally it is light yellowish-brown, the inner surface brown-gray and longitudinally striate. The bark breaks with a short or rather horny, somewhat porous fracture, and easily yields a yellowish-gray powder, which is inodorous and has a slightly bitter, not unpleasant, taste.

Constituents.—G. Gruppe, of Manilla, obtained from it about two per cent. of *ditain*, which was uncrystallizable, very hygroscopic, and bitter. Jobst and Hesse (1875) obtained from the aqueous solution of the alcoholic extract by acetate of lead a precipitate containing a crystalline and an oily acid, by subacetate of lead a precipitate containing resin-like bodies, and by phosphotungstic acid a precipitate containing the alkaloid *ditamina*, which is a white bitter powder, soluble in ether, alcohol, chloroform, and benzole; and by sulphuric acid is colored red, on warming violet-red; by nitric acid yellow, on warming dark green to violet. Only .02 per cent of the alkaloid was obtained, which yields very bitter salts. The bark yields to petroleum benzin several fatty and resinous substances, named *echicaoutchin*, *echicerin*, *echiretin*, *echitin*, and *echitein*, some of which are crystallizable. A second alkaloid, soluble in water and alkalies, but not in ether, appears to be likewise present.

Allied Species.—In the East Indies the root of *Ech. malabarica*, Lam., is used as a febrifuge, and the leaves as an application to carbuncles; the leaves of *Ech. caryophyllata*, Roxb., in arthritic fevers; and the bark of *Ech. pubescens*, Buch., and *Ech. antidysenterica*, Roxb., like the Brazilian *Ech. cururu*, Mart., *Ech. insignis*, Spr., and *Ech. longiflora*, Desf., in diarrhœa and dysentery. *Ech. syphilitica*, Lin. fil., of Surinam, is used there in syphilitic complaints.

Medical Uses.—The bark and also its alkaloid are said to have been used successfully in intermittent fever.

ALTHÆA, *U. S.*—MARSHMALLOW ROOT.

Radix althææ, P. G.—*Racine de guimauve*, Fr.; *Altheewurzel*, *Eibischwurzel*, G.

The root of Althæa officinalis, *Lin.* Woodville, Med. Bot., 198. Bentley and Trimen, Med. Plants, 35.

Nat. Ord.—Malvaceæ.

Origin.—This perennial herb is indigenous to Asia Minor and the greater part of Europe, and has been naturalized in the salt-marshes along the coast of New England and New York. For medicinal purposes the root of the cultivated plant is generally employed; and in Europe the leaves and, occasionally, the flowers are likewise used.

Description.—The root is fit for use when two or three years old; of older roots only the fleshy branches are used, the woody main root being rejected. It is collected early in the spring or in autumn, and deprived of the radicles and of its brown-yellow cork and outer bark by peeling. It occurs in nearly cylindrical, somewhat tapering, pieces about five to eight inches long, and about half an inch in diameter. It is of a white color externally and internally, breaks with a short and granular fracture, which is fibrous only in the cortical portion from the long slender bast cells, visible also upon the surface of the commercial article, and imparting to it a somewhat hairy appearance. The surface shows longitudinal folds, and is marked with the brownish circular scars of the radicles.

The transverse section is of a yellowish-white color, exhibits the internal bark, in diameter about one-tenth of the root, and separated by the brown cambium line from the meditullium, in which ligneous bundles are not discernible with the naked eye. Marshmallow root has a faint peculiar odor, and a sweetish mucilaginous taste.

Young and peeled *belladonna roots* bear some resemblance to marshmallow, but are readily distinguished by the absence of the hair-like bast fibres upon the surface, and by the yellowish wood-bundles which are plainly visible.

The leaves (*Folia althææ*, P. G.) are petiolate, two to three inches long, ovate, or subcordate, crenately toothed and often three-lobed, of a grayish-green color, and both sides velvety-downy with stellate hairs; their taste is mucilaginous.

The medium-sized *flowers* have a nine-leaved downy involucre, five sepals and petals, the latter rose-color; stamens numerous, united in a column, and with the short claws of the petals; taste mucilaginous.

Constituents.—A. Buchner obtained (1832) from marshmallow root, 37.5 per cent. starch, 35.6 mucilage, 11 pectin, 8 asparagin and sugar, 1.25 fixed oil, 1.8 glutinous matter, 7 cellulose, and 8 phosphate of calcium. Cold water will take up the mucilage, sugar, and asparagin, while the decoction will, in addition thereto, contain starch.

Asparagin $C_4H_8N_2O_3.H_2O$ was discovered (1805) by Vauquelin and Robiquet in asparagus, and by Bacon (1826) in marshmallow root. L. A. Buchner obtained it (1862) in a convenient manner by dialyzing the mucilaginous infusion in water, and concentrating this solution to the crystallizing point. It forms colorless, inodorous, and nearly tasteless crystals, which are insoluble in strong alcohol and ether.

Pharmaceutical Uses.—Powdered marshmallow root, being very absorbent, is advantageously used to impart to soft pill masses the proper consistence. *Syrupus althææ*, P. G., is made by macerating one part of the cut root with twenty parts of cold distilled water for two hours, then straining through muslin without pressure, and dissolving in fifteen parts of the liquid twenty-four parts of sugar. It is of a yellowish color, and has a mild agreeable odor.

Allied Species.—Nearly all the plants of the natural order *Malvaceæ* possess mucilaginous properties, and many are employed in their native countries in regular or domestic practice. The following appear to deserve a passing notice:—

ALTHÆA TAURINENSIS, *D. C.*, of Southern Europe, has a rather woody root, which is used like marshmallow root.

ALTHÆA (ALCEA, *Lin.*) ROSEA, *Cavanilles*, *hollyhock*, indigenous to the Levant, frequently cultivated in gardens. The flowers are three or four inches in diameter, have a tomentose calyx, a six-cleft involucre, and five petals, which are connected at the base with the column of the united stamens. The purple-colored flowers are generally preferred.

MALVA SYLVESTRIS, *Lin.*, a native of Europe, somewhat naturalized in North America, has an erect stem, about 2½ feet high, roundish-reniform, and sharply five- or seven-lobed leaves, and whitish or purplish flowers, which resemble the preceding, but are only one inch wide, and have a pubescent three-leaved involucre.

MALVA ROTUNDIFOLIA, *Lin.*, *Common mallow*, *Petite mauve* (Fr.), *Käsekraut* (G.), indigenous to Europe, extensively naturalized in America, has a procumbent stem, round heart-shaped, somewhat lobed and crenate leaves, whitish flowers about ¼ inch broad, and numerous one-seeded carpels circularly arranged. The flowering herb is employed.

HIBISCUS (ABELMOSCHUS, *Guill. et Per.*) ESCULENTUS, *Lin.*, *Okra* or *Gombo*, indigenous to tropical America, and cultivated in most subtropical countries. The heart-shaped, about five-lobed toothed leaves, and the unripe capsules are used. The latter are about 2½ inches long, pentagonal, hairy, often curved, and contain many roundish reniform seeds.

Abutilon avicennæ, *Gærtn.*, s. *Sida abutilon*, Lin., indigenous to India and China, naturalized in Europe and America, is known here as *velvet leaf*, and has roundish heart-shaped, pointed, irregularly toothed, pale-green, velvety leaves, and yellow flowers.

Medical Action and Uses.—Marshmallow is an emollient protective, and is somewhat nutritious. It is employed in Europe as a *demulcent* in all inflammatory and irritable conditions of the mucous membrane of the respiratory, digestive, and urinary organs, and poultices formed of the bruised or powdered root are applied to local *inflammations of the skin.* The decoction has been used as an injection to allay irritation of the *vagina* and the *rectum.* The so-called marshmallow paste contains no marshmallow.

ALUMEN, *U. S.*, *Br.*—Alum.

Aluminii et ammonii sulphas, Sulphas aluminico-ammonicus.—Ammonia alum, E.; *Alun ammoniacal*, Fr.; *Ammoniakalaun*, G.

Formula $NH_4Al2SO_4.12H_2O$. Molecular weight 453.5.

ALUMINII ET POTASSII SULPHAS, *U. S.*—Potassa Alum.

Alumen, P. G.; *Sulphas aluminico-potassicus.—Sulphate of aluminium and potassium*, E.; *Alun, sulfate d'alumine et de potasse*, Fr.; *Alaun, Kalialaun*, G.

Formula $KAl2SO_4.12H_2O$. Molecular weight 474.5.

Alums are compound sulphates, readily crystallizing in cubes and octohedrons of the regular system, and containing 12 molecules of water of crystallization, and one atom each of a univalent and trivalent basylous radical. The most important trivalent radicals which are capable of forming alums are aluminium, chromium, and iron, and the univalent radicals potassium, sodium, and ammonium. Ordinarily the name *alum* is indiscriminately used for the aluminio-ammonium and for the aluminio-potassium alum, the former being recognized as such by the U. S. and British Pharmacopœias, while the French and German Pharmacopœias recognize the latter only.

Preparation.—When calcined clay containing but little iron (pipe clay) is treated with sulphuric acid until a pasty mass is obtained, this, on exposure to the air, will be gradually converted into sulphate of aluminium, which needs merely to be mixed, while in solution, with ammonium or potassium sulphate to obtain crystals of alum. Previous to calcination, the clay is often mixed with 12 to 15 per cent. of charcoal or coke, after which the combination with the sulphuric acid is more readily effected.

Large quantities of alum are made from alum stone, alum shale, and a few other minerals. The former contains aluminium and potassium sulphates and aluminium hydrate; the latter consists mainly (about two-thirds) of clay or aluminium silicate, the remainder being pyrites (sulphide of iron) and coal, together with small quantities of lime, manganese, etc.

To prepare alum from alum stone, this is calcined and then made into heaps, which are kept moist; after several months it has become disintegrated and converted into alum, which is extracted by water and crystallized.

Alum shale is broken up, and made into heaps which are exposed to the air for several months or years; or, if the mineral be very hard, it is first subjected to a process of slow roasting, by stratifying it with coal, setting fire to the heaps, and covering it more or less in order to prevent too great a rise of temperature. During the exposure the sulphur of the pyrites is oxidized to sulphuric acid, aluminium and iron sulphates being formed, which are obtained in solution by lixiviating the heaps with water. This solution is concentrated and while hot mixed with potassium chloride, which, reacting with the ferric sulphate, yields potassium sulphate and ferric chloride, the latter remaining in solution in the mother liquor, from which the alum separates on cooling as a crystalline powder. If the lixivium of the alum heaps does not contain sufficient ferric sulphate, the chloride of potassium is partly replaced by the sulphate. It is obvious that by this process potassa alum is obtained, or ammonia alum if the corresponding ammonium compound is substituted for the potassium salt. The alum is purified by one or two recrystallizations, the last one being performed in large vats which can be taken apart.

The potassium chloride necessary in this process is obtained as soap-boiler's waste, and as the refuse of saltpetre refineries. The ammonium sulphate is cheaply obtained from the liquor of gas works.

Alum is extensively manufactured in the United States, but its consumption in the arts is so great that from seven to eight million pounds of the different commercial kinds are annually imported.

Properties.—The two officinal alums are similar in every respect, except that the ammonia alum gives the odor of ammonia on the addition of hydrate or carbonate of potassium, and, when heated to redness, leaves finally alumina; while the result of potassa alum under the same circumstances is a mixture of alumina and sulphate of potassium.

Alum crystallizes in colorless transparent regular octohedrons, which are usually combined with the cube. It has an acid, sweetish, and astringent taste, and a strongly acid reaction to test paper. Its aqueous solution dissolves iron and other metals which are soluble in diluted sulphuric acid. One hundred parts of water dissolve at ordinary temperature about twelve parts, but at 100° C. (212° F.) 357.5 parts of alum (*Poggiale*). It is insoluble in alcohol. Exposed to the air, alum effloresces slightly; when heated it fuses in its water of crystallization, and after this has evaporated, solidifies again (see Alumen exsiccatum); near red heat it is decomposed, as stated above.

Tests.—The alkalies and alkaline carbonates precipitate white gelatinous hydrate of aluminium, which is insoluble in ammonia and the carbonated alkalies, but dissolves in caustic soda and potassa. Commercial alum always contains iron, from which it cannot be freed by recrystallization. It is owing to its presence that solutions of alum become blue on the addition of ferrocyanide of potassium, and yield a grayish precipitate with sulphydrate of ammonium. The solution of alum in caustic potassa yields a slight black precipitate with sulphuretted hydrogen or sulphydrate of ammonium (iron), but not a white one with the same reagents (zinc).

Pharmaceutical Uses.—For the preparation of alumen exsiccatum and of aluminium hydrate in preparing other aluminium salts.

Physiological Action.—Primarily alum constringes all organic fibres, and hence tends to diminish blood-supply and secretion in a part; but secondarily it increases both as a result of its continued use. This operation is of the utmost importance to remember in its therapeutical applications. Alum is absorbed from the stomach, and is found in the urine, liver, and spleen (Orfila); but its local action is that of an irritant, whereby it readily excites vomiting when freely administered. Its operation is not violent, however, and it does not occasion nausea. In other words, it is a mechanical emetic.

Medical Uses.—Alum is of great advantage in several *hemorrhages*, particularly in such as are of a passive type. Thus in gastric and intestinal hemorrhage its efficacy will depend upon whether the blood is rapidly or slowly extravasated; in pulmonary hemorrhage, which is generally active, its efficiency is not very great; while in menorrhagia and hæmaturia it is appropriately and beneficially employed. In various *fluxes* its astringent operation is advantageous. In *gastric* and *intestinal catarrh* it represses the secretion of mucus and the vomiting or diarrhœa that results therefrom. The *diarrhœa* of *typhoid fever* is better treated by alum than by any other astringent, except, perhaps, acetate of lead. In chronic *dysentery* it is a valuable remedy for occasional use, and in the acute form of the disease alum enemata have been found efficient. In other fluxes it may restrain the discharge, as in *diabetes*, but its efficacy is not very great. In diabetes insipidus or *polyuria* it would probably be more useful. Formerly it had much repute in chronic *bronchial fluxes*, and it is still found advantageous in diminishing excessive secretion from the air-passages, and not merely in chronic but also in acute bronchitis, and especially in that form which occurs as an element of *whooping cough*, and is attended with a profuse secretion of ropy mucus. Strangely enough, from a rational point of view, some forms of *constipation* are favorably affected by alum, as that in which the condition depends upon atony of the bowels maintained by habitual distension of them by flatus. It is still more singular that in *lead colic*, a disease in which the intestine is spasmodically contracted, alum has been proved efficient in overcoming the constipation. For this purpose it should be given in doses of from one to three drachms daily, dissolved in a large quantity of water slightly acidulated with sulphuric acid. As an emetic, alum may be employed whenever mechanical emetics are indicated. This is particularly the case in *pseudo-membranous laryngitis*, or true *croup*, a disease in which such emetics are peculiarly called for, but in which nauseants are exceedingly mischievous. In *narcotic poisoning* similar evacuants are indicated, and none is better than alum, especially in children. It probably operates not only as an emetic, but, by its action on the gastric mucous membrane, checks the absorption of the poison. Alum is one of the many remedies that occasionally cure *intermittent fever*, even after the failure of quinia.

The topical uses of alum are numerous. It is extensively employed to check *hemorrhage*. As a local hæmostatic it is used to check bleeding from the nostrils, gums, anus, vagina, bladder, and rectum; from leech-bites and from the sockets of extracted teeth, etc. In all similar cases it may be applied in powder, or in strong solution upon sponge or lint. The solution should be used warm, and allowed to cool where it is applied. Lotions of alum-water are useful in repressing local and general *sweats*, and particularly the fetid secretion of the feet, armpits, etc.; the solution should not be strong, and should be applied warm. In *ophthalmia* a solution of four or five grains to the ounce of water may be applied to the eye by instillation; but a much better method is to apply a poultice made by stirring finely powdered alum and the white of egg together, and inclosing the coagulated albumen in a cambric bag. This application is a most excellent one for recent *ecchymoses*. *Aphonia*, from laryngeal atony, is speedily diminished by gargles containing a drachm of alum in two or three ounces of barley water; and the same remedy is of constant use for the relief of *sore throat;* especially of that form, *tonsillitis*, in which the soft parts are tumid. In the graver forms of *angina*, and especially in *diphtheria* and *gangrenous pharyngitis*, gargles, insufflations, and atomized solutions of alum have been much employed, and they probably tend to promote the separation of the exudation, if not to check its formation. As far as local treatment goes, alum is useful, although less so than other agents; but the diseases in question, and especially diphtheria, are not local affections, and cannot be cured by any local treatment. Alum washes are useful in all the forms of *stomatitis*, but especially in the ulcerative form. In subacute, in mild acute, and in chronic *laryngitis*, gargles containing alum are of decided advantage, but the medicine is still more useful when it is applied to the interior of the larynx in an atomized solution. Finely powdered alum, or burnt alum, is one of the best applications for *ingrown teeth*, as when a posterior molar tooth of the lower jaw becomes partially covered by the gum, subjecting it to contusion and irritation, and producing a very painful sore. The overhanging flesh should be first cut away with a gum-lancet. In the analogous affection, *ingrown toe-nail*, the same application is of great use if ulceration with granulation have already taken place; but it is essential that scraped lint should be introduced between the nail and the sore, and that the movement of the parts should be restricted by a narrow roller of adhesive plaster. The stimulant and astringent action of alum makes it a useful application in *chilblains*. In all cases of morbid and exuberant action of mucous membranes, besides those above noticed, alum renders important services. In all forms of indolent *ulcers*, whether arising from *burns* or otherwise, and in all profuse mucous and purulent discharges from mucous membranes, when the inflammatory element is not active, and the parts are relaxed, it is one of the best remedies. Its efficacy is shown conspicuously in cases of *relaxation* of the *gums*, *uvula*, *pharynx*, *vagina*, and *anus*. In vaginal *leucorrhœa* alum injections are better than any others, and washes of the same in leucorrhœa of the vulva. In the former of these two affections a tampon of cotton coated with finely powdered alum may be applied by means of a speculum; or a cylinder of cotton cloth saturated with a solution of alum, of which the strength should vary with the grade of inflammation present. Injections of a solution of alum may be used in the treatment of *gonorrhœa* and *gleet* in the male, a weak solution being generally the most efficient. A mixture of alum, mucilage, and sulphuric ether has been applied to carious cavities for the relief of *toothache*.

Administration.—Alum may be given internally in doses of from five to forty grains, mixed with powdered sugar or with syrup. A few grains of some aromatic prevent its nauseating effects. The emetic dose is from one to two drachms given in syrup; when retching commences, vomiting may be promoted by warm water. *Alum whey* is prepared by boiling two drachms of powdered alum in a pint of milk, and straining; the *curd* left behind is applicable to the purposes already mentioned, and may be prepared with white of egg instead of milk. Alum *gargles* are made with from half an ounce to an ounce of alum in a pint of water, which may be sweetened with honey. For *collyria* a solution of two or three grains of alum in an ounce of water is usually sufficient; for *hæmostatic* uses a hot saturated solution is preferable. Pulverized burnt alum is peculiarly appropriate for insufflations.

ALUMEN EXSICCATUM, *U. S.*, *Br.*—DRIED ALUM.

Alumem ustum.—*Burnt alum*, E.; *Alun calciné* (*desseché*, *brulé*), Fr.; *Gebrannter Alaun*, G.

Preparation.—Take of Alum in coarse powder four troyounces. Expose it, in a suitable vessel, to a temperature not exceeding 205° C. (400° F.) until the residue weighs two troyounces and one hundred and twenty grains; then reduce it, when cold, to fine powder. *U. S.*

At the temperature indicated, the water of crystallization only is expelled; the weight given in the formula indicates a loss of nearly 44 per cent., so that a small quantity of water will be retained, whether potassa or ammonia alum be used. According to the British Pharmacopœia, 47 per cent. of water is to be expelled by the heat given above, so that ammonia alum only can be used, potassa alum containing but 45.5 per cent., and ammonia alum 47.7 per cent. of water of crystallization.

Properties.—After exsiccation, dried alum forms a light porous mass, which is easily rubbed into a white granular powder. It is very slowly soluble in cold water, but dissolves in a short time in six times its weight of boiling water, these tests being sufficient to prove its faultless preparation. Owing to its slow solubility, its taste is at first slight, but soon becomes more styptic than that of crystallized alum. *Impurities* may be detected in the same manner as in alum.

Medical Uses.—Burnt alum is a powerful astringent and stimulant, and, when applied to tissues in process of growth, may become escharotic. Hence, as was more particularly pointed out in the preceding article, it is used to repress fungous granulations, and stimulate indolent and sanious ulcers as well as mucous membranes tending to hypertrophy, with morbid secretion.

ALUMINII SULPHAS, *U. S.*—SULPHATE OF ALUMINIUM.

Sulfate d'alumine, Fr.; *Schwefelsaure Thonerde*, G.

Formula (crystallized) $Al_2 3SO_4.18H_2O$. Molecular weight 667.

Preparation.—Take of Alum, Carbonate of Sodium, each four troyounces; Sulphuric Acid a troyounce and one hundred and fifty grains; Water a sufficient quantity. Dissolve the salts separately, each in six fluidounces of boiling water, pour the solution of the alum gradually into that of the carbonate of sodium, and digest with a gentle heat until the evolution of carbonic acid ceases. Collect upon a filter the precipitate formed, and wash it with water until the washings are no longer affected by chloride of barium. Next, with the aid of heat, dissolve the precipitate in the sulphuric acid, previously diluted with half a pint of water, and, having filtered the solution, evaporate it until a pellicle begins to form. Then remove it to a water-bath, and continue the evaporation, with constant stirring, until a dry salt remains. Lastly, preserve this in a well-stopped bottle. *U. S.*

When solutions of carbonate of sodium and of alum are added together, a decomposition takes place, resulting in the formation of sulphate of sodium, which remains in solution; hydrate of aluminium, which is precipitated, and carbonic acid, which escapes with effervescence. $3Na_2CO_3 + 2AlNH_4(SO_4)_2 + 3H_2O = 3Na_2SO_4 + (NH_4)_2SO_4 + Al_2(HO)_6 + 3CO_2$. The Pharmacopœia orders the carbonate of sodium in slight excess over the quantity necessary for the complete decomposition of the alum. The washed aluminium hydrate dried is officinal in *P. G.*, as *Alumina (s. Argilla) hydrata.* It is combined with the sulphuric acid, yielding aluminium sulphate, which is obtained solid by evaporation. Towards the close, the heat of a water-bath must be used, to avoid overheating and loss of a portion of the water of crystallization. The yield by this process would be 1400 grains, but is usually somewhat less, a portion of the water of crystallization having been driven off.

For use in the arts, sulphate of aluminium is prepared by heating ammonia alum to a dull-red heat, when the ammonium sulphate is decomposed and expelled, leaving anhydrous aluminium sulphate; or it is made from shale and other aluminous silicates, and is known to dyers as *concentrated alum*, or *cake-alum.*

Properties.—Sulphate of aluminium may, with some difficulty, be obtained in thin lamellar crystals; but usually forms a white crystalline powder, which is insoluble in alcohol, freely soluble in water, and fuses readily in its water of crystallization, which it loses when heated to between 150° and 200° C. (302° and 392° F.), leaving 51.4 per cent. of its weight of a light porous mass, of the anhydrous salt $Al_2(SO_4)_3$. When heated to bright redness, oxygen and sulphurous acid are given off, and alumina is finally left. The salt has an acid, styptic, and, at the same time, sweetish taste. Its aqueous solution does not yield a blue precipitate with ferrocyanide of iron (iron), but is precipitated by caustic potassa, the precipitate being soluble in an excess; this alkaline solution is not affected by sulphuretted hydrogen (zinc, manganese).

The following additional preparations of aluminium have been employed:—

Acetate of Aluminium, $Al_26C_2H_3O_2(+Aq.)$, prepared by dissolving aluminium hydrate in cold acetic acid, or by decomposing aluminium sulphate with lead acetate, and evaporating at a low temperature. It is a gum-like mass, having an acid reaction and a styptic taste. The solution, heated in presence of other salts, is decomposed, with the separation of basic aluminium acetate.

An impure solution of the salt, containing also sulphate of potassium or ammonium, obtained by mixing the aqueous solutions of 6 parts of sugar of lead and 5 parts of alum and filtering from the precipitated lead sulphate, is extensively employed in dyeing as a mordant, and is serviceable as a disinfectant.

Solution of Subacetate of Aluminium, which will bear boiling and diluting with 5 volumes of alcohol without becoming turbid, has been recommended by Hager (1871). To prepare it, 35 parts of crystallized acetate of lead, 10 of litharge, and 33 of water are heated until the sediment has become white; when cold, 100 parts of water are added, and the whole well agitated. A cold solution of 31 parts of crystallized sulphate of aluminium in 130 parts of water is added, and after settling, the liquid is decanted and filtered. A little lead is precipitated by sulphuretted hydrogen, and a portion of sulphate decomposed by a little acetate of barium, the precipitate being removed by agitation with some animal charcoal and filtering. The liquid has the specific gravity 1.025, and contains 5 per cent. of the salt.

Chloride of Aluminium, in an impure state, has been used to some extent. A solution sufficiently pure for disinfecting purposes is obtained by mixing the solutions of 2 parts of alum and 1 part of anhydrous calcium chloride and filtering from the precipitated calcium sulphate. The pure salt, Al_2Cl_6, is best prepared by dissolving aluminium hydrate in hydrochloric acid and evaporating carefully, when crystals containing $12H_2O$ are obtained, which are readily decomposed by heat. In the anhydrous state, however, aluminium chloride is volatile.

Medical Uses.—On account of the acid taste of this preparation it is seldom used alone, but is either combined with zinc, or is saturated with gelatinous hydrate of aluminium and mixed with the soluble constituents of benzoin. The zinc compound is not officinal, but, in a pure state, it acts as a caustic, and, either in this state or mitigated with glycerin, it may be used to repress fungous granulations, to destroy imperfectly organized tissues and certain hypertrophies, such as vascular *nævi* and *polypoid* growths, or to stimulate tissues *chronically inflamed*, as those of the nostrils, throat, vagina, rectum, urethra, etc.

AMBRA GRISEA.—Ambergris.

Ambra cinerea.—Ambre, Ambre gris, Fr.; *Ambra, Graue Ambra*, G.

Origin.—Ambergris is regarded as a morbid product of the sperm whale, *Physeter macrocephalus*, Lin., and is found in its intestines as well as floating on the sea. One whale has been known to yield 750 pounds of this product. (*Amer. Journ. Pharm.*, 1859, p. 183.)

Description.—It occurs in irregular pieces, varying considerably in size, is opaque, of a gray or gray-brown color, with lighter and darker colored streaks and spots, lighter than water, friable in the cold, but softening when held in the hand. It is of a waxy appearance, fusible in hot water, mixing with melted fats, and soluble in volatile oils, ether, and hot alcohol. It has a peculiar fragrance, and is nearly tasteless.

Composition.—Ambergris consists mainly (about 85 per cent.) of a fatty substance resembling cholesterin, which Pelletier and Caventou have named *ambreïn.* It crystallizes from hot alcohol in white, shining, tasteless, and inodorous needles which fuse near 35° C. (95° F.). The remaining constituents, according to John (1818), are some balsamic matter, chloride of sodium, benzoic acid (?), and coloring matter.

Adulterations.—Adulterated and fictitious ambergris are readily recognized by their different physical properties.

Pharmaceutical Uses.—*Tinctura ambræ* of the French Codex is prepared by macerating 10 parts of ambergris, which, according to Stanislas Martin, should be finely powdered by trituration with washed sand, in 100 parts of 80 per cent. alcohol. It is often used for fixing very volatile delicate perfumes.

Medical Action and Uses.—Ambergris, like other strongly odoriferous animal products, has been believed to possess a stimulant action upon the nervous and circulatory systems with a special direction to the generative organs. It was used in *low fevers* and in spasmodic disorders especially of the *hysterical* sort, and often associated with musk, castor, and valerian. It was prescribed in substance in the dose of from five to twenty grains, or more frequently in ethereal solution. It is seldom if ever used, at the present day, as a medicine, but it enters into various perfumes.

AMBROSIA.—Ragweed.

Ambrosie, Fr.; *Traubenkraut*, G.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—This genus comprises coarse-looking rough or hairy weeds, with mostly opposite leaves, and with inconspicuous, yellowish, staminate flower heads arranged in elongated racemes or spikes, at the base of which 1 to 3 staminate flowers are situated in the axils of the leaves. The following two, growing in waste places in North America, have been used:—

Ambr. trifida, *Lin.*, attains a height of 8 feet and more, and has entire oval or usually deeply-trilobed leaves with the lobes oval lanceolate and serrate.

Ambr. artemisiæfolia, *Lin.*, also known as *bitterweed, hogweed, Roman wormwood*, is about 3 feet high, its leaves are thinner, smoother, and of a lighter green than the preceding, and twice pinnatifid with the divisions lanceolate. It occurs southward to Brazil.

Both species have a slight and rather fetid odor and a bitter and slightly astringent taste. *Ambr. maritima*, Lin., which resembles the last, has an agreeable odor and an aromatic bitter taste.

The constituents of these plants have not been investigated.

Medical Uses.—The two species of ambrosia, like other bitter herbs, have been employed in the cure of *intermittent* fever; its astringency has caused it to be used to moderate *discharges* of blood and mucus, and to palliate mercurial *salivation;* the stimulant qualities attributed to it are supposed to be shown in the *typhoid state* of febrile affections.

AMMONIACUM, *U. S.*, *Br.*—Ammoniac.

Gummi-resina ammoniacum.—Ammoniacum, E.; *Ammoniaque, Gomme résine ammoniaque*, Fr.; *Ammoniakgummi*, G.

A gum-resinous exudation from Dorema ammoniacum, *Don.* Bentley and Trimen, Med. Plants, 129.

Nat. Ord.—Umbelliferæ.

Origin.—The plant, which is of a striking appearance, grows to the height of 6 or 7 feet; its leaves are all radical; the hollow stem divides towards the apex into about 16 ascending branches, upon which the small globular short-stalked umbels are borne, the inflorescence forming a paniculate raceme. The root is rich in milk-juice, which rapidly diminishes in quantity, when, in about the fifth year, the stem is produced, after which the plant perishes. The gum-resin exudes from the stem and flowering branches from punctures produced by insects; an inferior kind exudes near the base of the stem among the remnants of the leaf-sheaths, and in the soil considerable quantities of hardened milk-juice are often found, which has exuded from fissures in the root produced during the hot season.

This species of Dorema prefers a silicious soil, and occurs abundantly in the deserts and barren regions of Persia and Tartary, usually accompanied by Scorodosma fœtidum, the Persian asafœtida plant, but occurring further north and northeast than the latter, extending to the southern shore of the Sea of Aral and nearly to the southeastern extremity of the Caspian Sea, while its southern limits are near Bahziran in Southern Khorassan (Borszczow, 1860).

It is not impossible that Dorema Aucheri, *Boiss.*, likewise a Persian plant, but less frequent than the former, may yield some of the commercial ammoniac.

Description.—The best quality of ammoniac occurs in dry tears from $\frac{1}{16}$ to $\frac{1}{2}$ inch in diameter, which are globular or irregularly roundish in shape, more or less flattened, externally of a pale brownish-yellow and internally milk-white. Their fracture is somewhat conchoidal, and of a waxy lustre. The tears sometimes coalesce and form irregular masses, which, when broken, show the outlines of the individual grains, without any intervening darker-colored mass.

Cake-ammoniac is of an inferior quality, and consists of the tears imbedded in the brown gum-resinous mass obtained from the base of the stem; and a kind is occasionally seen in which the tears are not larger than a pin's head, and few in number, the greatest bulk consisting of a plastic brown mass mixed with vegetable fragments and earthy matter.

Ammoniac softens by the heat of the hand, and when triturated in the mortar. It has a peculiar odor, becoming stronger by heat, and a bitter, acrid, and nauseous taste. Chlorinated lime imparts to it an orange, and potassa a yellowish color. On being triturated with water, it readily yields a white emulsion. For medicinal purposes, the tears only should be used.

African ammoniac, obtained from Ferula tingitana, *Lin.*, is not found in our market; it has a more agreeable, faint odor, somewhat like that of benzoin, and an acrid, but not bitter, taste.

Composition.—According to the analyses of Bucholz, Hagen, and Braconnot, ammoniac contains from 1.8 to 4 per cent. of volatile oil, 70 to 72 per cent. of resin, 18 to 22 per cent. of gum, 1½ to 4 per cent. of bassorin or gluten, and about 6 per cent. of moisture. The volatile oil, of which usually only between ½ and 2 per cent. is obtained, is free from sulphur (Moss, 1873). The resin, according to Przeciszewki (1861), is a mixture of an acid and an indifferent resin, and the gum is nearly identical with gum arabic.

Fused with caustic potassa, Hlasiwetz and Barth obtained (1864) resorcin, oxalic and a volatile fatty acid. On the dry distillation of ammoniac, Sommer failed to obtain umbelliferon.

Pharmaceutical Uses and Preparations.—Ammoniac may be powdered after exposure to cold, or after having been dried over lime, in the same manner as asafœtida. It forms an ingredient in Emplast. ammoniaci, *U. S.*; Empl. ammoniaci cum hydrargyro, *U. S.*, *Br.*; Empl. galbani, *Br.*; Mistura ammoniaci; Pil. scillæ comp., *U. S.*, *Br.*; Pil. ipecacuanhæ cum scilla, *Br.*

Physiological Action.—Ammoniac has always been regarded as a stimulant of the circulation and nutrition. Large doses of it were reputed to produce an eruption on the skin, besides vomiting, colic, and diarrhœa. In a plaster it occasions a papular eruption. The above effects have been questioned, but are too well established clinically to be set aside by any experiments upon healthy subjects. It is probable that they depend chiefly upon the volatile oil, and, partly, upon the resin of ammoniac.

Medical Uses.—The most important internal use of ammoniac is in the treatment of chronic pulmonary catarrh, or *bronchitis*, in which the secretion is excessive and the expectoration difficult, and there is an absence of fever. The condition of the bronchia in such cases includes passive congestion, excessive secretion, and feeble action of the circular muscles; all stimulants tend to remove this condition, and those especially which are excreted through the lungs, including the whole resinous class. Its alleged benefits in spasmodic *asthma* are probably more demonstrable in asthma associated with pituitous and other analogous forms of bronchitis. It tends to remove the exciting cause of the nervous paroxysm, but probably has a minor influence upon the spasmodic element itself. There is a certain acrimony about ammoniac, which, perhaps, explains the fact that its continued use is apt to render the bronchial and laryngeal mucous membrane dry and irritable, and, therefore, the medicine, if long continued, may increase coughing after having lessened it. It is said to be very useful in *hysterical asthma*, but with the qualification that it should be associated with asafœtida. This gives the credit of the cure to the asafœtida, which is alone entitled to it. In bronchial affections ammoniac may be administered in the form of the officinal mixture, or in that of the compound pills of squill. Externally ammoniac is used as a rubefacient in plasters for the relief of chronic *rheumatism*, especially of the muscular form, for promoting the cure of bronchial *catarrh*, chronic *pleurisy*, and various other affections requiring superficial and sustained irritation of the skin. In some of these cases the plaster of ammoniac with mercury is preferable on account of the specific action of the metal, which is very apt to display itself. The *dose* of ammoniac is from ten to thirty grains.

AMMONII BENZOAS, *U. S.*—BENZOATE OF AMMONIUM.

Ammoniæ benzoas, Br.; *Ammonium benzoicum, Benzoas ammonicus.—Benzoate d'ammoniaque*, Fr.; *Benzoësaures Ammonium*, G.

Formula $NH_4C_7H_5O_2$. Molecular weight 139.

Preparation.—Take of Benzoic Acid two troyounces; Water of Ammonia three fluidounces and a half, or a sufficient quantity; Distilled Water four fluidounces. Dissolve the acid in three fluidounces and a half of the water of ammonia, previously mixed with the distilled water; evaporate with a gentle heat, occasionally adding water of ammonia, if necessary, to maintain a slight excess of the alkali; then set aside to crystallize, and dry the crystals without heat. *U. S.*

The formula of the British Pharmacopœia is identical with the foregoing. During the evaporation of the solution considerable ammonia is given off, and an acid ammonium benzoate would be left. To obtain the neutral salt, it is necessary to add sufficient ammonia until an alkaline reaction is obtained, when the liquid is set aside to crystallize, and to avoid heat while drying the crystals.

Properties.—Benzoate of ammonium occurs in colorless or white thin laminar crystals, having a slight odor of officinal benzoic acid, and a saline, somewhat bitterish taste; it is readily soluble in alcohol and water, and when heated fuses, gives off vapors of benzoic acid, and evaporates without leaving any residue. Its solution gives, with persalts of iron, a bulky light brownish-yellow precipitate, evolves ammonia when heated with potassa, and, if it be not too dilute, deposits benzoic acid when acidulated with muriatic acid. The acid salt is less soluble, requiring about 60 parts of water and 12 parts of alcohol.

The *purity* of the salt is ascertained by its not yielding any carbonaceous mass when heated, or leaving a non-volatile residue when ignited. Its diluted solution, if acidulated with nitric acid, should not be precipitated by chloride of barium or nitrate of silver.

Medical Action and Uses.—The action of benzoate of ammonium in the system appears to be much the same as that of benzoic acid alone; and the salt possesses over the acid only the advantage of greater solubility. Its special uses are treated of in the article on benzoic acid. *Dose*, from ten to twenty grains.

AMMONII BORAS.—BORATE OF AMMONIUM.

Borate d'ammoniaque, Fr.; *Borsaures Ammonium*, G.

Formula $2(NH_4HB_2O_4).3H_2O$. Molecular weight 264.

Preparation.—One part of boracic acid is dissolved in three parts of warm ammonia water spec. grav. .960, and the solution allowed to cool slowly. The crystals are rapidly dried between bibulous paper, and preserved in a well-stopped bottle.

Properties.—The salt crystallizes in white or transparent octahedrons which have a strong ammoniacal odor, and on exposure are converted into an acid salt; they dissolve in twelve parts of cold water, and the solution, when heated, evolves ammonia, and on evaporation separates transparent octahedral crystals of an acid salt, which have no ammoniacal odor.

Medical Action.—This salt was proposed as a remedy for disorders of the urinary secretion attended with an excess of acid or of earthy phosphates, and irritability of the bladder. It does not, however, seem to have answered these purposes, since it has fallen completely into disuse. Yet it would seem to be nearly as well fitted for them as borate of sodium. The dose is from ten to twenty grains in an abundant watery solution.

AMMONII BROMIDUM, *U. S.*, *Br.*—BROMIDE OF AMMONIUM.

Ammonium bromatum.—*Bromure d'ammonium*, Fr.; *Brom-ammonium*, G.

Formula NH_4Br. Molecular weight 98.

Preparation.—Take of Bromine two troyounces; Iron in the form of wire and cut in pieces a troyounce; Water of Ammonia four fluidounces and a half; Distilled Water a sufficient quantity. Add the iron and then the bromine to half a pint of distilled water, contained in a glass flask, having the capacity of two pints, loosely cork the flask, and agitate the mixture until the odor of bromine can no longer be perceived, and the liquid assumes a greenish color. Mix the water of ammonia with half a pint of distilled water, and add it to the mixture in the flask; agitate the mixture, and heat it by means of a water-bath for half an hour; then filter, and, when the liquid ceases to pass, wash the precipitate on the filter with boiling distilled water. Evaporate the solution in a porcelain capsule, until a pellicle begins to form, then stir it constantly with a glass rod, at a moderate heat, until in granulates. *U. S.*

Bromide of iron (ferrous bromide) is first formed by allowing the iron and bromine to act upon each other in the presence of water; the greenish solution, treated with ammonia water, gives a voluminous precipitate of ferrous hydrate, which, during the subsequent heating, is partly oxidized and becomes denser, so that the solution of ammonium bromide may be more readily washed out. The same result is attained if only five-sixths of the bromine is combined with the iron to form ferrous bromide, the remaining sixth being added after filtration. On the addition of ammonia and the application of heat, a dense ferroso-ferric oxide is precipitated, from which the bromide may be easily washed out by water. The solution requires then to be evaporated and granulated by stirring it with a glass rod.

The salt is also obtained by treating bromine in the presence of water with sulphuretted hydrogen, whereby hydrobromic acid is formed, and sulphur deposited. $Br_2 + H_2S$ yields $2HBr + S$. The acid may then be neutralized by ammonia or carbonate of ammonium, and evaporated.

But, according to Charles Rice (1873), ammonium bromide prepared by the processes just mentioned is prone to decomposition, bromine being gradually liberated. This change does not occur if the salt is prepared as follows: The solutions of four troyounces of bromide of potassium in six fluidounces of boiling water, and of three troyounces of ammonium sulphate in four and a half fluidounces of boiling water, are mixed while boiling hot, and, when cool, one and a half fluidounces of alcohol are added. After 24 hours the clear liquid is decanted from the crystalline deposit of potassium sulphate, the latter washed with a little 18 per cent. alcohol, and the filtrate evaporated as before.

When bromine and ammonia are brought into direct contact in the presence of water, bromide of ammonium is formed, and nitrogen escapes. According to Dr. Pile (1874), the violence of the reaction is best controlled by keeping the two liquids at first separate from each other by a layer of distilled water; he manipulates as follows: One pound of bromine is introduced into a five-gallon stone jar, under a layer of half a gallon of water; stronger water of ammonia is then added in quantities of two or three ounces at a time, so that it will float upon the surface of the water. The jar is covered with a glass plate, and after the reaction has subsided more ammonia is added. Should the reaction become too violent, it must be moderated by placing the jar in cold water. When the color of bromine has entirely disappeared, and the ammonia is finally in slight excess, the solution is evaporated. If the salt is desired in crystals, the solution is concentrated and set aside without stirring it.

Properties.—It is either in white granular or in larger colorless prismatic crystals, which become yellowish on exposure. It has a neutral reaction to test paper, is readily soluble in water, sparingly so in strong alcohol, and has a pungent saline taste. If heat be carefully applied, it may be sublimed without change.

Tests.—It may be regarded as pure if, on being heated upon platinum foil, a non-volatile residue is not left behind. Its solution should not be precipitated by chloride of barium (sulphuric and phosphoric acids). The solution, mixed with some mucilage of starch, should not yield a blue color (which would indicate iodide) if a drop of chlorine or bromine water be added. If ten grains of the salt are dissolved in water, and the solution is well mixed with a solution of 17 grains of nitrate of silver, a curdy yellowish precipitate will appear, and the clear liquid will be merely rendered cloudy on the further addition of nitrate of silver. A white precipitate would indicate the presence of ammonium chloride, which requires a larger quantity of silver nitrate for complete precipitation than the bromide, and if no cloudiness is produced, iodide of ammonium may probably be present, which, from its greater molecular weight, is completely precipitated by less nitrate of silver. The precipitate of ten grains of ammonium bromide by sufficient silver nitrate, after washing with water acidulated with nitric acid and drying, will weigh 19.15 grains. The presence of chloride of ammonium would increase the weight of the silver precipitate.

Physiological Action.—"Bromide of ammonium, in *almost* every respect, has the same action as bromide of potassium." In animals it induces capillary anæmia, and venous congestion of the brain, thereby producing drowsiness and anæsthesia, but at the same time a liability to clonic passing into tonic convulsions. It does not appear to restrain the movements of the heart. This salt has a more acrid taste and is more irritating than the potassium bromide. It obtunds the sensibility of the mouth and pharynx as well as general reflex sensibility. It produces a papular eruption upon the skin, and its prolonged use brings on a sort of hebetude or intellectual dulness. Its unpleasant taste and irritating qualities render it less convenient for administration than the bromide of potassium.

Medical Uses.—Bromide of ammonium, in conjunction with the potassium bromide, has been used extensively in the treatment of *epilepsy;* but while it is held by some authorities that this association diminishes the bad, while it increases the good effects, of the medicines, other observers have failed to recognize in it any advantage, while they object to the unpalatable taste of the bromide of ammonium, a grave defect in a medicine which must be continuously used for a long time in the treatment of this disease. The weight of authority, however, appears to be in favor of the opinion that ten grains of bromide of potassium with three or five grains of bromide of ammonium, produce a greater sedative influence than twelve or fifteen grains of either of them administered separately. This salt has been successfully employed in some cases of *delirium tremens.* It has also been recommended as possessing remarkable virtues in *whooping-cough* during the spasmodic stage of the disease; and the success of bromide of potassium in the same affection supports the recommendation. Probably a combination of the two salts would be more efficacious than either alone. In acute articular *rheumatism* this medicine has been supposed to exert a favorable influence; but since it was first proposed a period of six or seven years has elapsed without eliciting any confirmatory experience. The intolerable itching of *prurigo* is sometimes strikingly diminished by it when given in doses of ten grains three times a day.

Dose, from ten to thirty grains three times a day. It is conveniently administered in a bitter infusion, and especially in hop tea.

AMMONII CARBONAS, *U. S.*—CARBONATE OF AMMONIUM.

Ammoniæ carbonas, Br.; *Ammonium carbonicum*, P. G.; *Carbonas ammonicus*, *Sal volatile siccum.*—*Volatile salt*, E.; *Carbonate d'ammoniaque*, *Alkali volatil concret*, *Sel volatil d'Angleterre*, Fr.; *Flüchtiges Laugensalz*, *Reines Hirschhornsalz*, *Kohlensaures Ammonium*, G.

Formula $N_4H_{16}C_3O_8=2(NH_4)_2O.3CO_2=2NH_4HCO_3.(NH_3)_2CO_2$. Molecular weight 236.

Preparation.—This compound is extensively prepared on a large scale by heating a mixture of sal ammoniac or chloride of ammonium with twice its weight of chalk, in an earthen retort, and passing the vapors through an iron pipe into a leaden chamber where they condense. The chalk is used in excess to prevent sublimation of undecomposed chloride of ammonium, which would otherwise be apt to contaminate the product. It is then purified by resublimation from iron vessels. The reaction results in the formation of chloride of calcium and neutral carbonate of ammonium, which on condensation is converted into a salt of the above composition, water and ammonia being given off. $6NH_4Cl+3CaCO_3$ yields $3CaCl_2+2(NH_4)_2O.3CO_2+2NH_3+H_2O$. A similar result is obtained by using sulphate of ammonium in place of the chloride, when sulphate of calcium will be found in the residue in the retort. The ammonium salts used being almost exclusively those obtained from coal-gas liquor, the first sublimate contains tarry products, from which it is freed by resublimation. Nearly 600,000 pounds are annually imported into this country from Great Britain.

Properties.—Carbonate of ammonium is found in commerce in white crystalline translucent masses, having a strong ammoniacal odor and alkaline reaction. Exposed to the air it parts with ammonia and carbonic acid, becomes opaque, and falls into a white powder of bicarbonate of ammonium, NH_4HCO_3, which is likewise obtained by washing the powdered officinal carbonate with some cold water, when the acid carbonate is left behind, the solution containing neutral carbonate of ammonium: $2NH_4HCO_3.N_2H_6CO_2 + H_2O$ yields $2NH_4HCO_3 + (NH_4)_2CO_3$. The solution of the entire compound in water represents, therefore, a mixture of neutral and acid ammonium carbonate. It is not completely soluble in alcohol.

Composition.—Of the formulas given above, the first one is purely empirical. The second represents the salt as a compound of two molecules of oxide of ammonium with three of carbonic acid gas (anhydrid). According to the last formula it is a compound formed by the union of two molecules of ammonium bicarbonate with one of ammonium carbonate, from which a molecule of water has been separated. This last-mentioned compound $(NH_3)_2CO_2$ has been regarded as the ammonium salt of carbamic acid (which is unknown in the isolated state), and hence is called ammonium carbamate, the formula of which is $NH_4NH_2CO_2$.

Tests.—Carbonate of ammonium should be completely volatilized when heated upon platinum foil; a residue would indicate the presence of non-volatile salts. The solution in diluted acids should be free from empyreumatic odor. Dissolved in a slight excess of diluted nitric acid, it is not precipitated by chloride of barium (sulphate), nitrate of silver (chloride), or sulphuretted hydrogen (metals). Traces of iron may frequently be detected in this solution by ferrocyanide or sulphocyanide of potassium. The presence of ammonium bicarbonate is indicated by the change of the translucent mass into an opaque pulverulent condition. Occasionally the bicarbonate has been observed (see *American Journal of Pharmacy*, 1874, p. 540) in translucent solid masses mixed with the officinal article. In this condition it has but a faint odor of ammonia, which is entirely lost on exposure to the air; it dissolves slowly in water at the ordinary temperature, giving off carbonic acid gas.

Fifty-nine grains of carbonate of ammonium dissolved in one ounce of distilled water will be neutralized by 1000 grain measures of the volumetric solution of oxalic acid. *Br.*

Pharmaceutical Uses and Preparations.—Carbonate of ammonium reacts with nearly all inorganic and organic salts with the exception of those of sodium and potassium, and is therefore incompatible with them. Prescribed with syrup of squill or similar preparations the annoyance caused by the evolution of carbonic acid is best overcome by triturating in a mortar the carbonate with a little of the syrup, adding the latter gradually, if admissible alternately with water or a tincture. The generation of carbonic acid in many reactions renders it necessary to triturate the ingredients of pill masses containing carbonate of ammonium with some strong alcohol until the reaction has been completed, when the excipient may be added. The salt is used in making Cuprum ammoniatum, Ferri et ammonii tartras, *U. S.;* Liquor ammon. acetat., Spir. ammon. arom., *U. S.*, *Br.*

AMMONII BICARBONAS.—NH_4HCO_3 is obtained by treating the powdered officinal carbonate of ammonium with about twice its weight of water, when carbamate will be dissolved; or by exposing the former to the air, when the carbamate will evaporate, being decomposed into carbonic acid gas, CO_2, and ammonia, NH_3. Bicarbonate of ammonium is a white powder, which when perfectly dry is free from ammoniacal odor, has a cooling saline taste, is insoluble in alcohol, and is therefore precipitated by it from the aqueous solution of the officinal carbonate; it dissolves in eight parts of cold water and crystallizes in rhombic prisms.

AMMONII CARBONAS PYRO-OLEOSA s. *Ammonium carbonicum pyro-oleosum*, P. G., s. *Sal volatile cornu cervi.*—Thirty-two parts of carbonate of ammonium are thoroughly incorporated with one part of ethereal animal oil.

Physiological Action. *On Animals.*—In poisonous doses this salt, when given to dogs by the stomach, produces retching and vomiting, followed first by general convulsions, and then by tetanoid rigidity and death, after which the stomach is found actively congested and inflamed, and its epithelium softened. The blood in the veins is either liquid or but slightly coagulated. When the salt is introduced into the connective tissue, similar symptoms and lesions are produced, including the inflammatory alterations of the gastric mucous membrane. It does not render the urine alkaline. Fifteen and even twenty-five grains have been injected into the veins of dogs without notable result, except a transient spasm of the abdominal muscles. It is remarkable that the salt does not appear to undergo decomposition, nor does it cause any free ammonia to be exhaled with the breath or from the blood. This fact is the more remarkable since carbonate of ammonium mixed with blood no longer living becomes decomposed. The tetanoid spasms above referred to are very marked where the agent acts through the blood; there is a momentary suspension of the inspiratory act, which is followed by rapid breathing. Section of the vagi, after the rapid breathing has commenced, does not occasion the labored action which is observed in animals, not poisoned, after this operation. When the section is performed before the administration of the salt, the primary arrest of respiration is prevented, but not the subsequent hurried breathing. These phenomena are ascribed (*Lange*) to the production by ammonia of an abnormally excited action of the respiratory centre in the medulla oblongata, which, under normal conditions, is but transiently or not at all stimulated by inspiratory impulses conducted through the par vagum to the brain.

On Man.—The direct effect of carbonate of ammonium, when taken in doses of from five to ten grains, is to cause some increase of the fulness and force of the pulse and a sense of tightness about the head, sometimes with throbbing. It is also said to increase the temperature of the body during health, and excite the secretions of the skin, kidneys, and bronchia. In larger doses, say from ten to twenty grains, it excites vomiting. In still larger doses, it occasions symptoms of inflammation in the throat, gullet, and stomach, tetanoid convulsions, and death. In a case which proved fatal, intense inflammatory lesions were found in the organs last mentioned, and also congestion of the lungs, with œdema. Long-continued use of the salt deranges the stomach, causes diarrhœa, and emaciation, and a dissolution of the blood, with symptoms resembling those of scurvy. The last-mentioned effect it displays in common with the other alkaline salts, especially those of sodium.

Medical Uses.—This medicine has been used in *typhus fever* and in the *typhoid state* of various febrile affections, that is to say, in which nervous disorder is associated with a tendency to dissolution of the blood. Thus it has been found beneficial in the fever just named, in low forms of *typhoid fever*, *typhoid scarlatina*, *measles*, *erysipelas*, *pneumonia*, etc. There is no reason to suppose that it is, in any sense, a specific for those affections. Like other stimulants, it urges the organs to perform their functions until the poison which is the cause of their debility is eliminated, and probably it also quickens their performance of this work. In appropriate doses it has the advantage over alcohol that it leaves no depression behind it, and over turpentine that it is not apt to occasion any local derangements. Like other stimulants, its virtues depend upon the dose in which it is administered. In excessive doses, it is perturbative and irritant; and if long continued, even in doses which the stomach will tolerate, it impairs nutrition in the manner stated above. It is probable that its efficacy in the treatment of bites of *venomous serpents* and *insects* and in *alcoholic intoxication* is, in a great degree, due to its stimulant action; but the extraordinary rapidity with which it will, when applied locally, arrest the pain and inflammation of insect bites, and, when taken internally, suspend even a high degree of drunkenness, seems to render probable that it exerts also a more direct antidotal power. In various forms of *bronchitis*, both primary and secondary, it may be employed; the cases in which it is most useful being those which have passed the acute stage, and which tend to become chronic, with dilatation of the bronchia, or with consolidation of the vesicular tissue, constituting the so-called broncho-pneumonia. When this form of disease arises, as it often does, as a consequence of measles, ammoniacal medicines ought never to be neglected. The *dyspepsia* of drunkards is said to be favorably modified by this medicine, probably by its combined antacid and stimulant properties, which counteract the acidity and dissolve the tenacious mucous secretion of the organ. The antacid property of the salt has led to its use in cases of excessive secretion of *uric acid;* and in *diabetes* it sometimes diminishes the quantity, as well as the saccharine condition of the urine. Like other volatile ammoniacal preparations, it is useful in alleviating *headache*, whether dependent upon acidity of the stomach, or upon exhaustion of the nervous system. Its stimulant quality renders it useful in *faintness*, *syncope*, *nervous spasms*, etc.; and when mixed with sal ammoniac and scented with an aromatic oil, it forms the usual smelling-salts employed to relieve the symptoms just referred to, and also to dissipate congestion of the nostrils in commencing *coryza*. Externally, it is sometimes applied to promote the resolution of *glandular swellings*. It has also been administered internally for the same purpose.

Administration.—Carbonate of ammonium is generally given in a watery solution, and its acrimony is blunted by the use of mucilage, sugar, or liquorice. As a stimulant expectorant, its dose is two or three grains, or more, repeated every two or three hours. In low fevers, five or ten grains should be given every hour or two, until five or six doses are taken. An emetic effect is produced by thirty grains.

AMMONII CHLORIDUM, *U. S.*, *Br.*—CHLORIDE OF AMMONIUM.

Ammonia muriatica, *Ammonium muriaticum s. hydrochloratum*, *Chloruretum ammonicum*, *Sal ammoniacum*, *Ammoniæ hydrochloras s. murias.*—*Muriate of ammonia*, *Sal ammoniac*, E.; *Chlorure d'ammonium*, *Sel ammoniac*, *Muriate d'ammoniaque*, Fr.; *Salmiak*, *Chlorammonium*, G.

AMMONII CHLORIDUM PURIFICATUM, *U. S.*—PURIFIED CHLORIDE OF AMMONIUM.

Ammonium chloratum, P. G.; *Sal ammoniacum depuratum*, *Ammonium muriaticum depuratum.*—*Chlorure d'ammonium pur*, Fr.; *Reiner* (*gereinigter*) *Salmiak*, G.

Formula NH_4Cl. Molecular weight 53.5.

Preparation. 1. CRUDE CHLORIDE OF AMMONIUM.—Chloride of ammonium is most generally obtained from the so-called coal-gas liquor, a watery liquid, condensed in the preparation and purification of illuminating gas from coal, and containing principally carbonate of ammonium, besides some sulphide, cyanide, and empyreumatic products. This is occasionally neutralized by muriatic acid, or decomposed by chloride of calcium, in both of which cases a solution of ammonium chloride is obtained, which is evaporated and the dry salt afterwards sublimed. More frequently, the gas-liquor is neutralized by sulphuric acid, and the resulting solution of ammonium sulphate evaporated and crystallized. The more or less brown-colored crystals are mixed with sodium chloride (table salt), and the mixture is sublimed from iron pots, the vapors being condensed upon the inside of leaden or iron domes. On the application of heat a mutual decomposition of the ammonium sulphate and sodium chloride occurs, resulting in the formation of ammonium chloride which sublimes, and sodium sulphate which remains behind. $(NH_4)_2SO_4 + 2NaCl$ yields $2NH_4Cl + Na_2SO_4$. From the corrosive action of the vapors upon iron, the product is always contaminated with chloride of iron.

Instead of using sulphuric acid in the preparation of ammonium sulphate, the gas-liquor may be digested with powdered gypsum (sulphate of calcium), which is thereby converted into carbonate of calcium. Any liquid containing ammonia or carbonate of ammonium, like the aqueous liquor obtained on the destructive distillation of bones or other animal matter, may be employed in the same manner as coal-gas liquor. The annual importation of sal-ammoniac amounts to over 700,000 pounds.

2. Purified Chloride of Ammonium.—Take of Chloride of Ammonium in small pieces twenty troyounces; Water of Ammonia five fluidrachms; Water two pints. Dissolve the chloride of ammonium in the water, in a porcelain dish, with the aid of heat, add the water of ammonia, and continue the heat for a short time; filter the solution while hot, and evaporate to dryness, with constant stirring at a moderate heat, until it granulates. *U. S.*

The object of this process is to remove the iron, which is precipitated by the ammonia as ferric hydrate, and separated by filtration, while hot. If the sal ammoniac has been otherwise pure, the filtrate may be evaporated to dryness, and granulated, as directed by the Pharmacopœia. If, however, it contains other impurities besides the iron, it is best to allow the filtrate to cool, stirring it occasionally, and to collect the crystalline powder upon a muslin strainer. The impurities will remain in the mother-liquor.

Properties.—Sal ammoniac is imported in casks containing the salt in colorless or whitish translucent masses, which are of a fibrous crystalline structure, very tough and difficult to powder. It is free from odor, and has a cooling and strongly saline taste. Its specific gravity is 1.45, and it is soluble in about three parts of cold and in little more than its own weight of boiling water. During the solution of the salt in water much heat becomes latent, and the temperature is considerably reduced. It is less freely soluble in spirituous liquids. On the application of heat it volatilizes without residue, and is condensed again unchanged. When the solution is heated with potassa or lime, gaseous ammonia is given off; and when treated with nitrate of silver, a curdy white precipitate is produced; but no change occurs on the addition of chloride of barium. The ordinary sal ammoniac always contains iron, derived from the vessels in which it has been prepared; its solution in water, therefore, turns blue on the addition of ferrocyanide of potassium.

Purified chloride of ammonium forms a snow-white granular crystalline powder, the solution of which has a faint acid reaction, and does not acquire a bluish-black color by tannin, or a blue coloration on the addition of ferrocyanide of potassium. The solubility of pure chloride of ammonium in water has been ascertained by Alluard (1864) for the following temperatures, and a barometric pressure of 718 mm., at which 100 parts of water will hold in solution :—

	28.40	32.84	37.28	41.72	46.16	50.60	55.04	59.48	63.92	68.36	72.80	77.24 parts of NH_4Cl.
At	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110° C.

Gerardin gives (1865) the following figures indicating the solubility of chloride of ammonium in 100 parts of alcohol, specific gravity 0.939 : At 4° C. 11.2, at 8° 12.6, at 27° 19.4, at 38° 23.6, and at 56° C. 30.1 parts of NH_4Cl.

Pharmaceutical Uses.—Chloride of ammonium is used for generating ammonia, in preparing ammonii valerianas, aqua ammoniæ, and spiritus ammoniæ.

Physiological Action.—*On Animals.* The general result of experiments in which chloride of ammonium was administered internally by the stomach or by the veins to different animals, is that it acts as a depressant of the nervous system, generally inducing tetanic spasms. In some experiments the salt, when injected into the veins, produced temporary paralysis, and not spasm. On the mucous membrane of the alimentary canal it appears to act by increasing the secretion of mucus, and rendering the blood less coagulable, without, however, impairing the constitution of its corpuscles.

On Man.—The direct effects of doses of from five to twenty grains of the salt repeated at intervals of several hours, are a sense of oppression, warmth, and uneasiness in the stomach, some fulness of the head, and an increased tendency to urinate. If it is used for many days together in full doses, it disturbs the digestion, coats the tongue, and impairs the appetite; it may even occasion gastric pain, vomiting, and diarrhœa. Its habitual use is said to cause emaciation. The idea which has appeared chiefly to direct its use in medicine is, that it tends to render all the secretions freer and more abundant, while it, at the same time, lessens the plasticity of the blood; in other words, that its operation is in some respects identical with that attributed to mercury. Its efficacy in certain cases of neuralgia would appear to point to another mode of operation; those cases, namely, which are apparently pure neuroses, and not painful conditions of the nerves due to pressure upon them by the neurilemma or by the periosteum of bony canals.

Medical Uses.—Chloride of ammonium is sometimes used with a view of determining the cutaneous efflorescence in *eruptive fevers;* but it is of more value in promoting the cure of obstinate *intermittent fevers*, doubtless through its powerful influence upon the function of nutrition. This value is, however, very uncertain and restricted. In *bronchitis* that has passed its inflammatory stage few medicines are more efficient than this; and in all the chronic forms of the affection, especially in persons of a feeble and relaxed habit of body, it is a most valuable remedy when given either alone or associated with stimulant expectorants. *Whooping-cough* is benefited by its use when the sputa are tenacious and excessive. Its wholesome stimulation is manifested in cases of *chronic pharyngitis*, accompanied with a flaccid state of the mucous membrane and a glairy secretion. A similar secretion from other mucous membranes, constituting *gleet*, *leucorrhœa*, etc., is often modified favorably by it. The alterative action of the medicine, *i. e.*, its slow but steady modification of the nutrition of tissues, is exhibited by its beneficial action in *amenorrhœa* and *dysmenorrhœa*, when the former depends upon torpor of the uterine system, and the latter upon chronic engorgement of the uterus with or without catarrh. This action is doubtless exerted by it in those cases of cure which it brings about in the various general disorders that arise from sympathy with the uterine system at the *menopause.* It is also in this manner that it appears to be useful in certain cases of fibrous *tumors of the uterus.* To a similar mode of action may be referred its utility in chronic *glandular enlargements*, as in those of the *thyroid body*, the *prostate*, the *liver*, etc. In the case of the liver, its administration has been alleged to diminish the tendency to *hepatic abscess;* but such an assertion must be difficult to substantiate.

The forms of *neuralgia* in which hydrochlorate of ammonium is beneficial are not easily defined. According to certain statements it is equally useful in rheumatic and idiopathic neuralgias, in those depending upon local congestions, and those associated with anæmia, as well as those of less easy definition, which are connected with uterine, gastric, and other functional disorders. We have no doubt that it is chiefly serviceable in neuralgia depending upon cold, in which, indeed, especially in neuralgia of the fifth pair, the intercostal nerves, and the sciatic nerve, it sometimes exerts a very prompt and salutary action. In those cases of diffused neuralgic headache known as hemicrania, and often associated with gastric acidity, this medicine is sometimes beneficial, but less so than the carbonate or the liquid preparations of ammonia. In the muscular aches which are produced by the prolonged and repeated use of the same set of muscles, and which have been styled *myalgia*, this medicine is of service if the tired organs are allowed repose. A somewhat analogous condition obtains in chronic *muscular rheumatism*, for which, also, the medicine may be advantageously prescribed. Like other ammoniacal preparations, it has been used with alleged benefit for *snake-bites*, but associated with such other active remedies that a judgment of its share in the result is impossible. It has also been recommended in the treatment of *hemorrhage* from the stomach, the uterus, and the lungs; but, except in the case of the uterus, the tendency of bleeding to cease spontaneously is so well known that the influence of a medicine in controlling it demands a stronger demonstration than is offered in this case.

The stimulant action of this salt has been employed to stay the progress of *gangrene*, especially of the senile variety. It should be applied in cataplasms or in local baths, according to the situation of the disease. The same action is very usefully resorted to in the treatment of *contusions* and lacerated and contused *wounds*. In local *inflammations* the cold produced by this salt while dissolving may sometimes be taken advantage of. A mixture of five parts of it with as many of nitrate of potassium, and sixteen parts of water, will lower the thermometer from 50° to 10° F. Such a mixture contained in a bladder has been used to promote the reduction of hernial tumors, and in various cutting operations of minor surgery. Chloride of ammonium forms a useful ingredient of *errhine* powders, *gargles*, *dentifrices* for whitening the teeth, *cosmetic* preparations for removing the pimples of *acne* from the face, plasters for the treatment of enlarged *bursæ* and *joints*, and atomized solutions for the cure of *pharyngeal* and *laryngeal* affections requiring direct stimulation. Among the last are nervous *aphonia* and *chronic bronchitis*.

Administration.—The dose of chloride of ammonium varies from five to thirty grains; but a larger dose than ten grains is seldom necessary. It is best administered in solution, and its taste may be disguised by the addition of extract of liquorice or the syrup of liquorice root. In bronchial diseases its virtues are increased by this association.

AMMONII IODIDUM, *U. S.*—IODIDE OF AMMONIUM.

Ammonium jodatum, *Ioduretum ammonicum*—*Iodure d'ammonium*, Fr.; *Jodammonium*, G.

Formula NH_4I. Molecular weight 145.

Preparation.—Take of Iodide of Potassium in coarse powder four troyounces; Sulphate of Ammonium in coarse powder a troyounce; Boiling Distilled Water two fluidounces; Alcohol, Water, each a sufficient quantity. Mix the salts, add them to the boiling water, stir well, and allow the mixture to cool; then add a fluidounce of alcohol, mix well, and reduce the temperature, by a bath of iced water, to about 40°, throw the mixture into a cooled glass funnel, stopped with moistened cotton, and when the clear solution has passed, pour upon the salt a fluidounce of a mixture containing two parts of water and one part of alcohol. Lastly evaporate the solution rapidly to dryness, stirring constantly; and preserve the residue in a well-stopped bottle. *U. S.*

One molecule of ammonium sulphate and two molecules of potassium iodide decompose each other when mixed in solution with the formation of iodide of ammonium and sulphate of potassium. $2KI + (NH_4)_2SO_4$ forms $2NH_4I + K_2SO_4$. The latter salt, being insoluble in alcohol, will separate from the solution as a crystalline powder on the addition of alcohol and the cooling of the mixture, after which the filtrate may be evaporated to dryness. This is essentially the process suggested by Jacobson in 1863. The minute quantity of sulphate of potassium contained in it does not interfere with its medical properties. If a chemically pure salt is desired, the product may be dissolved in alcohol, filtered from the insoluble potassium sulphate, and evaporated as before.

Other processes have been proposed, of which the following may be mentioned: Hydriodic acid is neutralized with ammonia or carbonate of ammonium. Ferrous iodide is decomposed by carbonate of ammonium, and the filtrate evaporated (Ch. Ellis, 1835). Iodide of potassium and bitartrate of ammonium are made to react upon each other in hot solutions. On cooling, bitartrate of potassium crystallizes, and the evaporated filtrate, still containing some of this salt, is treated with 70 per cent. alcohol, which dissolves only the ammonium iodide (W. H. Pile, 1862). Iodine is treated with sulphide of ammonium until the brown color has completely disappeared, when the solution is boiled, filtered from the liberated sulphur, and evaporated (Spencer, 1852).

When iodine is added to ammonia water, iodide of ammonium is produced; but at the same time the extremely explosive compound iodide of nitrogen results. Mixtures of the two substances named should therefore be made with great caution.

Properties.—Iodide of ammonium is in white granular crystals having the specific gravity 2.498. If the air is excluded, they sublime undecomposed, but in contact with the atmosphere acquire a yellowish-brown color. The salt is deliquescent, and dissolves freely in water and alcohol, the solutions becoming yellow on exposure. Iodine is liberated on the addition of nitric acid, and ammonia by potassa or lime. The aqueous solution, mixed with some mucilage of starch, becomes blue on the addition of a little chlorine water.

Tests.—The purity of the salt is recognized by its complete volatility and by its solution yielding not any, or only a slight, turbidity with barium chloride (sulphate). Bromide and chloride of ammonium are recognized by precipitating the solution with silver nitrate, and adding ammonia in excess, in which silver iodide is very sparingly soluble, so that the ammoniacal liquid will yield merely a slight turbidity on the addition of nitric acid. If a precipitate occurs, this is agitated with chlorine water gradually added in the presence of chloroform, which will be colored red if bromine be present; if the chloroform is not colored, the impurity is a chloride. The solution of ten grains of iodide of ammonium, treated with nitrate of silver, yields a precipitate which, after washing and drying, weighs 16.8 grains.

Physiological Action and Medical Uses.—This salt has the general properties of the alkaline iodides, but is more active as well as more transient in its effects. It is said that eight grains (Böcker) and even twenty grains (Gamberini) may be taken at a dose without other bad effect than some warmth and irritation of the throat and stomach. It was first used in an ointment for *psoriasis*, *tinea capitis*, and other scaly affections of the skin, particularly those due to a syphilitic infection; and it was afterwards administered internally for the same class of affections with success. As a topical application in ointments and poultices, it reduces *enlarged glands*, and being more irritating than iodide of potassium, is probably superior to the latter salt for this purpose; but it is inferior to the iodide of lead. A solution of thirty or forty grains of the salt in a fluidounce of glycerin has been used with the same object, and also as an application to enlarged and indurated *tonsils*. The *dose* of this iodide is from one to five grains and upwards. It should be dissolved in water with syrup, and dispensed in bottles of blue glass to prevent its decomposition by the light. An ointment, containing from thirty to sixty grains of the salt in an ounce of lard, should be freshly prepared when required.

AMMONII NITRAS, *U. S.*—NITRATE OF AMMONIUM.

Ammoniæ nitras, Br. Add.; *Ammonium nitricum, Nitrum flammans.—Nitrate of ammonia*, E.; *Azotate d'ammoniaque, Nitre inflammable, Nitre ammoniacal, Sel ammoniacal nitreux*, Fr.; *Salpetersaures Ammon (Ammonium, Ammoniak)*, G.

Formula NH_4NO_3. Molecular weight 80.

Preparation and Properties.—Nitric acid is neutralized with ammonia or carbonate of ammonium, or, in place of the latter, the pulverulent bicarbonate, which accumulates in the shops, may be advantageously employed; the solution is concentrated by evaporation and crystallized, or until it congeals on cooling. It crystallizes in hexagonal prisms or needles, or occurs in colorless crystalline masses. It has the specific gravity 1.70, and possesses a sharp bitterish taste. It deliquesces in contact with moist air, and dissolves at ordinary temperatures in about half its weight of water, and in about three parts of alcohol of the specific gravity 0.880. On the application of heat it softens and then fuses at 108° C. (226.4° F.), and when rapidly heated, is decomposed into water, nitrous acid, and nitrogen, or into nitrous and nitric oxides, nitrite of ammonium, and ammonia; but, if gradually heated to near the temperature of 200° C. (392° F.), it is decomposed into water and nitrous oxide or *laughing gas*, N_2O. This decomposition is effected according to the following equation: $NH_4NO_3 = N_2O + 2H_2O$. It is evident from this that in the preparation of nitrous oxide gas, to be used for inhalation, the heat should be carefully regulated, and the gas passed through solutions of potassa (or lime-water) and ferrous sulphate, whereby all the gaseous impurities, except the nitrogen which may be present, are completely removed, even if chlorine should have been evolved in consequence of the presence of ammonium chloride in the nitrate.

It detonates when thrown upon red-hot charcoal, or when mixed with powdered charcoal and heated to 170° C. (338° F.). When mixed with sulphuric acid, nitric acid vapors are given off, and potassa or lime evolves ammonia when heated with the aqueous solution.

Tests.—The salt should be completely volatilized without charring when heated upon platinum foil, and its aqueous solution should not be precipitated either by silver nitrate or barium chloride (absence of chloride and sulphate).

Medical Action.—This substance is not used in medicine. It is made officinal as the source from which nitrous oxide gas is derived by means of heat.

AMMONII PHOSPHAS.—PHOSPHATE OF AMMONIUM.

Ammoniæ phosphas, Br.; *Ammonium phosphoricum*, P. G.; *Phosphas ammonicus.—Phosphate of ammonia*, E.; *Phosphate d'ammoniaque*, Fr.; *Phosphorsaures Ammon (s. Ammonium s. Ammoniak)*, G.

Formula $(NH_4)_2HPO$. Molecular weight 132.

Preparation.—Take of Diluted Phosphoric Acid twenty fluidounces; Strong Solution of Ammonia a sufficiency. Add the ammonia to the phosphoric acid until the solution is slightly alkaline, then evaporate the liquid, adding ammonia from time to time so as to keep it in slight excess, and when the crystals are formed, on the cooling of the solution, dry them quickly on filtering-paper placed on a porous tile, and preserve them in a stoppered bottle. *Br.*

This process yields the salt by the direct union of tribasic phosphoric acid and ammonia. Since the salt has a distinct alkaline reaction, and heat expels a portion of the ammonia, it becomes necessary to add ammonia water from time to time, and particularly when the solution is set aside to crystallize, in order to preserve the alkaline reaction; otherwise, this so-called neutral salt will be mixed in variable proportions with the acid phosphate, having the composition $NH_4H_2PO_4$. The officinal salt may also be obtained from bones calcined to whiteness, by the officinal process for phosphate of sodium (which see), if the carbonate of sodium there directed is replaced by carbonate of ammonium, and the resulting liquid, after suitable concentration, is rendered alkaline by the addition of some ammonia. If necessary, the salt obtained is to be purified by recrystallization from distilled water, with the addition of a little ammonia until the crystals are free from sulphate. If the crystallizing liquid should have been rendered very strongly alkaline by ammonia, the salt would consist of or contain some so-called basic orthophosphate of the formula $(NH_4)_3PO_4$.

Properties.—The officinal phosphate of ammonium occurs in transparent colorless prisms having the specific gravity 1.678 (Buignet, 1861). It has a cooling and sharply saline taste, effloresces superficially in a dry atmosphere, is insoluble in alcohol, but dissolves in 4 parts of cold and in less of boiling water. The solution evolves one-half of the ammonia on continued boiling, and the salt, when heated, fuses and is gradually converted into metaphosphoric acid. The solution yields a yellow precipitate with nitrate of silver, and evolves ammonia when heated with potassa.

Tests.—Twenty grains of the salt, dissolved in water and precipitated by ammonio-sulphate of magnesium, yield a crystalline precipitate, which, when well washed with diluted ammonia water, dried and ignited, weighs 16.8 grains (*Br.*). The solution acidulated with nitric acid should yield no precipitate with barium chloride (sulphate) or silver nitrate (chloride). Ten grains of the salt, gradually heated upon platinum foil to redness, should leave a residue weighing 6.1 grains.

Physiological Action and Medical Uses.—This medicine was originally proposed as a remedy for *gout* and *rheumatism*, upon the theoretical ground that it would produce, with the uric acid in the system, more soluble salts than those of soda and lime, which form the bases of gouty concretions. By a singular perversion of logic, the same condition was assumed to exist in rheumatism, which is a totally different disease, essentially as well as clinically. It was, indeed, pointed out that, even from a chemical point of view, the administration of the medicine would be apt to favor the formation of ammoniaco-magnesian calculi. However, it was alleged that during the use of the medicine uric acid rapidly disappeared from the urine, and the pains and other local phenomena in the joints during acute gout and rheumatism subsided, just as they do in the latter disease under the use of the carbonates of the alkalies. No general concurrence in the results of observation has confirmed the special if not specific advantages ascribed to this medicine at its introduction, and which are neither greater than those of the other alkalies, nor different from them. Like them, phosphate of ammonium has been found very serviceable in many cases of *diabetes*, by maintaining a highly alkaline condition of the blood, and thereby diminishing the amount of sugar eliminated with the urine. The *dose* is from ten to twenty grains, three times a day, dissolved in water, or in some mild liquid such as barley- or rice-water.

AMMONII SULPHAS, *U.S.*—SULPHATE OF AMMONIUM.

Ammonium sulphuricum, Sal ammonium secretum Glauberi.—Sulfate d'ammoniaque, Sel secret de Glauber, Fr.; *Schwefelsaures Ammon* (*s. Ammonium s. Ammoniak*), G.

Formula $(NH_4)_2SO_4$. Molecular weight 132.

Preparation.—Sulphate of ammonium is largely obtained from coal-gas liquor (see Ammonii chloridum) by neutralizing it with sulphuric acid, or by digesting it with sulphate of calcium. A convenient process is to percolate the gas liquor through powdered gypsum, whereby carbonate of calcium is left in the percolator, and sulphate of ammonium is found in the filtrate. $CaSO_4+(NH_4)_2CO_3$ yields $CaCO_3+(NH_4)_2SO_4$. The solution is evaporated, the resulting crystals are gradually heated to about 240° C. (464° F.) to expel tarry compounds, and then recrystallized from water. Nearly all that is consumed in the United States is manufactured here.

Properties.—It forms colorless rhombic crystals, isomorphous with sulphate of potassium, and having a sharp saline and bitterish taste. It has the specific gravity 1.76, fuses at 140° C. (284° F.), and is decomposed at a heat exceeding 260° C. (500° F.), yielding ammonia, water, nitrogen, and sulphite of ammonium. 100 parts of water dissolve, according to Alluard (1864),

71.00	73.65	76.30	78.95	81.60	84.25	86.90	89.55	92.20	94.85	97.50 parts
at 0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100° C.

It is insoluble in absolute alcohol, but dissolves sparingly in alcohol diluted with water. When heated with potassa or lime, its solution evolves ammonia, and chloride of barium produces in it a white precipitate, but nitrate of silver does not disturb it.

Uses.—This salt is extensively used in the manufacture of ammonia water, chloride of ammonium and ammonia alum; also for Ferri et Ammonii Sulphas.

Medical Action.—This salt is not used as a medicine.

AMMONII VALERIANAS, *U. S.*—VALERIANATE OF AMMONIUM.

Valérianate d'ammoniaque, Fr.; *Baldriansaures* (*Valeriansaures*) *Ammonium*, G.

Formula $NH_4C_5H_9O_2$. Molecular weight 119.

Preparation.—Take of Valerianic Acid four fluidounces. From a mixture of chloride of ammonium in coarse powder, and an equal weight of lime previously slaked and in powder, contained in a suitable vessel, obtain gaseous ammonia, and cause it to pass, first through a bottle filled with pieces of lime, and afterwards into the valerianic acid, in a tall, narrow, glass vessel, until the acid is neutralized. Then discontinue the process, and set the vessel aside that the valerianate of ammonium may crystallize. Lastly, break the salt into pieces, drain it if necessary in a glass funnel, dry it on bibulous paper, and keep it in a well-stopped bottle. *U. S.*

The practical details of this process were published by B. J. Crew (1860), and are based upon Chevreul's observation that concentrated valerianic acid, placed in an atmosphere of ammonia, yields this salt in crystals. On the combination of the dry ammonia gas with the acid much heat is produced, and after neutralization has been attained, the salt crystallizes readily on cooling.

Properties.—Valerianate of ammonium, thus prepared, forms colorless or white quadrangular plates, having the odor of valerianic acid and possessing a sharp and sweet taste. It effloresces when placed in a dry atmosphere, and deliquesces in moist air. On the application of heat, it fuses, giving off ammoniacal and acid vapors, and is finally dissipated without leaving any residue. It dissolves freely in water and alcohol, the solutions, on evaporation, acquiring an acid reaction from the loss of ammonia. Alkalies decompose it with the evolution of ammonia, and the stronger acids with the separation of oily valerianic acid floating upon the aqueous solution. Should the salt have an acid reaction, its solution, when dispensed, should be neutralized by the careful addition of some ammonia, whereby the disagreeable odor and taste of valerianic acid are masked to a considerable extent.

Tests.—Heated to redness upon platinum foil, the salt leaves no residue (potassium, etc., salts). Its aqueous solution, after having been acidulated with nitric acid, is not precipitated by chloride of barium (sulphate) or nitrate of silver (chloride), or, after having been rendered alkaline by ammonia, by sulphate of magnesium (phosphate). When the aqueous solution is treated with an excess of sulphuric acid and the clear watery liquid is nearly neutralized with ammonia, a red coloration is not produced on the addition of a little tersulphate of iron (absence of acetate).

Medical Uses.—Of the physiological action of this salt we have no knowledge; like several other medicines, including valerian itself, its influence is exhibited chiefly in certain morbid conditions due to exhaustion of the nervous system. It was first employed successfully for the relief of *neuralgia* of this description, and it continues to be used as a convenient palliative for that affection, for *nervous headache*, *nervousness*, *insomnia*, *hysterical disorders*, *palpitation of the heart*, etc. It would be a waste of time to prescribe it in cases of epilepsy, chorea, and fully-formed hysterical convulsions. *Dose*, from two to ten grains dissolved in water, with the addition of a flavoring tincture, which also preserves the salt from decomposition.

AMPELOPSIS.—VIRGINIA CREEPER.

American ivy, E.; *Vigne vierge*, Fr.; *Amerikanischer Epheu*, G.

The young branches and bark of Ampelopsis quinquefolia, *Mich.*

Nat. Ord.—Vitaceæ.

Description.—The Virginia creeper is a woody vine, climbing extensively by adventitious roots and by tendrils; it has digitate leaves composed of five oblong lanceolate somewhat dentate leaflets, and cymose clusters of greenish flowers, producing acidulous blue-black berries of the size of a pea. The young branches and bark are employed, and collected in autumn. The plant is indigenous to North America, and is often cultivated here and in Europe as a covering for walls.

Constituents.—The leaves were analyzed by Wittstein (1845) and by Gorup-Besanez (1872 and 1874). Collected in June they contain albumen, sugar, pyrocatechin, free tartaric acid, potassium bitartrate, and calcium tartrate; when collected in September no potassium bitartrate or free tartaric acid was found, and in addition to the other constituents pectin and glycolate of calcium were obtained. The berries contained the same principles except glycolic acid.

The root of *Amp. botrya*, DeC., of Southeastern Africa, is reputed to possess diuretic properties.

Medical Action.—There appears to be nothing recently added to the scanty statements long ago made regarding this plant. A decoction or infusion of the bark was said to be useful in dropsy, and "to act rather by stimulating absorption than as a diuretic." The therapeusis of this statement is probably as ill-founded as its physiology.

AMYGDALA AMARA, *U. S.*, *Br.*—BITTER ALMOND.

Amygdalæ amaræ, P. G.; *Semen amygdali amarum.*—*Amandes amères*, Fr.; *Bittere Mandeln*, G.

The seed of the bitter almond tree, Amygdalus communis, var. amara, *Lin.*

AMYGDALA DULCIS, *U. S.*, *Br.*—SWEET ALMOND.

Amygdalæ dulces, P. G.; *Semen amygdali dulce.*—*Amandes douces*, Fr.; *Süsse Mandeln*, G.

The seed of the sweet almond tree, Amygdalus communis, var. dulcis, *Lin.* Woodville, Med. Bot., plate 83; Bentley and Trimen, Med. Plants, 99.

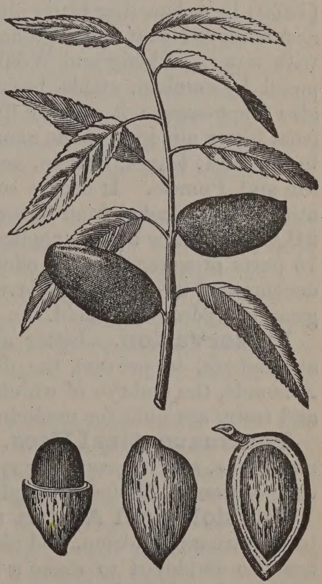
Amygdalus communis, *Lin.*, s. Prunus Amygdalus, *Baillon.*

Nat. Ord.—Rosaceæ, Amygdaleæ.

Origin.—The almond tree is probably indigenous to Western Asia, but at an early period was introduced into Northern Africa and Southern Europe, where, by long cultivation, numerous varieties have been produced, differing mainly in the size and shape of the fruit, and in the hardness of the shell (endocarp). The tree attains a height of 15 to 20 feet, and with its bright green foliage and large rose-colored or white flowers, presents a handsome appearance. The bitter and sweet almond trees do not differ from each other botanically, and even the fruits and seeds of the two varieties resemble each other closely.

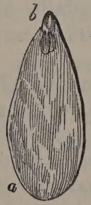
Description.—The sweet and bitter almonds cannot be distinguished from each other except by one of their constituents and their taste. Bitter almonds are usually thinner, broader, and shorter than the larger variety of the sweet almond, which is ordered by the British Pharmacopœia, and which is known in our commerce by the name of *Jordan Almonds.* They are cultivated in Spain, and exported from Malaga, and are a hard-shelled variety, but occur frequently in commerce deprived of the shell. The soft-shelled sweet almonds are exported from Valencia and the Mediterranean ports of France and Italy.

Fig. 7.



Amygdalus communis, *Lin.*

Fig. 8.



Almond split longitudinally. *a.* Cotyledon. *b.* Radicle and plumule.

Jordan or Malaga almonds are about an inch in length, flattened and ovate lanceolate in shape. The testa is of a cinnamon-brown color, and scurfy upon its surface from detached cells; it adheres to the whitish tegmen, and the two integuments are easily detached from the white embryo or kernel (blanched) after the seed has been soaked in lukewarm water for a short time.

The hilum is just below the pointed end and upon one edge of the almond, the raphe running along this edge to the broad end where it forms the broad chalaza, and divides into about 16 branches, which pass in plainly visible lines towards the pointed end. The embryo consists of two plano-convex white and oily cotyledons of the size and shape of the seed, between which, near the pointed end, the flat plumule is placed, with the short thick radicle somewhat projecting. Almonds are inodorous, and have a sweetish bland taste, that of the bitter variety being decidedly bitter and aromatic.

The embryo of both varieties of almonds yields, on being triturated with water, a milk-white emulsion, which is either inodorous and sweet, or aromatic and bitter, according to the variety used.

Constituents.—Both varieties of almonds have qualitatively the same composition except that amygdalin is found in bitter, but not in sweet almonds. The fixed oil (see Oleum amygdalæ expressum) is present to the amount of 45 to 56 per cent., the sweet almonds yielding usually from 5 to 10 per cent. more than the bitter. About 3 per cent. of mucilaginous matter, 6 per cent. of sugar, and 24 to 30 per cent. of protein compounds, besides water and cellular tissue, are found in almonds. The sugar is mostly glucose, but Pelouze obtained (1855) also cane sugar. The two protein compounds are, according to Ritthausen (1872), modifications of vegetable casein. Both are soluble in cold water; one, the *amandin* of Comaille (1866), being precipitated by acetic acid, while the second compound, known as *emulsin* or *synaptase*, may afterwards be precipitated by alcohol, together with some inorganic salts. Both protein compounds act as emulsionizing agents in suspending the fixed oil when the almonds are triturated with water; but it appears to be the emulsin only which is capable of decomposing the amygdalin of bitter almonds into hydrocyanic acid and benzaldehyd (see Oleum amygdalæ amaræ).

Amygdalin $C_{20}H_{27}NO_{11}$ was discovered by Robiquet and Boutron-Charlard (1830) by exhausting bitter almonds, deprived of their fixed oil, by alcohol; they also observed that the residue would not yield oil of bitter almonds in contact with water. Liebig and Wöhler found (1837) that amygdalin, on being decomposed by emulsin, yields, besides oil of bitter almonds and hydrocyanic acid, also grape-sugar; it was the first glucoside discovered. Amygdalin is obtained from bitter almonds to the amount of from 1 to 3 per cent., and is also contained in the bark, leaves, flowers, and seeds of many trees of the suborders Amygdaleæ and Pomeæ. It occurs sometimes in an amorphous condition, but as obtained from alcohol from bitter almonds, peach kernels, etc., it crystallizes with $2H_2O$, the water being expelled at 120° C. (248° F.). It is soluble in about 15 parts of water, has no odor, but a bitter taste, and is not poisonous unless decomposed by emulsin. Seventeen grains of anhydrous amygdalin yield one grain of hydrocyanic acid.

Preservation.—Bitter almonds should be kept unbroken and in a dry atmosphere, to prevent the decomposition of amygdalin and of the fixed oil. Almonds, the embryo of which has become discolored or acquired a rancid odor and taste, are unfit for medicinal purposes.

Pharmaceutical Uses.—Both varieties are employed for obtaining oleum amygdalæ, and in preparing syrupus amygdalæ. Sweet almonds enter into the composition of Mistura amygdalæ, *U.S.*, and Pulv. amygdalæ comp., *Br.*

Physiological Action and Medical Uses.—Sweet almonds are used to prepare an emulsion, and also an oil, which are treated of elsewhere. They are also employed to make a kind of bread which is a tolerable substitute for wheaten bread in the treatment of *diabetes.* Bitter almonds and their essential oil, are excessively poisonous in large doses, owing to the quantity of hydrocyanic acid developed in the former by a mixture with water, and by the presence of the same acid in the latter. A drachm of bitter almond pulp will kill a pigeon or a kitten. The symptoms produced in man by an overdose of this substance are great debility and depression, and, if the dose is fatal, there is sudden insensibility and frothing at the nose and mouth, and after death the eyes remain fixed and glistening. Non-poisonous doses are apt to produce an eruption of urticaria; an effect which sometimes follows the ingestion of sweet almonds.

In preparing the almond for food in cases of *diabetes*, it is first blanched, then subjected to a strong pressure to expel a portion of the oil, treated with boiling water slightly acidulated with tartaric acid to remove the sugar, and then ground to a fine powder which can be made into cakes and puddings with eggs and cream. These products have a pleasant taste and are said to be quite digestible.

AMYL NITRIS, *Br. Add.*—NITRITE OF AMYL.

Amylum nitrosum, Amylæther nitrosus.—Amylo-nitrous ether, E.; *Azotite d'amyl*, Fr.; *Amylnitrit*, G.

Formula $C_5H_{11}NO_2$. Molecular weight 117.

Preparation.—Purified amylic alcohol is introduced into a capacious glass retort with about an equal bulk of nitric acid; a gradually increasing heat is applied until the mixture approaches boiling, when the reaction will proceed spontaneously. The distillate is collected until the temperature in the retort rises above 100° C. (212° F.), the portion distilling at a higher temperature containing much nitrate of amyl and ethylamylic ether. The distillate obtained below 100° is agitated with water and an alkali (potassa, lime, or their carbonates) to remove hydrocyanic, nitric, and nitrous acids; and the oily layer, which separates, is rectified from a clean retort by a gradually increased heat; amylic aldehyd coming over in the first portion, that distilling between 95° and 100° C. is collected separately. (See *Amer. Journ. of Pharmacy*, 1871, p. 147.)

This is Balard's process (1844), with some modifications. A. B. Tanner (1871) prepares it more advantageously by mixing, in a glass retort containing some copper wire, ten measures of pure amylic alcohol with one measure of sulphuric acid, and one measure of nitric acid previously diluted with an equal bulk of water. On the application of a gentle heat, the reaction will commence at about 18.3° C. (65° F.), and gradually rise to about 36.6° C. (98° F.). The contents of the retort are cooled, more nitric acid is added, and the distillation continued as before as long as any ether is obtained. This is then washed and rectified as before.

Properties.—Nitrite of amyl is an ethereal liquid of a yellowish color and a peculiar, not disagreeable, odor. It has the specific gravity 0.877, and boils at 96° C. (205° F.). It is insoluble in water, but dissolves in rectified spirit in all proportions. If it be added drop by drop to caustic potassa while fused by the application of heat, valerianate of potassium will be formed, frequently with the production of flame. It may be considered pure if its physical properties agree with the above. *Nitrate of amyl* has the spec. grav. 0.902 and boils at 137° C. (278.6° F.).

Physiological Action. *On Animals.*—Experiments made with this compound (which was introduced as an anæsthetic by Dr. Richardson in 1863) show that it is readily absorbed by all the tissues, is not an anæsthetic or a local irritant, nor does it produce unconsciousness until its other effects are fully developed. It prevents the changes which give to arterial and venous blood their contrasting hues, and causes a cyanotic hue of the tongue and other vascular parts. The blood in both sets of vessels acquires a brownish color. Primarily it quickens the respiration, but its prolonged action retards the movements of the chest. It greatly lowers the animal temperature, especially when given in a lethal dose. These phenomena are explained by the fact, which was determined experimentally, that under the influence of the vapor the blood contains two-thirds less than the normal proportion of oxygen, and the hæmoglobulin loses its power of crystallizing. This nitrite primarily reduces arterial pressure, dilating the capillaries; while the action of the heart, for this reason probably, becomes very frequent; but, if the use of the nitrite is prolonged, the pulse-rate is lowered. It is held, on the one hand, to increase the irritability of the spinal cord, on the ground that animals under its influence pass into a tetanoid condition (Meyer and Friedrich); and on the other, that it is a direct and paralyzing poison to the muscles (Pick).

On Man.—On being inhaled the heart becomes excited, the pulse rising from 70 to 160; its force, as measured by the sphygmograph, diminishing; the skin, and especially the face, turning crimson; some vertigo is experienced, and the breathing is hurried as it is after rapid walking. If the dose is large, the sight may be dimmed; and in the field of vision sometimes a yellow circle appears, surrounded by a violet border. It neither increases nor lessens general sensibility. In full doses it depresses the normal temperature by from one to three degrees Fahr. Sanders has recorded cases in which sudden collapse followed upon its administration, and Samelsohn one in which the usual flush was succeeded by deadly pallor; the pulse becoming thread-like and slow, the skin cold and clammy, and respiration difficult and gasping, although consciousness was retained. Others are referred to by Jastrowitz. It is alleged that the action of this medicine is exceedingly capricious; that while some persons can without injury inhale thirty or forty drops, others are sensibly affected even by the fraction of a drop.

Uses.—The power of nitrite of amyl to dilate the capillaries is said to have suggested its use in *angina pectoris*, *epilepsy*, and other spasmodic diseases. It is certain that in many cases of the former disease the inhalation of two or three drops suffices to arrest the paroxysm of pain, or materially to mitigate it. The various lesions which may give rise to angina render these differences of effect intelligible. In some cases, probably those which are either purely functional or connected with the less serious organic lesions of the heart and aorta, the habit of using the medicine appears to render the attacks both less frequent and less severe. But, in course of time, like other nervines, its influence declines. The mode of action of the medicine in this disease appears to be simply anodyne, and not antispasmodic, as is generally taught. In pure *neuralgia*, especially of the fifth nerve, it sometimes relieves the pain promptly; and the same may be said of *nervous headache* and of *gastralgia*. In *spasmodic asthma*, also, it frequently brings prompt relief in proportion to the purely nervous character of the attack. In several cases it appears to have suspended dyspnœa produced by fatty degeneration and other debilitating lesions of the heart. Persistent *hiccough* has yielded to its use. There appears to be good reason for believing that it sometimes cures *chorea;* but for this purpose it must be administered two or three times daily for several days. Several cases of traumatic *tetanus* have recovered under the use of this medicine; and since, in experiments upon frogs tetanized by strychnia, death was prevented by the use of nitrite of amyl until the elimination of the poison, it is probable that the same effect might ensue, and even more promptly, in man. In the cases of tetanus successfully treated by the nitrite, it was administered two or three times a day, and in doses of only five drops. In *trismus nascentium* it has also been found to control the spasms. The same statement is true of *puerperal eclampsia.* In one such case the use of the medicine was followed by relaxation of the uterus and profuse hemorrhage. In *hysterical convulsions* it has also arrested the paroxysm, but in no degree modified the general course of the disease nor lessened the frequency of the attacks. If we may trust the published reports, its influence upon *epilepsy* is more permanent and radical; it would seem not only to prevent the development of the paroxysms when applied early, but also to render their occurrence less frequent. This is particularly true of the cases in which several successsive paroxysms make up the attack. Necessarily it must be most useful when the fit is preceded by an aura or other warning symptom; but in those cases in which the fits are subintrant, the remedy usually produces a very sensible amelioration. It is to be noted that when the medicine is applied during the fit, and when the face is very livid, this color is gradually replaced by a vivid flush in proportion as consciousness returns. Epilepsy cannot be cured by this medicine. It has been employed to relieve *pain* more or less of a *spasmodic nature* occurring in the œsophagus, diaphragm, stomach, bowels, bladder, urethra, uterus, vagina, etc. A case of *blepharospasm* is recorded in which the patient is said to have been cured by the inhalation of this compound in very unusual doses, viz., from f℥ss to f℥j from one to three times a day for four successive days. It has arrested the paroxysm of *intermittent fever*, when inhaled during the cold stage, in the dose of four drops. In a case of *exophthalmic goitre* two drops were found to be an excessive dose; and "one-tenth of a drop" was directed to be taken half an hour before eating, with a complete relief of all the subjective symptoms (Blake). The patient was a nervous female. In a case of profound and prolonged, and apparently fatal *syncope* in a man affected with cardiac "dilatation and hypertrophy," the inhalation of the nitrite produced a complete restoration (O'Neill). This medicine is highly recommended in *sea-sickness.*

One of the most important qualities of nitrite of amyl consists in the antagonism of its primary action to *chloroform narcosis.* It is certain that chloroform contracts, and that the nitrite of amyl dilates, the capillaries of the brain and of the skin of the face; under the former the patient grows pale, under the latter he is flushed. Or, in experiments upon animals, if the nitrite be used in an excessive dose, cyanosis arises in consequence of venous engorgement. Experiments have also shown that if it is given, according to the latter method, to an animal already narcotized by chloroform, it deepens, instead of relieving the narcotism, while if it be administered in moderate quantities, either by inhalation or hypodermically, it revives the heart's action and removes the pallor caused by the chloroform. These effects have been happily illustrated in at least five cases of chloroform poisoning. In all of them the patients were rescued from imminent death.

Administration.—Nitrite of amyl may be given in the dose of from three to five drops by the mouth, dissolved in a little aromatic spirit; and it has sometimes been injected hypodermically in cases of chloroform poisoning. Usually, however, it is administered by inhalation, about five drops being poured upon the palm of the hand, a piece of sponge, or a folded napkin; or else it is carried in a well-stoppered bottle (especially by epileptics), to be used when the fit threatens. Tubes and, still better, tears of glass, containing about five drops each, are also employed by the same class of patients; the glass being crushed in a handkerchief and its contents inhaled. It should rarely be used when syncope is produced by profuse hemorrhage, or when there is organic disease of the heart or brain.

AMYLENUM.—AMYLENE.

Valerene, E.; *Amylène*, Fr.; *Amylen*, *Valeren*, G.
Formula C_5H_{10}. Molecular weight 70.

Preparation.—It was discovered by Balard (1844) by distilling amylic alcohol with a concentrated solution of chloride of zinc. Bauer (1861) recommends the leaving in contact for several days 2 parts of amylic alcohol with 3 parts of fused chloride of zinc, and then distilling until the temperature has risen to about 135° C. (275° F.). The distillate contains some amylic alcohol, water, and amylene with its polymeres. All these impurities have a much higher boiling point, and are removed by careful rectification in a water-bath and over chloride of calcium; it is more difficult to separate from amyl hydride, which boils at nearly the same temperature.

Properties.—Amylene, when pure, is a thin, volatile, inflammable liquid, having a disagreeable cabbage-like odor. It boils at 34° C. (93.2° F.), has at 10° C. (50° F.) the specific gravity .6549, and is soluble in alcohol and ether, but insoluble in water.

Amyl hydride, C_5H_{12}, which is contained among the most volatile portions of petroleum, and in the light tar-oil of cannel coal, resembles the preceding, but has a more agreeable ethereal odor, recalling that of chloroform, and boils at 30° C. (86° F.).

Physiological Action.—This substance, which was introduced by Snow in 1856, was shown by him to produce unconsciousness and anæsthesia in animals very rapidly, but not in proportion to the amount inhaled, since a very large part of it was expelled without having been absorbed. It produced death suddenly by causing arrest of the heart. In *surgical operations* in which it was used, anæsthesia was observed to be complete in many instances before consciousness was lost; while under ether or chloroform, unconsciousness precedes anæsthesia. Its action occurs more promptly than that of either of the substances just named, but its effects pass off with like rapidity. It does not cause sickness at the stomach as readily as they do. But, whatever its advantages may be, the occurrence of several cases of sudden death during its use caused it to be laid aside.

AMYLUM, *U. S.*, *Br.*—STARCH.

Amylum tritici.—Wheat starch, E.; *Fécule (Amidon) de froment, de blé*, Fr.; *Stärke, Kraftmehl, Weizenstärke*, G.

Composition $C_6H_{10}O_5$. Molecular weight, 162.

The fecula of the seed of Triticum vulgare, *Kunth.*

Nat. Ord.—Graminaceæ.

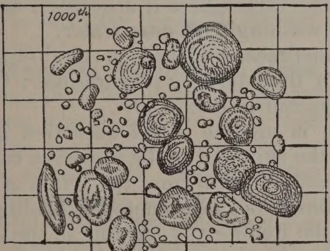
Preparation.—Wheat or other grain is soaked in warm water to which sometimes an alkali is added, until the outer coating has become soft; it is then ground under water, and, upon suitable sieves, washed with pure water, with which the starch passes through and is collected by subsidence in suitable tanks, the alkaline water retaining the gluten; or the latter is removed by allowing it to undergo decomposition, when acetic, butyric, or lactic, and other acids are produced. After sufficient washing with pure water, the starch is drained in boxes, cut into cubical blocks, and dried in properly constructed drying chambers.

Description.—Starch is found in most vegetables at some period of their growth, and occurs in the different plants in very different proportions. It is nearly always deposited in the cellular tissue; but is also found suspended in the milk-juice of some plants. From whatever source obtained, starch appears to the naked eye in the form of a fine white powder, the particles of which frequently adhere together superficially so as to form irregular columnar masses. Under the microscope, the powder is observed to consist of distinct grains of a peculiar shape and size, which vary with the plant from which the starch has been obtained. The smallest starch granules, observable with the aid of a microscope, are globular in appearance, but the form of the larger granules, such as potato-starch, arrow-root (see Maranta), etc., is quite characteristic, so that the origin of starch may, by this means, be detected with tolerable certainty.

These granules are evidently made up of layers, apparently differing somewhat in density, and more or less concentrically arranged around a nucleus or hilum, which in many cases is not in the centre, but near the margin or one end of the granule. With respect to the relative age of the different layers, the fact that the innermost ones are softer or less dense is regarded by Schleiden, Payen, Nägeli, and others as conclusive evidence that the outer ones were first deposited, and that those near and around the hilum originated later, while Fritzsche, Berg, and others, on the contrary, find that this condition is a proof of the external growth of the granules, by deposits of fresh and denser layers around the more or less gelatinous nucleus. All these layers are considered by many investigators to be of the same composition, and to differ from each other mainly in the amount of moisture retained by them. Opinions, however, in relation to the existence of an enveloping membrane differing in composition, are considerably at variance with one another. Those investigators who explain the formation of the starch granules by external additions, reject its existence, and, according to Schleiden, the denser outer layer of the granule which is first deposited is uniform and of precisely the same chemical behavior as the remainder. Payen, Persoz, and Nägeli, on the other hand, find that the starch proper has been deposited within a very thin membrane, which has some of the characteristics of cellulose. If starch is acted upon by being digested with saliva, pepsin, or bile, it is dissolved, according to Nägeli, with the exception of a minute residue which does not swell on being boiled with water, and requires to be treated with sulphuric acid before it is colored blue by iodine, but dissolves in ammoniacal solution of cupric oxide. For this outer membrane the name *amylin* has been proposed, while the portion soluble in hot water has been named *granulose* and *amidin.* The chlorides of zinc and calcium dissolve starch completely without leaving any residue.

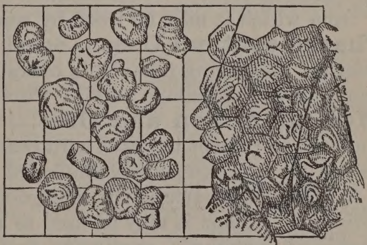
Wheat starch, when viewed under the microscope, is found to consist of nearly circular and flat or lenticular granules, the largest of which are about $\frac{1}{1000}$ inch in diameter, and are mixed with many minute granules, but with few of an intermediate size. The hilum, if observable, is near the centre of the circle, the indistinct layers forming nearly uniformly concentric rings.

Fig. 9.



WHEAT (TRITICUM)

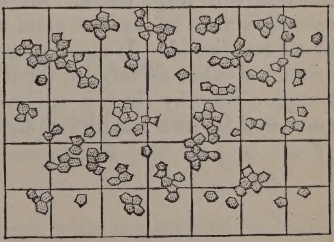
Fig. 10.



MAIZE (ZEA)

Corn starch, which is extensively used in the United States, is obtained from maize or Indian corn, Zea Mays, *Lin.* The granules are more uniform in size, but only about two-thirds as large as those of wheat-starch; they are oblong muller-shaped or roundish and irregularly angular, with a usually slit hilum and indistinct layers.

Fig. 11.



RICE (ORYZA)

Rice starch from Oryza sativa, *Lin.*, consists of polygonal granules less than one-fifth the diameter of wheat starch, and smaller than all other commercial starches.

For a description of other starches see Avena, Hordeum, Maranta, Sago, and Tapioca.

Properties.—Starch forms a white, inodorous, and tasteless powder, with a peculiar slippery feel between the fingers; it is insoluble in ether, alcohol, and cold water; the last-mentioned liquid, however, when triturated with starch so that some of the granules are ruptured, evidently dissolves a little, since it acquires, after filtration, a blue color on the addition of iodine. Starch becomes soluble in cold water in the presence of the chlorides of zinc and of calcium, and of other deliquescent or freely soluble salts. Its solution in hot water gelatinizes on cooling, the jelly of wheat starch being milk white; that of potato starch, particularly when made with much water, being more translucent.

Mucilage of starch, when heated to about 160° C. (320° F.), or when boiled with very diluted sulphuric acid, or when digested with diastase at about 70° C. (158° F.), is converted, according to Musculus (1860), first into dextrin and dextrose, $C_6H_{12}O_6$, the former passing finally likewise into glucose. *Dextrin*, which has the composition of starch, $C_6H_{10}O_5$, is prepared on a large scale by heating starch in an oven for an hour or two to 180° C. (356° F.). In its pure state it is an amorphous gummy mass, readily soluble in water, but insoluble in alcohol and ether; its solution is dextrogyre and does not reduce an alkaline solution of copper. Iodine imparts to starch in the presence of water a blue color; this so-called *iodide of starch* contains not over 7.5 per cent. of iodine, and is generally regarded as not being a chemical compound, and the color, which varies in intensity and shade, as being due to the fine division of the iodine; the color disappears on the application of heat, but reappears on cooling. (See *Iodinium.*) Bromine colors the starch brown. Fuming nitric acid transforms starch into *xyloidin*, $C_6H_9(NO_2)O_5$, which is a white, tasteless powder, insoluble in alcohol, but softening in boiling water. A filtered solution of starch in water yields with tannin a flocculent precipitate which is soluble in boiling water.

Starch which has been exposed to the atmosphere contains from 10 to 13 per cent. of moisture, which is given off at 100° C. (212° F.), and is reabsorbed on exposure. The spec. grav. of starch is about 1.5, but after complete drying is increased to 1.56. When confined in a damp atmosphere it acquires a musty odor from which it may be freed by repeated washing with pure water.

Pharmaceutical Uses.—Starch is sometimes employed as an absorbent powder for preserving pills; it is contained in the following preparations: Glycerinum amyli; Mucilago amyli; Pulvis tragacanthæ comp. *Br.*

Medical Action and Uses.—Starch is used in dilute decoction as a demulcent, to protect irritated surfaces upon the skin and in the digestive canal. As a powder it is extensively employed to shield the skin from the action of the air; to diminish the friction of contiguous surfaces, and to promote the healing of excoriations. Thus it may be used to allay the itching and burning of the skin in *erythema*, *urticaria*, *erysipelas*, and in cases of confluent *smallpox*. In the form of a thick mucilage it has been employed to prevent pitting in the last named disease. Bandages saturated with starch mucilage are used in dressing *fractures* and other injuries in which absolute rest of the injured part is required. This mucilage is constantly employed as a lenitive injection in inflammations of the *rectum* and the *bladder*, and as a vehicle for applying narcotic and other substances to those parts. Mixed with water, starch is the best antidote to the caustic action of *iodine* upon the stomach, as it forms with this substance a bland compound. It also forms the surest test of the presence of iodine in the urine and other secretions, for it strikes a characteristic blue color with this substance. Starchy food is to be avoided in fermentative *dyspepsia*, in consequence of its own liability to undergo fermentation.

ANACARDIUM.—CASHEW-NUT.

Acajou à pommes, Fr.; *Caschunuss*, G.

The fruit of Anacardium occidentale, *Lin.* *Nat. Ord.*—Terebinthaceæ.

Origin.—This is the fruit of a small tree, with coriaceous, shining, oval, entire, and very obtuse leaves, and loose racemes of small whitish or purplish flowers. After fructification the pedicels of the pistillate flowers become large, fleshy, pear-shaped, and edible, having an acidulous taste, and bear upon their summits the nut-like fruit. The plant is indigenous to tropical America, and has been naturalized in some portions of Africa and the East Indies.

Description.—The fruit is about an inch long, somewhat less broad, and about one-third of an inch thick. It is kidney-shaped, convex on the back, with a scar on one of the rounded ends, of a gray-brown color, and inodorous. The shell is hard and brittle, contains a very acrid oily liquid, and incloses a single white seed, having the shape of the fruit, and possessing a mild oily taste.

Constituents.—The cotyledons contain some bland fixed oil. Vieira de Mattos (1831) found in the pericarp tannin, gallic acid, soft acrid resin, etc. Staedeler (1847, 1848) separated the vesicating principle, *cardol*, $C_{21}H_{30}O_2$, as a yellowish or reddish oil, evolving, when heated, a faint aromatic odor, and readily soluble in alcohol and ether. It is obtained from the ethereal extract, which is washed with water to remove tannin, dissolved in alcohol, and digested and afterwards boiled with hydrate of lead to remove *anacardic acid* and ammonia salt. The remaining color is removed by some basic lead acetate. Anacardic acid, when pure, is white and crystalline, has an aromatic, afterwards burning taste, but is not vesicating.

The *oriental cashew-nut* is the fruit of *Semecarpus anacardium*, Lin. fil., s. *Anacardium latifolium*, Lam., a tall tree of India. The nut is about an inch long, flattish heart-shaped, obtuse, smooth, glossy, and black. The pericarp and cotyledons have the same properties and probably the same constituents as the preceding.

Medical Action and Uses.—Although the kernel, when roasted, and even when raw, is edible, the juice furnished by the rind of the cashew-nut is acrid and almost caustic, and has been used for destroying *corns*, *warts*, and *vegetations*, and as an epispastic. But the latter application of it is very objectionable, not only because it is slow in its operation, but because it is very apt to be carried by the patient's fingers to the genitals and other parts, and give rise to a very painful and persistent eczematous eruption. The liquid contained in the blisters has a similar property. A like effect is produced by the fumes arising from the nuts while roasting. It is stated (Buchheim) that the oil has a very faint and hardly acrid taste, and that three or four drops of it may be swallowed without marked effects. This contrast with its action upon the skin is attributed to its total insolubility in the watery fluids of the digestive canal, while upon the dry skin nothing interferes with its irritant action. It has, however, been used as a *vermifuge*.

ANDIRA.—CABBAGE TREE BARK.

Écorce de geoffrée, Fr.; *Kohlbaumrinde*, *Wurmrinde*, G.

The bark of Andira (Geoffroya, *Swartz*) inermis, *Kunth*, and of Andira (Geoffroya, *Lam.*) retusa, *Kth.*

Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—Both species are medium-sized trees, with impari-pinnate leaves, terminal racemes of red flowers, and roundish hard one-seeded pods. The first-named species is a native of Jamaica and other West Indian islands, the second is found in Surinam and Cayenne.

Description.—*Jamaica* cabbage tree bark occurs in long pieces about one-eighth of an inch thick, gray or whitish, and fissured externally, upon the inner surface brownish and striate, internally brown or brownish, radially striate, and with yellowish bast fibres in tangential rows, which cause the laminated fibrous appearance of the bark when broken transversely. It yields a grayish powder, has a feeble but disagreeable odor, and a mucilaginous bitter taste.

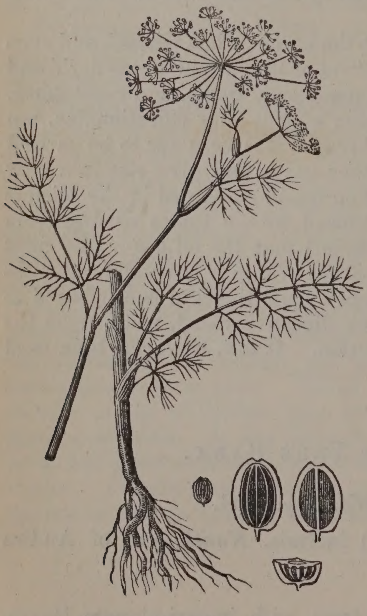
Surinam cabbage tree bark resembles the preceding, but is internally dark-red brown, has a checkered and glossy appearance on transverse section, yields a cinnamon-colored powder, is nearly inodorous, and has a bitterish acrid taste.

Constituents.—Hüttenschmid (1824) discovered in each of the cabbage tree barks an alkaloid, which he named *jamaicina* and *surinamina*, the former of which was proved by Gastell (1866) to be identical with berberina. The latter is described as being in fine white needles, scarcely soluble in cold water, alcohol, and ether, but readily soluble in boiling water. The other constituents are those commonly occurring in plants; the bark from Surinam contains also notable quantities of tannin.

Allied Species.—AND. ANTHELMINTICA, s. *Geof. vermifuga*, Marat, is a tall forest tree of Brazil. The seeds known there as *angelim amargosa* are of the size of a nutmeg, oblong, somewhat horny, yellowish, usually in transverse or longitudinal sections, whitish internally, inodorous, and almost tasteless. They are regarded as anthelmintic. According to Peckolt (1858) the wood contains *andirin*, a brown-yellow coloring principle, soluble in water, fixed and volatile oils, but insoluble in alcohol and ether. The drastic and anthelmintic principle is an acrid resin soluble in ether and alcohol.

Medical Action and Uses.—In medium doses andira is said to occasion nausea, vomiting, diarrhœa, fever, and delirium, especially when given in cold infusion. Sometimes it augments the urinary secretion. It was used in the West Indies as a remedy for *lumbricoid worms.* The dose is stated at from five to ten grains for children, and from ten to thirty grains for adults. An infusion or decoction was made with an ounce of the bark in eight fluidounces of water, and was given in tablespoonful doses.

Fig. 12.



Anethum graveolens, Lin.

ANETHI FRUCTUS, *Br.*—
DILL FRUIT.

Aneth, *Fenouil puant*, Fr.; *Dill*, G.

The fruit of Anethum graveolens, *Lin.* *Nat. Ord.*—Umbelliferæ.

Origin.—The plant is indigenous to Southern Europe and Asia Minor, and is cultivated in other parts of Europe and in this country. It is an annual, with finely divided glaucous leaves, growing to the height of about two feet and bearing yellow flowers.

Description.—The fruit is oval, about one-eighth of an inch long, dorsally compressed, of a brown color, and separates when ripe into the two mericarps, which are flat upon their face, and somewhat convex upon the back. The three dorsal ribs are filiform, and rather sharply keeled, while the two lateral ones are extended into a light-colored broad membranous margin. Of the six dark-colored vittæ, two are found on the commissure, the remaining four in the valleculæ of the back. The odor and taste of dill are aromatic.

Constituents and Uses.—The fruit contains a fixed and an oxygenated volatile oil (see Oleum anethi), to which its medicinal properties are due. It is used for preparing dill water.

Medical Action and Uses.—Dill is not much used in this country. It has the properties of the aromatic stimulants generally, and is employed to relieve *flatulent colic*, and the *hiccup* which is occasioned by gastric indigestion and flatulence. Dill water is the usual form of exhibiting it, and may be given in doses of a fluidrachm or more. The essential oil may likewise be used in the dose of from two to five minims with sugar, or incorporated with magnesia.

ANGELICA.—ANGELICA ROOT.

Racine d'angélique, Fr.; *Engelwurzel*, G.

The root of, 1, Archangelica officinalis, *Hoffm.*, s. Angelica archangelica, *Lin.*, s. Ang. officinalis, *Moench*—and of, 2, Arch. (Angelica, *Lin.*) atropurpurea *Hoffm.*, s. Ang. triquinata, *Mich.*

Nat. Ord.—Umbelliferæ.

Origin.—These plants attain a height of six feet. The former is indigenous to Northern Europe, and the latter to North America, from Pennsylvania northward. The European angelica root is solely obtained from plants cultivated in Germany, which differ in some respects from the wild species named, of which they are regarded by some botanists as a variety merely, and by others as a distinct species, *Archan.* (*Angelica*, Miller) *sativa*, Fries.

Description.—European or garden angelica root consists of a short, thick root-stock, which is closely annulated above, and below abruptly divided into a large number of nearly simple branches, which are about one-quarter of an inch thick, and six inches long, longitudinally wrinkled, of a grayish-brown color externally, yellowish inside, with a spongy, radiated meditullium, and numerous shining resin-cells in the thick bark. It has a strong aromatic odor, and a sweetish, pungently aromatic and bitter taste, and breaks with a smooth, somewhat waxy fracture.

American angelica root is very similar, but smaller, with few branches, of a lighter color, with fewer resin dots in the bark, and less strongly aromatic. The very similar, but rather smaller root of *Archan.* (*Angelica*, Mich.) *hirsuta*, Tor. and Gr., which occurs southward to Florida, is not unfrequently collected with it.

The root of the European *Ang. sylvestris*, Lin., is light-gray yellow, internally white, and more woody.

All the above roots are readily attacked by insects.

Constituents.—Garden angelica contains about a half per cent of volatile oil, a white waxy matter crystallizing from hot alcohol in wart-like masses, *angelicin*, which is a somewhat acrid acid resin, soluble in alkalies, and crystallizing from alcohol in colorless needles; volatile angelicic acid, an amorphous bitter principle, some tannin, pectin, and other common principles (Buchner, 1842). The composition of the American roots is probably similar.

Medical Action and Uses.—Angelica is a tonic stimulant and diaphoretic, and in large doses may act as an emetic or a diaphoretic. It was formerly employed in the treatment of *typhoid* conditions, to meet the same indications for which serpentaria and valerian are now generally administered. It appears to have been beneficial in *chronic bronchitis* under conditions similar to those in which senega is recommended. It has also been used in chronic *rheumatism* and *gout*, and in *intermittent fever*. Angelica root may be given in powder, in doses of from ten to thirty grains; or an infusion made with an ounce of the root to a pint of water, or of white wine, may be used in the dose of one or two teaspoonfuls.

ANGUSTURA, *U.S.*—ANGUSTURA BARK.

Cuspariæ cortex, Br.; *Cortex angusturæ.—Angusture*, Fr.; *Angustura-Rinde*, G.

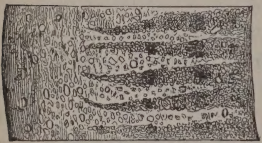
The bark of Galipea cusparia, *D. C.*, s. Gal. officinalis, *Hancock*, s. Gal. febrifuga, *Baillon*, s. Cusparia febrifuga, *Humb.*, s. Bonplandia trifoliata, *Willd.* Bentley & Trimen, Med. Plants, 43.

Nat. Ord.—Rutaceæ.

Origin.—The tree attains a height of twenty feet, and is found abundantly in the mountains near the Orinoko River.

Description.—The bark is met with in commerce in flat or curved pieces, usually between one and three inches in length, rarely longer, about one to one and a half inches wide, and one-sixteenth to one-eighth inch thick. Its color is reddish-brown, the inner surface smooth, and lighter than the outer surface, which is uneven, and covered with an ochrey-yellow, scurfy, and friable cork. It breaks readily, with a smooth, somewhat granular fracture, which is of a reddish-brown color, resinous in appearance, and displays to the naked eye numerous white, glistening striæ of crystals of calcium oxalate. The latter are more plainly visible with a lens, whereby also the radiating medullary rays and bast wedges are revealed. The odor of the bark is aromatic, not agreeable; its taste is aromatic and bitter.

Fig. 13.



Angustura bark. Transverse section.

Substitutions.—The so-called false angustura bark, obtained from *Strychnos nux vomica*, Linn., was found in Europe, early in the present century, mixed with the former, to which it bears no resemblance; it is usually thicker and harder, externally gray, with bright rust-colored patches of cork, and white warts; the inner surface brown; the fracture smooth, and destitute of white striæ. It has a bitter taste, and contains strychnia and brucia.

Another substitution appears to be of frequent occurrence in France, and has also been noticed in this country (*Amer. Journ. Pharm.* 1874, p. 50, 414). This bark comes from Brazil, from *Esenbeckia febrifuga*, Mart., and consists of dark-brown inner layers, covered with patches of a soft, brownish-gray cork, which is of a pale-orange rust-brown within; it breaks with a short fibrous fracture, is without the white striæ, and has a purely bitter taste.

Constituents.—Angustura bark contains between .3 and .7 per cent. of volatile oil, resins, gum, salts, and cusparin. The volatile oil, according to Herzog (1858), has the composition $C_{13}H_{24}O$, and boils at 266° C. (511° F.). Cusparin was obtained by Saladin (1833) by spontaneously evaporating the tincture prepared with strong alcohol. It crystallizes in the cold in needles and tetrahedrons, fuses at a moderate heat, is inflammable, insoluble in ether and volatile oils, soluble in 100 parts of boiling water, but readily soluble in alcohol; it is neutral in behavior, and has a bitter taste. Herzog was unable to obtain it.

The medicinal properties appear to be due to the volatile oil and bitter principle. Tannin is not present, but the infusion yields a red-brown precipitate with ferric chloride, and several other metallic salts.

Off. Prep.—Infusum angusturæ (cuspariæ), *U. S.*, *Br.*

Medical Action and Uses.—Angustura has a tonic operation without astringency, and a slightly stimulating action. It was at one time supposed to be a valuable antiperiodic; but experience has proved it to have no more claim to this virtue than the simple bitters. It is probably of more use in the *typhoid states* of fevers and inflammations, and especially in that of tropical *dysentery*, in which its highest reputation has been gained. In ordinary cases of atonic *dyspepsia*, and especially in those in which flatulence predominates, it has been found of service. But it has no special superiority over numerous other tonic and aromatic stimulants which can be more readily procured. The dose of angustura in powder is from ten to thirty grains.

ANILINA.—ANILIN.

Aniline, Fr.; *Anilin*, G.

Formula $C_6H_7N = C_6H_5H_2N$. Molecular weight 93.

Formation and Preparation.—Anilin is found among the products of the dry distillation of coal (in the heavy tar oil), indigo, and other substances; and is conveniently prepared from nitrobenzol by the reducing action of sulphuretted hydrogen, whereby sulphur is liberated; or of nascent hydrogen, prepared from dilute sulphuric acid and zinc; or by digesting with a mixture of iron filings and acetic acid, in which case the deoxidizing action of ferrous acetate, $Fe(C_2H_3O_2)_2$, first produced, materially assists the change. Nitrobenzol is thereby converted into anilin and water. $C_6H_5(NO_2)+3H_2$ yields $C_6H_7N+2H_2O$. When the reaction is completed, the anilin is distilled off, the receiver being charged towards the close of the distillation; the temperature then rises, and a red oil, *azobenzid*, $C_{12}H_{10}O_2$, passes over, which congeals to a crystalline mass. The separation of anilin from the heavy oil of coal tar is effected by a complicated process depending upon its solubility in hydrochloric acid, the insolubility of this compound in ether, the liberation of the bases by an alkali, and their separation from each other by fractional distillation.

Anilin was discovered by Unverdorben (1826), and named *crystallin;* subsequently it was also called *kyanol*, *benzidam*, *phenamid*, and *amidobenzene.*

Properties.—Anilin is a colorless, limpid, oily, inflammable liquid, of a peculiar wine-like odor and burning aromatic taste. It has the spec. grav. 1.02, does not congeal at —20° C. (—4° F.), boils at 182° C. (359.8° F.), acquires in contact with air a yellow and brown color, is sparingly soluble in cold water, and in all proportions of wood-spirit, alcohol, ether, aldehyd, aceton, fixed and volatile oils. It dissolves phosphorus, camphor, several resins, and by the aid of heat much sulphur; coagulates albumen; precipitates the salts of iron, zinc, and aluminium; and unites with acids to form salts, which are mostly crystallizable, readily soluble in water, inodorous and colorless, but acquire a red color in contact with the air; alkalies decompose them, with the separation of anilin. It is characterized by the production of a violet color with chlorinated lime, a reaction which has led to its application in the production of *coal-tar dyes*, the more important of which are the following:—

ANILIN-PURPLE, or *mauve*, is obtained by acting upon anilin with sulphuric acid and potassium bichromate, whereby the alkaloid *mauveïna*, $C_{27}H_{24}N_4$, is produced.

ANILIN-RED, or *magenta*, is formed by heating anilin with corrosive sublimate or arsenic acid, and is a salt of *rosanilina*, $C_{20}H_{19}N_3$, the alkaloid being colorless.

ANILIN-YELLOW, or *chrysanilina*, $C_{20}H_{17}N_3$, is a yellow secondary product of the preceding process; its hydrochlorate has a scarlet color, and its nitrate is ruby-red, and very sparingly soluble in water.

ANILIN-BLUE is a salt of *triphenyl-rosanilina*, $C_{20}H_{16}(C_6H_5)_3N_3$, obtained by boiling a salt of rosanilina with anilin; and by treatment with iodide of methyl, ethyl, and similar compounds, a large variety of blue, violet, and green (*iodine green*) dyes are obtained.

When anilin is acted upon by hydrochloric acid and potassium chlorate, a *green* and *black* dye may be obtained.

Most of the anilin dyes used in the United States, to the amount of about 200,000 pounds annually, are imported from Europe.

Physiological Action and Medical Uses.—A substance of so little apparent value as a medicine does not here require an extended consideration. It is well, however, to be acquainted with its physiological effects, since many cases of poisoning have occurred from its use. In experiments upon animals it does not appear to act as a powerful local irritant, although in large doses it excites vomiting. Its special action seems to be upon the spinal marrow, for it causes staggering, more or less loss of muscular power and of sensibility in the hinder limbs of quadrupeds, with tonic and clonic spasms affecting all the muscles or only some particular muscles or portions of them. The heart-pulse and the respiration are quickened, and death occurs during convulsion, or afterwards in resolution. In some experiments death by coma took place. The lethal dose for rabbits is from fifteen to twenty grains, and for dogs about eighty grains. Anilin is recognized in the blood and in the urine by its characteristic smell. After death the lungs are found congested, the heart distended with blood, which there and everywhere else is dark and uncoagulated. The poison is discoverable in the blood and the principal solid organs.

Workmen exposed to the vapors evolved in the manufacture of anilin acquire a cyanotic hue of the face, lips, and mouth, suffer from giddiness, headache, and chilliness, and weakness of the lower limbs. They are subject also to bronchial irritation, nausea, constipation, diarrhœa, and cutaneous eruptions. In one case, a lad of sixteen, employed in scrubbing out an anilin vat, was seized with giddiness and insensibility; the skin was cold, the pulse slow and thready, the breathing laborious. The cyanotic color of his skin and mouth gave him the appearance of a person in the last stage of cholera. The graver symptoms were promptly dissipated, but the blueness had not disappeared on the following day. In the case of a man who swallowed a mouthful of a concentrated solution of "magenta red," the cyanotic symptoms mentioned were present in a high degree; the pulse was thready and frequent (120–140); the inspirations shallow, 30 in a minute; muscular tremor and twitching pervaded the body; the head ached and there was some drowsiness, but the mind was otherwise clear; the patient was restless, and his breathing oppressed as if by a weight. Vomiting was provoked by an emetic, and on the third day he had entirely recovered. The skin continued bluish for more than forty-eight hours. Stockings, cravats, gloves, etc., dyed with anilin have occasioned eczematous eruptions upon the skin in contact with them.

The only disease in which anilin has been used is *chorea*. Six inveterate cases are reported to have been speedily cured by this agent in doses of one or two grains three times a day (Turnbull); while in another group of five cases, in which anilin was given persistently until the doses reached six or seven grains three times a day, not the slightest impression was made upon the symptoms (Fraser, etc.).

ANISUM, *U. S.*—ANISE.

Fructus (Semen) Anisi, s. Anisi vulgaris.—Aniseed, E.; *Anis, Anis vert*, Fr.; *Anis*, G.

The fruit of Pimpinella anisum, *Lin.* *Nat. Ord.*—Umbelliferæ.

Origin.—The plant is an annual, which is indigenous to the eastern portion of the basin of the Mediterranean, and extensively cultivated in Southern and Central Europe, and occasionally in this country. It grows about a foot in height, has the radical leaves cordate, lobed, and serrate, the stem leaves pinnate with lanceolate lobes, and the upper ones trifid or undivided and linear. The flowers are small and white.

Description.—The fruit is about two lines long, ovate, tapering above towards the thick stylopode, somewhat compressed at the sides, of a grayish or greenish-gray color, and covered with short appressed hairs. The two mericarps are usually united. Each has five lighter-colored filiform ridges, and from 12 to 16 oil-tubes situated on the commissure and in the furrows. The fruit has an agreeable aromatic odor and a sweet spicy taste. About 115,000 lbs. of anise and star anise are annually imported.

Impurities.—Anise of commerce is not unfrequently mixed with earthy matters, resembling the fruit in color. An accidental admixture of conium fruit has been reported. This is easily distinguished from anise by the mericarps, when ripe, being separate, smooth, with the ribs prominent and crenate, and by being destitute of oil-cells.

Constituents.—The fruit contains, according to Brandes and Reimann, 3 per cent. of volatile oil, 3.38 per cent. of fixed oil, some gum, sugar, resin, malates, phosphates and other salts. The volatile oil represents the medical properties of the fruit.

Pharmaceutical Uses.—Anise is used for preparing Oleum anisi and Aqua anisi.

Medical Action and Uses.—Anise is an aromatic stimulant and carminative, and its oil and infusion are habitually employed to relieve *flatulent colic*, and the seeds enter into the composition of many culinary products as a condiment which tends to render them less indigestible. It has been imagined to have some special influence upon the *bronchial tubes*, modifying their secretions and promoting expectoration. But all volatile oils and resins are exhaled by the bronchia, and all have more or less repute as stimulant expectorants. In *infantile catarrh*, when the acute stage has passed, infusion of anise may be given with advantage. It may be made with two or three drachms of the bruised seeds in half a pint of boiling water, and given in teaspooful doses to infants at the breast. The dose of bruised anise is from ten to twenty grains.

ANTHEMIS, *U. S.*—CHAMOMILE FLOWERS.

Anthemidis flores, Br.; *Flores Chamomillæ romanæ*, P. G.—*Roman* or *English chamomile*, E.; *Chamomille romaine*, Fr.; *Römische Kamille*, G.

The flowers of Anthemis nobilis, *Lin.*

Nat. Ord.—Compositæ, Anthemideæ.

Origin.—A low perennial plant indigenous to Southern and Western Europe as far north as England, and cultivated in Germany, Great Britain, France, and Belgium.

Description.—The flower-heads of the wild plant, which have a single row of white ligulate ray florets and numerous yellow tubular disk florets, are not met with in commerce. In the cultivated plant the tubular florets are more or less changed into white ligulate florets, and therefore, the heads have either a smaller yellow centre or are entirely white. The heads are about three-fourths of an inch broad, and consist of an involucre composed of numerous imbricated oblong ovate scales with a scarious margin, of a solid convex, finally conical receptacle with narrow concave chaff, and of numerous white strap-shaped and three-toothed florets which are pistillate. The yellow disk florets, if present, are tubular, five-toothed, and hermaphrodite, with the two branches of the style projecting. The tapering achene is destitute of a pappus. Since the oil-glands are found mainly on the tubular portion of the florets, the so-called *single chamomile*, with one or a few rows of ray florets, appears to be better adapted for medicinal use, and has a stronger and more agreeable odor.

Adulterations.—The flower-heads of several compositæ, like Anthemis arvensis, *Lin.*, Maruta cotula, *D. C.*, Matricaria chamomilla, *Lin.*, Pyrethrum parthenium, *Lin.*, and Achillea ptarmica, *Lin.*, have been named as occasional adulterations, but they are much smaller than Roman chamomile. The first-named three species not being cultivated have the heads always with a single row of ray florets; while the last two are frequently double in cultivation. Of these, the feverfew (Pyrethrum) has a flat or merely convex and nearly naked receptacle, and the Achillea flowers have shorter and rounded rays, are inodorous, and of an acrid taste.

Constituents.—According to J. P. Wyss (1833), chamomile flowers contain volatile oil (Oleum anthemidis), traces of tannin, 5.25 per cent. resin, 1.50 per cent. wax, albumen, gum, bitter principle, fixed oil, chlorophyll, extractive and salts. The bitter principle is soluble in water and alcohol.

Pharmaceutical Uses.—For preparing Oleum anthemidis, Extract. anthemidis, *Br.*, and Infusum anthemidis, *U. S.*, *Br.*

Physiological Action.—Chamomile is stimulant and tonic. The former property is due to its essential oil, the latter to its bitter principle. In substance or strong infusion it occasions a sense of warmth in the stomach; it expels flatus, improves digestion, does not constipate, and, like other stimulants, is reputed to possess emmenagogue virtues. In large doses it occasions nausea, vomiting, diarrhœa, pain, and fulness of the head, and sometimes a degree of somnolent intoxication. In medicinal doses the infusion is tonic if cold, but emetic if warm.

Medical Uses.—Chamomile is commonly used as a mild stimulant tonic to improve the *digestion* during convalescence from acute diseases, and in many states of general debility. It is particularly indicated when the gastric digestion is laborious, and accompanied with flatulence, and also when the latter stage of digestion is attended with colic. It is an excellent preventive remedy for periodical sick headache, and its warm infusion is a salutary emetic during the attack. It is reputed also to be *emmenagogue*, to cure *neuralgia*, and to diminish chronic *suppuration*. Evidently it exerts these powers indirectly, and only by its power of improving the nutrition of the whole system. In the same way, probably, it sometimes cures *intermittent fever*. Many bitter tonics have a similar operation, but cinchona alone exhibits a direct curative power over periodical fevers, while chamomile and other bitter medicines appear rather to possess the indirect power just alluded to. These remarks apply only to their use as tonics; chamomile and its associate bitters often cure mild intermittents, when administered in the form of a hot infusion immediately before the paroxysm. This is a physiological mode of cure, and may be practised with the aid of anything whatever that will equally well excite copious diaphoresis. In forms of malarial fever distinguished by biliary derangement, warm chamomile tea is often used to produce both vomiting and diaphoresis, and thereby moderate not only the general severity of the paroxysm, but also to lessen hepatic congestion, and the evils which ensue thereon. As an emetic, chamomile is peculiarly appropriate whenever it is desired to empty the stomach without depressing the system; and hence in those numerous cases of crapulous *indigestion* occurring in coarse feeders, and in drunkards. It often will put an end to an attack of *delirium tremens* in the forming stage. Subsequently, nothing excels a cold infusion of chamomile in repairing the exhausted condition of the digestive organs.

Externally, fomentations made with chamomile flowers saturated with hot water, or with hot vinegar and water, form a most soothing application for *local pains*, whether neuralgic or congestive, in intestinal and uterine *colic*, *toothache*, *earache*, *abscess*, *sprains*, etc. It is believed by high authorities that the odor of chamomile is destructive of the *itch-insect*, the *gnat*, etc. Oil of chamomile has been applied to painful *rheumatic* parts, and to the abdomen in *flatulent colic*.

Chamomile is never prescribed in substance, except as a masticatory, and in this manner it is often useful in slight dyspeptic disorders. The extract (*Br. Ph.*) is a good simple bitter tonic, in the dose of from three to ten grains. A fluid extract is prepared, a fluidrachm of which represents thirty grains of chamomile. The oil is sometimes prescribed internally in doses of five or six drops upon sugar, in ether, or in Hoffmann's anodyne, or in pills made with crumb of bread.

ANTIARIS.—UPAS ANTIAR.

Upas antiar, Fr., G.

A gum-resinous exudation of Antiaris toxicaria, *Lesch.*

Nat. Ord.—Urticaceæ, Artocarpeæ.

Origin.—The Upas tree is one of the largest trees of the forests of Java, and of some of the neighboring islands. When wounded it yields a milk-white or yellowish exudation, which on exposure turns brownish, and constitutes the principal ingredient of the Upas antiar, or Javanese arrow-poison.

Description.—Upas antiar is reddish-brown, of a waxy consistence, and an extremely bitter, and, at the same time, acrid taste. Triturated with water, it yields an emulsion. It is partly soluble in alcohol and ether.

Constituents.—It contains gum, sugar, albumen, wax, resin, and *antiarin*, the poisonous principle discovered by Pelletier and Caventou (1824). The latter is obtained by exhausting the alcoholic extract with boiling water. Mulder obtained from the dry juice 3.5 per cent. of antiarin, the composition of which is $C_{14}H_{20}O_5$. It crystallizes from water in silvery scales, containing 11.86 per cent. ($2H_2O$) of water, is soluble in 70 parts of alcohol, very slightly in ether, more freely in dilute acids and alkalies. The resin is readily soluble in ether, sparingly in cold alcohol, and is not poisonous.

Physiological Action.—Under the name Upas, which, in the Malay language, signifies poison, or, specifically, arrow-poison, several quite different products are included. Upas Tieuté contains strychnia, and the symptoms it occasions are more or less distinctly tetanic; but Upas antiaris, and its active principle, antiarin, produce very different effects. However introduced into the system, it impairs or suspends voluntary movements, without causing convulsions. It is a paralyzing poison to the heart as well as the voluntary muscles, and appears to act directly upon these organs, and upon the great nervous trunks, but not upon the brain or spinal marrow. A specimen of arrow poison has been found to contain both a convulsing and a paralyzing agent, which could be separated and made to display their respective effects.

We are unacquainted with any instances of the therapeutical use of this product, but the remarkable analogy of its operation with that of physostigma would seem to indicate its application to similar conditions.

ANTIMONII ET POTASSII TARTRAS, *U. S.*—TARTRATE OF ANTIMONY AND POTASSIUM.

Antimonium tartaratum, Br.; *Antimonii potassio-tartras*, *Antimonium tartarizatum*, *Tartarus stibiatus*, P. G.; *Tartarus emeticus*, *Stibio-kali tartaricum.*—*Tartarated antimony*, *Tartar emetic*, E.; *Tartrate de potasse et d'antimoine*, *Emétique*, *Tartre stibié*, Fr.; *Brechweinstein*, G.

Formula $2(KSbOC_4H_4O_6).H_2O$. Molecular weight 668.

Preparation.—Take of Oxide of Antimony in very fine powder two troyounces; Bitartrate of Potassium in very fine powder two troyounces and a half; Distilled Water eighteen fluidounces. To the water, heated to the boiling point in a glass vessel, add the powders, previously mixed, and boil for an hour; then filter the liquid while hot, and set it aside that crystals may form. Lastly, dry the crystals, and keep them in a well-stopped bottle.

By further evaporation the mother-water may be made to yield more crystals, which should be purified by a second crystallization. *U. S.*

Take of Oxide of Antimony five ounces; Acid Tartrate of Potash in fine powder six ounces; Distilled Water two pints. Mix the oxide of antimony and acid tartrate of potash with sufficient water to form a paste, and set aside for twenty-four hours. Then add the remainder of the water, and boil for a quarter of an hour, stirring frequently. Filter and set aside the clear filtrate to crystallize. Pour off the mother liquor, evaporate to one-third, and set aside, that more crystals may form. Dry the crystals on filtering paper at the temperature of the air. *Br.*

The manipulations in the above processes differ from each other mainly in the method of combining the oxide of antimony with the acid tartrate of potassium, which, in the U. S. formula, is effected by boiling for one hour, water being added from time to time to supply the loss by evaporation. This long-continued application of heat is apt to produce a change whereby the liquid becomes colored, and a portion of the salt is converted into an uncrystallizable compound; the mother liquor from the first crystallization yields, on further evaporation, crystals which are colored and require to be recrystallized. By the British process heat is avoided, except for a much shorter time, the combination being effected at the ordinary temperature; or digestion at a gentle heat may be resorted to with little danger of inducing the changes alluded to. The compounds are made to react upon each other in the presence of a little water, and the subsequent boiling with a larger quantity of water mainly aims at bringing the tartar emetic already formed into solution, so that it may be freed by filtration from the excess of oxide used, and obtained in crystals. Both formulas direct an excess of oxide of antimony, which is smallest in the U. S. process, but quite sufficient for the purpose.

In preparing the salt in question it is of importance that the antimonious oxide should be free from oxychloride, otherwise the mother liquor will become acid, and more or less of the salt will be lost by refusing to crystallize. The acid potassium tartrate should be free from calcium tartrate, which would contaminate the crystals of tartar emetic, necessitating their recrystallization, and thus occasioning loss.

Other processes have been recommended, and are, perhaps, followed by some manufacturers; they agree in this that an impure oxide of antimony, which may be obtained in various ways, is used. While the trouble of its purification is thus avoided, a subsequent loss cannot be prevented as explained above. Operating on a large scale, such a course is probably the cheapest; but for the pharmacist the use of pure materials is by far more advantageous, since with proper and careful manipulation the entire solution may be made to crystallize.

Properties.—Tartrate of antimony and potassium produce colorless transparent crystals, which have the form of a rhombic octahedron, become white and opaque on exposure to the air, and have a strong metallic taste. According to Brandes one part of the salt

Dissolves in 19.0, 12.6, 8.2, 7.1, 5.5, 4.8, 3.2, 3.0, 2.8 parts of water
at 8.7°, 21°, 31°, 37.5°, 50°, 62.5°, 75°, 87.5°, 100° C.

The aqueous solution is precipitated on the addition of alcohol in the form of a crystalline powder; in this manner a pure powder of tartar emetic is readily and most advantageously obtained for pharmaceutical purposes. The solution yields with hydrochloric and other mineral acids a white precipitate of an oxysalt of antimony, which is soluble in hydrochloric acid, and does not occur if tartaric acid has been previously added to the solution. Hydrosulphuric acid causes an orange-red precipitate, which, when obtained from 20 grains of the salt, after washing and drying at 100° C. (212° F.), weighs 9.91 grains. A solution of tartar emetic which is not too diluted, produces a flocculent precipitate on the addition of infusion of galls; an excess of the latter redissolves the precipitate.

Tests for Purity.—Chlorides and sulphates, if present, are detected in the solution previously acidulated with acetic acid, by nitrate of silver and chloride of barium, calcium by ammonium oxalate, and copper by ferrocyanide of potassium. Arsenic is detected by carefully heating about 20 or 30 grains of the salt until a black residue remains; on gradually increasing the temperature to redness, a garlic-like odor will be evolved. The impurity which is likely to be met with in consequence of faulty preparation is cream of tartar, the presence of which cannot be detected by its behavior to test paper, since the solution of tartar emetic has an acid reaction. By dissolving 24 grains of the salt in a fluidounce of warm water and cooling the solution to 10° C. (50° F.), it should remain clear. A crystalline deposit will occur if more than 8 per cent. of cream of tartar is present. A more delicate test, which, however, does not indicate the nature of the impurity, consists in preparing the sulphide of antimony from a given weight of the salt, as stated above. The test given by the U. S. P. that "a solution containing one part in forty of water, is not disturbed by an equal volume of a solution of eight parts of acetate of lead in thirty-two of water and fifteen of acetic acid," is not reliable. The solution of pure tartar emetic, even if largely diluted, will at once become turbid on the addition of a little carbonate of potassium; in the presence of acid tartrate of potassium no permanent precipitate will appear until after this impurity has been neutralized.

Pharmaceutical Uses and Preparations.—Tartar emetic is a convenient test for distinguishing different kinds of tannin, some of which yield no precipitate with it. It is an ingredient in Emplastrum antimonii, Syrup. Scillæ comp., Unguent. antimonii (antimonii tartarati, *Br.*), and Vinum antimonii (antimoniale, *Br.*), *U. S.*

Physiological Action. *On Animals.*—The following conclusions in regard to the action of tartar emetic were reached by Dr. Richardson in 1856, but they remain substantially correct at the present time: "1. Tartar emetic excites the same symptoms in dogs as in man. 2. All the permeable tissues absorb it, and its effects are specifically the same by whatever channel, including the blood, it may enter the system. 3. After absorption it may be detected in the blood, the serum, the urine, and all the organs. 4. It excites marked local effects in any membrane by which it is eliminated, and hence, however introduced into the system, it causes redness of the lining membrane of the stomach, and the symptoms which attend its direct application to that organ. 5. In large doses it produces vomiting and purging, and rapid collapse; but small doses long continued may cause death by exhaustion. 6. The immediate cause of death from this agent is, in all cases, failure of the heart's action. 7. The post-mortem lesions produced by it are general congestion, fluidity of the blood, intense vascularity of the greater curvature of the stomach, and in some cases of the rectum and other parts of the intestinal tube, but without ulceration; and a pale-yellow glairy mucous secretion. 8. In rapid poisoning by tartar emetic the fatal effect seems due to a direct chemical change in the blood, and an indirect effect therefrom upon the heart; while in slow poisoning there is added an interference with the assimilative powers, the result of the lesions excited in the stomach or other parts of the alimentary canal." In this summary there is an apparent incongruity between the statement that death is due to failure of the heart's action and also to a chemical change in the blood. Doubtless both modes occur; but the first is shown by experiment to be a primary effect of the poison, the heart being weakened and its contractions retarded, the respiration and the temperature declining in a like proportion, while paralysis of sensation and motion supervene. This mode of action accounts for the venous engorgement of the heart, lungs, and abdominal organs found after death. The injection of the gastro-intestinal mucous membrane is due not so much to the direct irritant action of the poison as to the fact, already implied, that it is in great part eliminated by this channel, however it may have been introduced into the body.

On Man.—When tartar emetic in strong solution or in an ointment is applied to the skin, it produces a pustular eruption, almost identical in appearance with that of smallpox, forming scabs and leaving indelible scars. If the skin is very delicate, it may ulcerate or slough. The pustulation is less apt to occur in persons of a naturally tough integument, and also during high febrile action. Occasionally the constitutional operation of the medicine has been developed by its endermic employment. A solution of tartar emetic has been injected into the veins for the purpose of dislodging foreign bodies from the stomach by vomiting. This effect has also followed its administration by enema.

Taken internally, even in such doses as the one-hundredth of a grain frequently repeated, it occasions malaise and nausea with colic and looseness of the bowels, loss of appetite, a pasty state of the mouth, debility and depression, and sometimes a pustular eruption on the skin. When the dose is large enough to produce vomiting, it occasions a sense of sinking, nausea, copious salivation, violent and prolonged retching, and often liquid stools, coldness of the hands and feet, and a cool perspiration. The matters vomited usually contain bile before the end of the operation. If the salt is given with but little fluid, the evacuations may be confined to vomiting; if the liquid is abundant, there may be copious purging without emesis. The more depressing is the operation of the medicine, as indicated by the preceding symptoms, the more frequent and feeble does the pulse become. In poisoning by this substance the symptoms mentioned are greatly intensified. The patient is attacked with pain in the stomach, followed by incessant retching, præcordial cramps and burning heat, distension of the epigastrium, severe colic, watery and frequent stools, dryness of the throat, difficult deglutition, and salivation. The muscles are sometimes rigid, but generally relaxed, the skin pale, cool, and clammy, the pulse feeble and at first infrequent, but subsequently rapid and thready; respiration is slow. The dose required to produce such symptoms cannot be precisely stated. It may be but the fraction of a grain which occasions them with a fatal result. In other instances several drachms of the salt have been taken without fatal consequences. The continued use of the salt usually establishes a tolerance of its operation, as was formerly shown by its employment in the treatment of pneumonia, a method which is now forgotten except as a monument of rashness and folly. The use of this method illustrated the local action of the salt by the inflammation and ulcers which it sometimes produced in the mouth, fauces, œsophagus, and stomach. It is to be noted that after fatal acute poisoning by tartar emetic, gastric lesions are not always found, a fact which further illustrates the previous proposition, that it causes death by its action upon the heart and lungs through the nervous system, and not merely by its local operation on the stomach.

Medical Uses.—The idea that fever must be combated by means of agents which directly tend to lessen the frequency and lower the force of the pulse, and which at one time was put into practice by means of venesection and purgation, and in these latter times by veratrum viride, aconite, and digitalis, was at one period attempted by means of tartar emetic. The palpable mischief wrought by all of these agents, when so employed, reached its extreme development when Rasori, an Italian theorist, demonstrated that it was possible to administer twenty-four grains, in as many hours, of this salt, to a pneumonic patient, and as much as two ounces in the course of an attack of *pneumonia*, without occasioning such a mortality as might reasonably have been expected. Indeed, many of the most distinguished clinical observers have recorded their eulogies of this treatment, and if it were to be compared with those alone which approach it in their perturbative effects, it might still maintain the claims which once were made in its behalf. But since it has been demonstrated that the most successful by far of all methods of treating pneumonia is simply to place the patient in the most favorable conditions for the exertion of his natural powers of cure, a discussion of the relative values of different active medications has greatly declined in interest as well as utility.

A confusion produced by ignorance of the essential differences between pseudo-membranous *larynyitis* and spasmodic laryngitis led to the use of tartar emetic in the former disease, although clinical observation and analogy are strong against it, for it tends to produce a sudden and extreme prostration, and thereby to lessen the chances of the removal of the false membrane by muscular power. On the other hand, the spasmodic affection, which also involves a superficial inflammatory element, is beneficially treated by nauseants and emetics, which relieve at once the congestion and the spasm of the larynx, and terminate the attack. It is not generally necessary to excite vomiting with this object; nauseant doses of the medicine are usually sufficient. This statement is indirectly illustrated by the usually prompt effect of opiates and revulsives in the same affection. Among inflammatory diseases *acute bronchitis* is most decidedly modified by nauseant doses of this medicine, and even by smaller ones than produce any sensible effect besides an increase of the bronchial secretion and greater facility of expectoration. Acute articular *rheumatism* was, at one time, treated by sedative doses of tartar emetic, but the evidence in its favor, which was originally small, is less than nothing at the present day. It has been said that nauseating and depressing doses of it will sometimes cut short various local inflammations in their forming stage, such as *tonsillitis*, *mammary abscess*, *hernia humoralis*, acute *ophthalmia*, *mumps*, etc. There is very little doubt of the fact; but the uncertainty of action of the medicine and its distressing operation, have, for the present at least, rendered its use quite exceptional. It has been employed in *dropsy* produced by cold (renal dropsy); to arrest mercurial *salivation;* in acute *meningitis*, in *epilepsy*, *chorea*, *mania*, *convulsions*, *mania-à-potu*, etc.; but in none of these diseases does the good it effects outweigh the inconveniences arising from its depressing and exhausting operation. Its power of overcoming *rigidity of the os uteri* during labor has been attested by the highest authorities; but, owing to the superior advantages of ether and chloroform, it is now seldom resorted to. The same remark applies to its use for producing relaxation in *strangulated hernia* and *dislocations.* Locally it has been applied to excite inflammation and thereby destroy *nævi*, and also to produce the constriction and closure of *varicose veins.*

Tartar emetic should seldom be administered to the very young or very old, or to those who from any cause are feeble. If it produces poisoning by being swallowed, the stomach should be emptied as soon as possible by large draughts of tepid water containing or followed by vegetable astringents, such as green tea, galls, tannic acid, etc. The further and constitutional effects may be moderated by strong coffee, by wine, alcohol, ether, or opium.

The average emetic *dose* of tartar emetic is one grain; or three grains may be dissolved in a fluidounce of water, of which one-half may be administered; if this have no effect, half of the remainder may be given in fifteen minutes, and in fifteen minutes more the rest. Warm water should be freely administered. As a nauseant sudorific the dose is from a quarter to half a grain every hour or more. As a diaphoretic and expectorant from one-twelfth to one-sixth of a grain may be given at intervals of from one to three hours. Pustulation by tartar emetic may be produced by means of the ointment, by a strong watery solution applied on a compress, or by inoculation of a paste made with the salt, by means of a fine lancet.

ANTIMONII OXIDUM, *U. S.*, *Br.*—OXIDE OF ANTIMONY.

Stibium oxydatum, Oxydum antimonicum vel stibicum.—Oxyde d'antimoine, Fr.; *Antimonoxyd*, G.

Formula Sb_2O_3. Molecular weight 292.

Preparation.—Take of Sulphuret of Antimony in very fine powder four troyounces; Muriatic Acid eighteen troyounces; Nitric Acid a troyounce and one hundred and twenty grains; Water of Ammonia a fluidounce and a half; Water, Distilled Water, each a sufficient quantity. Introduce the sulphuret into a flask of the capacity of two pints, and having added the muriatic acid, digest by means of a sand-bath until effervescence ceases. Then, having removed the flask from the sand-bath, add the nitric acid gradually; and, when nitrous acid vapors cease to be given off, and the liquid has grown cold, add to it half a pint of water, and filter. Pour the filtered liquid gradually into twelve pints of water, constantly stirring, and allow the precipitate to subside. Decant the supernatant liquid, and wash the precipitate twice by decantation, using each time eight pints of water. Then transfer it to a muslin filter to drain, and, after the drainage is completed, wash it with water until the washings cease to have an acid reaction. Next introduce it into a suitable vessel, and subject it to the action of the water of ammonia for two hours; at the end of which time transfer it to a moistened muslin filter, and wash it with distilled water as long as the washings produce a precipitate with nitrate of silver. Lastly, dry the precipitate upon bibulous paper with the aid of a gentle heat. *U. S.*

The process of the British Pharmacopœia is essentially the same as the preceding, the solution of chloride of antimony being precipitated by water, and the precipitate, after having been repeatedly washed by water, being treated with a solution of carbonate of sodium, then again washed, and finally dried at a heat not exceeding 100° C. (212° F.).

According to the U. S. formula antimonious chloride is first prepared by acting upon sulphuret of antimony with hydrochloric acid, whereby, the chlorine combining with the antimony, sulphur is liberated as sulphuretted hydrogen gas. $Sb_2S_3 + 6HCl$ yields $2SbCl_3 + 3H_2S$. The chloride of antimony remains dissolved in the excess of muriatic acid, together with ferrous chloride resulting from the iron usually contained in the black antimony. The subsequent step of adding nitric acid is an unnecessary complication; it will oxidize any sulphuretted hydrogen that may have remained in solution to sulphuric acid, and convert the ferrous into ferric chloride; but the former can be expelled more expeditiously and with less cost by boiling the solution, and the ferrous chloride will not be precipitated on the addition of water. On adding the solution to water, antimonious oxychloride, or *powder of Algaroth*, is precipitated, and obtained of the composition $2SbCl_3.5Sb_2O_3$. By washing this with water, the chlorine is gradually but not completely removed as hydrochloric acid, a more basic oxychloride remaining. The conversion into the oxide is most readily effected by an alkali or alkaline carbonate, as directed by the two Pharmacopœias. In the one case chloride of ammonium, in the other case chloride of sodium and carbonic acid gas are formed, antimonious oxide remaining behind in both instances: $2SbCl_3.5Sb_2O_3+3Na_2CO_3$ yields $6Sb_2O_3+6NaCl+3CO_2$. The resulting antimonious oxide must be dried at a not too elevated temperature, to avoid the formation of higher oxides of antimony. A contamination with arsenious acid, resulting from the sulphide of arsenic, frequently present in the black antimony, need not be apprehended; the greater part of it will be expelled during the first part of the operation, as chloride of arsenic, and what little may remain in the liquid will remain in solution on precipitating with water. The large quantity of noxious gases which are given off, renders it necessary to operate under a hood, or to dispose of the gases by consuming them in a furnace.

Properties.—Antimonious oxide is a dense white or grayish-white powder, which is insoluble in water, but dissolves readily in muriatic or tartaric acid. It fuses at a dull red heat into a yellowish liquid, solidifying on cooling into a pearl-colored crystalline mass. At a higher heat it volatilizes with white vapors, and when heated with soda upon charcoal by means of the blowpipe, very brittle metallic globules are obtained. Its solution in muriatic acid yields a white precipitate with water, and an orange-red precipitate with sulphuretted hydrogen.

Tests.—Oxide of antimony should dissolve completely when boiled with an excess of acid potassium tartrate (earthy impurities, etc.), and its solution in tartaric acid should not be precipitated by nitrate of silver (chlorides), chloride of barium (sulphates), or ferrocyanide of potassium (metals).

Other oxides of antimony, more or less pure or combined with sulphide of antimony, were formerly employed in medicine, and are occasionally, though very rarely, called for. They are briefly described under Antimonii Sulphuretum.

Pharmaceutical Uses.—Oxide of antimony is employed in preparing tartar emetic, and is a constituent of Pulv. Antimonialis, *Br.*

Medical Action.—The oxide of antimony is rarely used in medicine. It is stated to possess the general properties of antimonial preparations, with a less tendency to excite nausea and vomiting, owing to its inferior solubility. Its dose is from two to four grains.

ANTIMONII OXYSULPHURETUM, *U.S.*—OXYSULPHURET OF ANTIMOMY.

Stibium sulfuratum rubeum, P. G.; *Sulphur stibiatum rubeum*, *Kermes minerale*, *Alkermes aurificum minerale.*—*Kermes mineral*, E.; *Sulfure d'antimoine hydraté*, *Kermès minéral*, *Poudre des chartreux*, Fr.; *Mineralkermes*, G.

Composition, a mixture of Sb_2S_3 and Sb_2O_3.

Preparation.—Take of Sulphuret of Antimony in very fine powder a troyounce; Carbonate of Sodium twenty-three troyounces; Water sixteen pints. Dissolve the carbonate of sodium in the water previously heated to the boiling point, and, having added the sulphuret of antimony, boil for an hour. Then filter rapidly into a warm earthen vessel, cover this closely, and allow the liquid to cool slowly. At the end of twenty-four hours, decant the supernatant liquid, drain the precipitate on a filter, wash it with cold water that has been previously boiled, and dry it without heat. Lastly, preserve the powder in a well-stopped bottle, protected from the light. *U. S.*

This is, in its main features and relative proportions, the process of Cluzel, to which the prize of the Paris Pharmaceutical Society was awarded in 1806. During the boiling of the mixture some carbonic acid is given off, and the soda, reacting with the sulphuret of antimony, produces antimonious oxide and sulphide of sodium, the latter dissolving some sulphuret of antimony, while the former enters into solution in the strongly alkaline liquid. Both compounds are more freely soluble at an elevated than at the ordinary temperature; hence the dissolved portions are precipitated on cooling, and if the reduction of temperature takes place very gradually, the two compounds, oxide and sulphuret of antimony, are deposited as an intimate mixture. The amount of oxide present in the kermes depends upon the relative proportions of the ingredients used, the time during which the heat has been applied, and the care with which the cooling of the solution during filtration has been avoided. The liquid from which the kermes has been deposited will, when boiled with the residuary powder, again decompose some black antimony, a larger proportion of antimonious oxide being formed and dissolved and subsequently precipitated on cooling. Although a product similar in appearance is obtained on a second and third boiling, it must vary considerably in composition from that first obtained. Sonnenberg obtained by four successive boilings kermes containing 8, 33, 43, and 67 per cent. of oxide of antimony. It is obvious, therefore, that its composition may easily vary even with slight modifications of the process, and while it can be readily spared from the list of officinal preparations, it should be prepared in strict conformity with the Pharmacopœia as long as it is medicinally employed.

Properties.—Oxysulphuret of antimony is a purplish-brown, tasteless powder, soft and velvety to the touch, wholly and readily soluble in muriatic acid with evolution of hydrosulphuric acid gas, and partly soluble in a hot solution of potassa, leaving a residue soluble in tartaric acid. On examination with the microscope it is found to be a mixture of amorphous globules of the sulphuret with minute transparent prisms of oxide of antimony, which latter is dissolved by the action of solution of tartaric acid.

Medical Action.—Kermes mineral does not differ essentially from other antimonials in its action, but is generally described as being "alterative, diaphoretic, and emetic," although of very uncertain operation. Its dose as an alterative may be stated to be one or two grains twice a day; and as an emetic, from five to twenty grains.

ANTIMONII SULPHURETUM, *U. S.*—SULPHURET OF ANTIMONY.

Antimonium nigrum, Br.; *Stibium sulfuratum crudum et lævigatum*, P. G.; *Antimonium crudum*, *Stibium sulfuratum nigrum*, *Sulfuretum stibicum.*—*Black* (*crude*) *antimony*, E.; *Sulfure d'antimoine*, *Antimoine cru*, *sulfuré*, Fr.; *Schwefelspiessglanz*, G.

Formula Sb_2S_3. Molecular weight 340.

Origin.—It is found native as gray antimony ore or black antimony, and associated with galena, iron pyrites, quartz, and heavy spar, from which it is freed by fusion in pots arranged in such a manner that the fused sulphide runs off into earthen vessels where it cools.

Properties.—Thus purified it is known in commerce as crude antimony, and contains iron, arsenic, and lead. From the shape of the pots in which it has cooled, it usually occurs in the form of blunt cones, which are of a blackish color, and when broken have a metallic lustre and a crystalline texture. Its ready fusibility distinguishes it at once from black oxide of manganese. It has the specific gravity 4.62. When gradually heated to redness in contact with the air, it is partly oxidized to antimonious antimoniate, $Sb_2O_3.Sb_2O_5$, and constitutes then an ash-gray powder known as *cinis antimonii* (*antimony ash*). When this is fused with a little black antimony, a transparent garnet-red mass, known as *vitrum antimonii* (*antimonial glass*) is obtained. When a mixture of equal parts of black antimony and potassium nitrate is deflagrated by igniting it in small quantities, it yields *hepar antimonii* (*liver of antimony*), and when this is exhausted with water to remove sulphate and sulphantimoniate of potassium, *crocus of antimony* is left behind, which is mainly a mixture of oxide and sulphuret of antimony. *Antimonium diaphoreticum* (*diaphoretic antimony*) is prepared like liver of antimony, except that more (two parts of) potassium nitrate is used, so that the preparation contains, besides oxide of antimony, antimoniate, sulphate, nitrate, and nitrite of potassium in varying proportions. By washing this with water, the residue consists mainly of *antimoniate of potassium*, which is recognized by the French Codex. The other preparations described were formerly employed in medicine.

Sulphuret of antimony is almost completely soluble in muriatic acid, sulphuretted hydrogen gas being given off. The solution yields with water a white precipitate of oxychloride of antimony (*powder of Algaroth*), which dissolves in tartaric acid. Sulphuretted hydrogen produces orange-red precipitates with the acid solutions.

Pharmaceutical Uses.—Sulphuret of antimony, being the commonest and cheapest antimony ore, is employed for preparing the metal, and as the source of all compounds of antimony, of which the following are officinal: Antimonii et potassii tartras, *U. S.* (Antimonium tartaratum, *Br.*); Antimonii oxidum, *U. S.*, *Br.*; Antimonii oxysulphuretum, *U. S.*; Antimonium sulphuratum, *U. S.*, *Br.*; Liq. antimonii chloridi, *Br.*

Medical Uses.—Sulphuret of antimony is not employed in medicine.

ANTIMONIUM SULPHURATUM, *U. S.*, *Br.*—SULPHURATED ANTIMONY.

Antimonii sulphuretum aureum s. præcipitatum, *Stibium sulfuratum aurantiacum*, P. G.; *Sulphur stibiatum aurantiacum*, *Sulphur auratum antimonii.*—*Golden sulphuret of antimony*, *Golden sulphur*, E.; *Soufre doré d'antimoine*, Fr.; *Goldschwefel*, G.

Composition Sb_2S_5 and Sb_2S_3 mixed with a small and variable amount of Sb_2O_3.

Preparation.—Take of Sulphuret of Antimony in very fine powder six troyounces; Solution of Potassa four pints; Distilled Water, Diluted Sulphuric Acid, each a sufficient quantity. Mix the sulphuret of antimony with the solution of potassa and twelve pints of distilled water, and boil the mixture over a gentle fire for two hours, constantly stirring, and occasionally adding distilled water so as to preserve the same measure. Strain the liquid immediately through a double muslin strainer, and drop into it, while yet hot, diluted sulphuric acid so long as it produces a precipitate. Then wash the precipitate with hot water to remove the sulphate of potassium, dry it, and rub it into a fine powder. *U. S.*

This process agrees with that of the British Pharmacopœia, except that the latter uses solution of soda in the proportion of 4½ imperial pints to 10 oz. of black antimony.

The action of potassa and soda upon the sulphuret of antimony is similar to, but more energetic than that of their carbonates. If the liquid was allowed to cool, it would deposit kermes mineral of a less bright color than that obtained by the action of alkaline carbonates. The prolonged contact with the air has caused a decomposition of the alkaline sulphide, the alkali being regenerated and antimonic sulphide with some polysulphuret of potassium or sodium produced. If the liquid is now acidulated, the antimonic sulphide, together with some sulphur, will be precipitated, and this mixture constituted the golden sulphur of the older Pharmacopœias. In the above processes, however, the filtered liquid is acidulated before cooling, and it must therefore consist of a mixture of the so-called oxysulphuret of antimony (antimonious sulphide and antimonious oxide), and antimonic sulphide with sulphur. This sulphuretted antimony is, therefore, not really identical with the old golden sulphuret of antimony, but they resemble each other in color, and to some extent in composition.

Many modern Pharmacopœias have either abandoned this preparation altogether, or substituted for it the antimonic sulphide, which has a definite composition, and which was prepared by the Prussian Pharmacopœia as follows:—

A solution of 70 parts of crystallized carbonate of sodium in 250 parts of water is boiled, and mixed with milk of lime containing 26 parts of lime and 80 parts of water. 36 parts of levigated sulphuret of antimony and 7 parts of sublimed sulphur are added, and the whole boiled until the gray color has disappeared, when the liquid is filtered and crystallized. 24 parts of these crystals, which are known as *Schlippe's salt*, and have the composition $Na_6Sb_2S_8 + 18H_2O$, are dissolved in 700 parts of water, and added to a mixture of 9 parts of sulphuric acid and 200 parts of water. A brownish-orange colored precipitate, having the composition Sb_2S_5 takes place, which is washed and dried.

Properties and Tests.—Sulphurated antimony is a reddish-brown powder, insoluble in water. When treated with twelve times its weight of officinal muriatic acid, with the aid of heat, it is nearly all dissolved, with effervescence of hydrosulphuric acid gas. The residue, after having been washed and dried, burns with the characters of sulphur, and leaves a scanty ash. The solution in muriatic acid, when added to water, deposits a white powder. The liquid filtered from this powder yields an orange-red precipitate with hydrosulphuric acid. Water in which the preparation has been boiled should not yield a white precipitate with chloride of barium, or with oxalate of ammonium. The last two tests indicate the absence of sulphates and of calcium compounds. The precipitate occurring when a solution of 60 grains of sulphurated antimony in sufficient hydrochloric acid is dropped into water, should, after washing and drying, weigh about 53 grains.

Off. Prep.—It forms a constituent of Pil. antimonii comp., *U. S.* (Pil. hydrarg. subchloridi comp., *Br.*).

Medical Action.—Sulphurated antimony has essentially the same medicinal properties as the oxysulphuret, and may be prescribed in the same doses. It is very rarely employed.

APOCYNUM ANDROSÆMIFOLIUM, *U. S.*—DOG'S-BANE.

The root of Apocynum androsæmifolium, *Lin.* *Nat. Ord.*—Apocynaceæ.

Origin.—This is a perennial herb growing in copses, on the border of woods, etc., in Canada and the United States. It attains the height of two or three feet, has a smooth, often purplish, stem with spreading branches, opposite ovate mucronate, smooth or somewhat downy leaves, a cymose inflorescence, bell-shaped rose-colored flowers, and bears a slender follicular fruit about four inches long, tapering above and containing many narrow seeds which are truncate at the apex, and comose, with a long tuft of silky down. All parts of the plant contain a white milky juice.

Description.—The long root is from one-eighth to one-quarter inch or more in thickness, somewhat branched, and beset with thin and mostly short fibres. It is of a light-brownish color externally, and finely wrinkled longitudinally, and somewhat fissured transversely. The thin and unpleasantly bitter bark covers a rather porous, white, and nearly tasteless, wood. The bark and pith contain starch.

Constituents.—Little is known of the chemical constituents of dog's-bane. Bigelow found a red coloring matter soluble in water and insoluble in alcohol, a trace of volatile oil, and a caoutchouc-like body. The bitter principle was obtained as an extract-like mass.

Medical Action and Uses.—Dog's-bane is said to be emetic and diaphoretic without causing much nausea, and to operate more gently and certainly than ipecacuanha; but it deteriorates by keeping. It is also reputed to be tonic, cathartic, and alterative, and to possess antisyphilitic virtues. In reality, its virtues, if it have any that entitle it to a place in the materia medica, are not well defined. The powder of the recently dried root is emetic in the dose of thirty grains. From ten to twenty grains may be given as a tonic or alterative, in substance, infusion, decoction, or tincture.

APOCYNUM CANNABINUM, *U. S.*—INDIAN HEMP.

Chanvre du Canada, Fr.; *Canadische Hanfwurzel*, G.

The root of Apocynum cannabinum, *Lin.* *Nat. Ord.*—Apocynaceæ.

Origin.—The plant is similar in appearance to the preceding, and grows in similar localities. Its common name refers to the strong fibres of the stem bark, which somewhat resemble the bast fibres of hemp. The plant differs from dog's-bane in having a more erect stem and branches, oblong or ovate lanceolate leaves, smaller flowers with a greenish-white erect corolla, and more slender follicles.

Description.—The root is horizontal, several feet long, one-quarter to one-half inch thick, slightly branched and beset with very few fibres; when dry, longitudinally wrinkled, and the thinner portions somewhat annulated by deep transverse fissures. It has a brownish-gray color externally, and under the thin corky layer a fleshy whitish bark which is one-sixteenth to one-eighth inch thick, contains laticiferous vessels, and incloses a white porous wood composed of several rings, and radiate by fine medullary rays. It is inodorous, and the wood tasteless, but the bark develops gradually a very persistent bitter taste. It is usually mixed with the lower portion of the stem, which has a smoother bark and harder wood, the latter inclosing a central pith.

Constituents.—The earlier analyses of Dr. Knapp and Dr. Griscom (1833) failed to isolate the active principle, but proved the presence of the widely distributed proximate constituents, among which are stated to be tannin, gallic acid, gum, starch, resin, and wax.

Medical Action and Uses.—"Indian hemp" is a powerful emetic and cathartic, and when it produces the former operation is diaphoretic also. It also promotes expectoration and a tendency to drowsiness, increases the urinary secretion, and diminishes the frequency and force of the pulse. Its evacuant properties have sometimes been made available in *dropsy;* but it does not appear in what forms of dropsy, cardiac, renal, hepatic, or splenic, its efficacy has been chiefly shown. Probably it is a mere evacuant of dropsical effusions, the ultimate tendency of the dropsy depending on the nature of its organic cause. There can be little doubt of its having this value in common with jalap and other hydragogue cathartics. Possibly it possesses advantages by exciting diaphoresis and diuresis, while it purges and vomits. It is said to destroy *intestinal worms.* An infusion and a tincture of this root have both been regarded as tonic and alterative in *dyspeptic* derangements, and as curative of mild cases of *intermittent fever.* These properties are doubtless owing to the bitter principle which it contains. The dose of the powdered root is about five grains as an antiperiodic, and twenty grains as an emetic. The decoction is usually made with an ounce of the root in a pint and a half of water boiled to a pint, and may be given in doses of a wineglassful three times a day. Some physicians recommend as a diuretic in dropsy an infusion made with a drachm of the bark of the root in eight ounces of water, of which half an ounce may be given once in six hours.

APOMORPHIA.—APOMORPHIA.

Apomorphine, Fr.; *Apomorphin*, G.
Formula $C_{17}H_{17}NO_2$. Molecular weight 267.

Preparation.—One part of pure morphia and twenty parts of pure hydrochloric acid are introduced into a strong glass tube, having at least fifteen times the capacity of the mixture; the open end is securely sealed, the glass tube introduced into a strong metallic tube closed by a screw cap, and the whole immersed for three hours in an oil-bath heated to between 140° and 150° C. (284° and 302° F.). After cooling, the tube is opened, the liquid diluted with water, and bicarbonate of sodium added in excess. The liquid is decanted from the precipitate, and this is agitated with ether. To the ethereal solution a few drops of hydrochloric acid are added, whereby hydrochlorate of apomorphia is separated; this is recrystallized from boiling water, and then redissolved in little water, the solution precipitated by bicarbonate of sodium, and the precipitated alkaloid rapidly washed with a little cold water, and dried without delay. In this process chloroform may be used in the place of ether.

This process is the one devised by Matthiessen and Wright (1869). The hydrochloric acid acting upon the morphia at the temperature stated above, merely abstracts one molecule of water from the molecule of morphia, and on opening the cooled tube no pressure is observed in it and no gas escapes. During the heating, however, there is considerable pressure in the sealed tube from the volatile acid, and to guard against accidents its inclosure in a strong metallic tube, as directed above, is advisable. A portion of morphia may possibly not undergo the change, and will be precipitated with the apomorphia by the bicarbonate. Morphia being insoluble in ether, it is left behind, when the precipitate is treated with this solvent, which readily dissolves apomorphia. On the addition of some hydrochloric acid, hydrochlorate of apomorphia is produced, and being insoluble in ether, separated in a crystalline condition. The recrystallization of the salt from boiling water renders it perfectly pure. Since apomorphia is soluble in aqueous liquids, the mother liquor decanted from the precipitate contains notable quantities of the alkaloid, which may be recovered by agitation with ether or chloroform, and by treating these solutions with a little hydrochloric acid. On the final separation of the alkaloid, it should be rapidly dried upon bibulous paper, or over sulphuric acid under a bell glass, and kept in stoppered bottles protected from moisture and light.

Matthiessen and Wright have obtained the same compound from codeia and hydrochloric acid, which yield at first *chlorocodid*, $C_{18}H_{20}ClNO_2$, and on continuing to heat in a sealed tube, this compound is split into chloride of methyl CH_3Cl, and apomorphia $C_{17}H_{17}NO_2$.

Mayer (1871) noticed that hydrochlorate of morphia is more rapidly and at a lower temperature converted into apomorphia by heating it to 120° C. (248° F.) with a solution of zinc chloride of such strength that its boiling point is at 200° C. (392° F.); the change is then effected in 90 minutes, and the apomorphia may be obtained pure by the above process, the carbonate of zinc, which is precipitated at the same time, being insoluble in ether.

In 1845 Arppe had obtained *sulpho-morphid*, by heating sulphate of morphia with an excess of sulphuric acid and water to 150° C. (302° F.). This is white, nearly insoluble in water, and was proven by Matthiessen and Wright to be sulphate of apomorphia. Arppe had given it the formula $C_{17}H_{18}NSO_4$. Nadler (1873) separated from it the alkaloid, and converted it into hydrochlorate.

Properties.—Apomorphia is a white or more generally a grayish amorphous powder, which is rather freely soluble in water and dissolves in ether, benzol, and chloroform. On exposure to the air while still moist, it rapidly turns green, and then dissolves in chloroform with a blue color. Nadler observed that on being precipitated from its solution in sulphuric acid by ammonia, it speedily acquires a reddish-brown color, and yields with chloroform a rose-colored solution. Apomorphia is colored red by nitric acid, brown by iodic acid, and rose-red by ferric chloride; this last reaction being quite distinct from the blue color produced by the same reagent with morphia.

The salts of apomorphia appear to be slightly soluble in cold water, but more freely so in warm and in acidulated water; these solutions on exposure to air acquire a green color.

Physiological Action. *On Animals.*—The introduction of apomorphia into medicine dates from 1869, when the first experiments with it were made by Dr. Gee. He found that two grains of the chloride of apomorphia injected into a dog occasioned vomiting, and in two or three minutes the animal began to course around the room in a curiously persistent and methodical manner. Three grains injected into a cat caused the animal to run around in the same manner and also to turn vaulting somersaults in the air. Two more grains induced epiliptiform convulsions, and two additional grains caused perfect relaxation. The next morning the animal was found dead.

On Man.—The effects of this substance are essentially alike, whether it be administered by the mouth or hypodermically, but in the former case they are more slowly developed. In twenty minutes after one-fifth of a grain had been taken internally, headache, dizziness, oppression, and qualmishness were complained of; the face grew pale, there was free salivation, the pulse was infrequent, small, and feeble, and free vomiting occurred in from ten to twenty minutes. In some cases there is said to have been drowsiness rather than the apathy of depression; but the statement is probably incorrect. Sometimes there is retching, or, again, free vomiting without effort occurs. This operation is apt to be repeated several times at intervals of a few minutes, and is followed by a quiet sleep. No marked action upon the pulse is observed, except during the emetic operation, when it is apt to be slower than natural as well as feebler and smaller; but it speedily returns to the normal rate. Unlike antimony, ipecacuanha, and other nauseant emetics, it neither irritates the stomach nor causes diarrhœa, nor has it the former effect like mechanical emetics. A repetition of it does not appear to diminish its efficacy, but whatever tends to blunt sensibility impairs its action. Thus it acts but feebly upon animals under the influence of chloroform or chloral; all morbid conditions that induce a like condition have the same effect, as stupor, asphyxia, etc. It may produce its specific effects by absorption through the sound skin; so, a gentleman who sometimes had his hands wetted with solutions of this agent, vomited frequently, was depressed, uncomfortable in the head, and unfit for work.

Some persons appear to be readily poisoned by this substance, which then produces, usually, a degree of sedation which may reach full collapse. This has happened even in robust persons. In one nausea occurred at the end of ten minutes, in three minutes more the patient grew very giddy and pale and fell to the ground; he then broke into a cold sweat and appeared to be dying, but he vomited copiously and recovered. In another case one-thirty-second of a grain was very unwisely injected in the case of a child affected with capillary bronchitis. Violent and repeated vomiting took place, the patient grew as pale as wax, a tracheal rattle was heard; but the patient survived. A drunkard affected with albuminuria had injected one-sixth of a grain of muriate of apomorphia. Vomiting presently took place, and then sudden syncope; the pulse was extinct and respiration hardly perceptible; the skin was pale and livid, and covered with a cold sweat; there was complete extinction of consciousness and sensibility. Under electrical stimulus he was saved. Very similar effects occurred in the following case: A middle-aged woman, suffering from sore throat, received a hypodermic injection of one-sixteenth of a grain of muriate of apomorphia. Symptoms nearly identical with those last mentioned occurred, besides convulsive twitchings of the corners of the mouth. For some hours after the return of consciousness she was inclined to faint. In a case of quinsy, one-sixth of a grain was injected subcutaneously. In ten minutes the patient suddenly threw himself backwards, and flexed his arms rigidly; the pulse was very small, the skin cool, and the heart-sounds feeble. Opisthotonos followed, the man supporting himself on the neck and heels. In a few minutes the rigidity disappeared, and the patient sank into a deep sleep.

According to Harnack the action of apomorphia may be described, in the conventional language of the day, in the following manner: 1. In man, and in mammalia capable of vomiting, a moderate dose excites the centre of emesis, but large ones depress and even paralyze it. 2. In rabbits the respiratory centre is affected in a similar manner. 3. The centre of voluntary motion in rabbits is strongly excited, even to convulsions, by small doses; dogs and cats are excited to active movements resembling those due to volition. 4. In rabbits, cats, and frogs, the centres of sensation appear to be depressed. 5. Striated muscles in frogs have their irritability lessened by this agent; but in higher animals, and in man, it is uncertain whether the muscular relaxation which occurs is due to an action on the spinal marrow or on the muscular fibres. 6. The heart, in frogs, is paralyzed.

Medical Uses.—The sedative, or rather the depressing, action of apomorphia has been occasionally invoked. Thus in the case of a boy in *maniacal delirium*, with dilated and insensible pupils, one-tenth of a grain given hypodermically produced in a few minutes calmness and then vomiting, after which he slept, and the next morning was well. It is said to have produced relaxation of a *rigid os uteri;* and it has been given with negative results in *epilepsy*. It has been administered hypodermically as an emetic in cases of alcoholic *intoxication*, with the effect of dissipating the condition rapidly after free vomiting had taken place. In a case of poisoning with *oil of bitter almond*, it acted as a prompt and sufficient emetic in the dose of one-eighth of a grain, hypodermically. Half a grain administered in the same manner in three minutes produced copious emesis in a case of poisoning with *carbolic acid*, and the patient recovered. In *quinsy*, when swallowing is very difficult, this medicine may be used hypodermically to excite vomiting with the intention of breaking the abscess. It is clearly contraindicated in all cases attended with obstruction of the air-passages; for such the mechanical emetics are alone appropriate.

Administration.—The use of this product is very limited. Fortunately, the cases for which it is exclusively adapted are very few indeed, as the above enumeration of them demonstrates. The difficulty of preserving it forms another obstacle to its employment, although it is alleged not to lose its special mode of action when its color changes to a green or olive tint. Even this change is said to be preventable by adding glycerine or glucose to its solution, while the former renders muriate of apomorphia more soluble. The hypodermic dose for an infant is from one-sixteenth to one-thirtieth of a grain; for a child of ten years, one-twentieth of a grain; and for an adult, one-tenth of a grain, subcutaneously, or one-fifth of a grain by the mouth. For such injections a one-per-cent. solution is eligible.

AQUA, *U. S.*, *Br.*—WATER.

Aqua communis, P. G.—*Eau*, Fr.; *Wasser*, G.

Natural water in the purest attainable state, *U. S.;* cleared, if necessary, by filtration, *Br.*, through alternate layers of sand and charcoal, *G.*

AQUA DESTILLATA, *U. S.*—DISTILLED WATER.

Eau distillée, Hydrolat simple, Fr.; *Destillirtes Wasser*, G.

Composition H_2O. Molecular weight 18.

Preparation of Distilled Water.—Take of Water eighty pints. Distil from a tin or glass condenser two pints and throw them away; and then distil sixty-four pints and keep them in well-stopped glass bottles. *U. S.*

According to the British Pharmacopœia 100 pounds of the water are distilled from a copper still connected with a block-tin worm, rejecting the first 5 pounds, and preserving the next 80 pounds.

Properties.—Water is often combined in nature as in many crystalline compounds, and is very abundant in the free state. Natural water is an excellent solvent for most gases and many salts, but it is rarely found pure; B. M. Brackenridge and Dr. E. Stieren observed (1860) chemically pure water in the spring of a ravine known as "the dark hollow," in Allegheny County, Pa. With few exceptions *spring water* contains carbonic acid gas in solution, and by its agency dissolves some carbonate and sulphate of calcium and carbonate of magnesium from the soil. Such water precipitates an insoluble lime soap from solution of ordinary soap, and is called hard. This hardness may be removed by expelling the excess of carbonic acid by heat; the carbonate and a portion of the sulphate of calcium, also magnesium carbonate if present, are thus precipitated. A similar precipitation takes place in rivers, from the water of which, owing to its extended surface, the carbonic acid is mostly given off; hence *river water* is usually soft. Both spring and river water contain variable quantities of salts of alkalies, in solution of which they cannot be deprived except by distillation.

Rain and snow water are free from such saline compounds, except the portions falling first; these contain particles of dust and various organic and inorganic matters, which had been suspended or dissolved in the air. Among them, ammonia, iodine, chlorine, and nitric acid have been found, the latter more particularly during a thunder storm, the former two elements occasionally, while ammonia or allied compounds are always present in inhabitated regions. It is advisable, therefore, to collect rain water only some time after the rain has commenced falling, and as far removed from dwellings as possible; it will then contain a little carbonic acid, which has been dissolved from the air.

The purity of running and well water is affected by the nature of the surrounding soil and the proximity of decaying animal or vegetable matter, the decomposition products of which may find an outlet into the former by natural drainage, sometimes from a considerable distance, and render such water unwholesome and unfit for many purposes. The refreshing taste of spring water is mainly due to the carbonic acid dissolved therein. Of secondary importance is the small quantity of saline compounds contained in it. When the latter is permanently increased beyond a certain quantity, the spring is called a *mineral spring* (see Aquæ minerales).

Most spring waters are unfit for chemical and pharmaceutical uses, but may often become adapted therefor after boiling and filtering. River water, if not naturally bright and transparent, is improved by filtration through sand and charcoal, and may then be employed if nearly free from organic matter, the amount of which may be approximately ascertained by a dilute solution of permanganate of potassium, which will permanently impart its color to the water, as soon as the organic matter and other deoxidizing agents accidentally present, have been destroyed or oxidized.

Distilled water is best for all the purposes indicated. When ordinary water is heated to ebullition the gases and volatile compounds are also vaporized and carried off with the vapors of the water, which if condensed, would then be more highly charged with these volatile compounds, hence the necessity of rejecting the first portion of the distillate, as directed by the Pharmacopœias. On the other hand, if the distillation is continued until all the water is vaporized from the still, the last portions are apt to be contaminated with volatile products resulting from the decomposition of ammonia compounds and organic matter. The Pharmacopœias avoid this possibility by discontinuing the distillation, when from 10 to 15 per cent. of the water is left in the still.

The material of which the distillatory apparatus used for this purpose is constructed is of considerable importance, but more particularly in relation to the condenser. Iron, copper, and lead condensers must not be used, since the water corrodes these metals, traces and sometimes larger quantities of which will always be found in the distillate. Where a glass condenser is available, it may be regarded as the most desirable; apparatus made of metals (silver and platinum) which are not in the least corroded during distillation, being too costly for general use. The material best adapted for practical purposes is block-tin, of which the condenser and all those portions of the apparatus should be made from which the vapors are made to descend. A minute quantity of tin is nearly always dissolved, but separates again on standing for a few days in contact with the air. The occasional appearance of confervæ in distilled water depends upon its direct contact with the air, and may be prevented by keeping it in vessels arranged in such a manner, that the air can enter only after having passed through a layer of cotton, by which the spores are retained.

The taste of distilled water is insipid, owing to the absence of carbonic acid, or to the minute quantity of this gas absorbed by contact with air. At the temperature of 0° C. (32° F.) water freezes, forming transparent crystals of ice; if entirely undisturbed, it may be cooled to several degrees below this point without freezing, and if now slightly agitated will at once congeal, the temperature rising to the freezing point in consequence of the liberation of latent heat. Water impregnated with salts, particularly such as are readily soluble in it, freezes at a lower temperature, the ice being free from the compounds which were dissolved in the water. Hence water equal in purity to distilled water, may be obtained by melting perfectly clear and transparent ice under conditions which preclude the admixture of dust and other impurities. *Sea water*, which has the specific gravity 1.027, and contains about $3\frac{1}{2}$ per cent. of salts, yields ice of as great purity as river water.

The boiling point of water is 100° C. (212° F.), and rises beyond this temperature, if notable quantities of salts, etc., are dissolved in it, or if the pressure is increased; on the reduction of pressure water boils at a lower temperature.

The density of distilled water at 15° C. (59° F.) or at 15.5° C. (60° F.) is by general consent, regarded as the unit, by which the density of liquid and solid bodies is measured. The specific gravity of water decreases with the rise of temperature, and increases gradually as the temperature is lowered until +4° C. (39° F.) is reached, when it has its maximum density, becomes lighter again towards the freezing point, and expands very considerably when passing into the solid state, ice having the specific gravity 0.916. When converted into vapor, water expands to nearly 1700 times its bulk, and forms a transparent and colorless gas, having the specific gravity 0.455 at 100° (C. 212° F.); it has therefore less than one-half the density of atmospheric air. When mixed with air it condenses into minute drops to which the opaqueness of steam is due; the over saturation of air with aqueous vapor causes a similar condensation in the atmosphere, hence the appearance of clouds.

Tests of Purity.—Distilled water is colorless, inodorous, and tasteless, leaves no residue on being evaporated, and is not affected by sulphuretted hydrogen, oxalate of ammonium, nitrate of silver, chloride of barium, or lime-water.

Pharmaceutical Uses.—The utility of water as a solvent and vehicle is well known; it is employed in preparing most chemicals, constitutes the solvent of the medicated waters, decoctions, infusions, and most solutions and syrups, and as an addition to alcohol is present in many fluid extracts, tinctures, etc.

Physiological Action of Cold Water.—Water constitutes by far the larger portion of the bulk of all organized beings, and is essential as well to their organic constitution as to the molecular actions and movements by which life is manifested. It is important, therefore, as an article of food which directly supplies one constituent of the body; it is not less so as a means of promoting the solution of solid food in the digestive organs, and facilitating its absorption; it is equally the solvent of all the secretions and excretions, and the vehicle by which the latter are carried out of the body. But all natural water is not adapted for food. The greater part of the water in the world is contained in the ocean; another large portion consists of spring and of river waters, which are so mineralized as to be unfit for ordinary drinking; or of other waters in certain sluggish rivers and in marshes, which contain too large a portion of animal and vegetable matter to be wholesome. The purest natural waters are rain water, which is, however, insipid, and contains but little air, and certain springs which are remarkable for their purity as well as the vivacity of their taste. For pharmaceutical, and indirectly for medicinal purposes, water must be deprived, as far as possible, of its foreign constituents, an object which is most perfectly attained by distillation. But for many of such objects water that has been boiled, or filtered rain water, has been found sufficiently pure.

In a general way, water acts chiefly as a direct means of modifying the temperature of the body. But the mechanism by which the temperature is raised or lowered is identical with that which quickens or retards organic processes, for it is chiefly upon the degree of activity of the latter that the animal temperature depends. Water of a temperature higher than that of the body is a direct stimulant of the circulation, and therefore of all the functions; cold water, on the other hand, robs the body of a portion of its caloric, and therefore is a direct sedative of the circulatory and the other functions. But cold may indirectly become a stimulant of the animal functions, since it is a property of living organisms to react against whatever power tends to depress them, and this the more vigorously the more abruptly the depressing influence has been exerted. Therefore cold applied to the body, in a certain measure and for a given time, produces a diminished activity of function, which is followed by a degree of activity greater than that which originally existed. In this manner the primary effect of heat and the secondary effect of cold resemble one another. But cold and heat are conventional terms; they do not designate any definite temperatures. The normal animal temperature being about 98° F., whatever is higher than this may be described as heat; whatever lower, as cold. Hence different degrees of heat may be expected to produce different grades of effect from a mild to a powerful stimulation, and thence to the destruction of vitality; and, in like manner, coolness, cold, congelation, etc., are terms applied to the different degrees in which caloric has been abstracted. It is evident, therefore, that the action of water, and consequently its uses in medicine, will vary between very remote extremes; that it may stimulate moderately or violently; soothe gently, or depress more or less profoundly, according to the conditions which have been pointed out for illustration. The effects of cold water upon the living body are complex; they comprise the direct abstraction of caloric, the diminished production of it, and a multitude of reflex effects due to the relations between the skin and internal organs. The loss of caloric by the contact of cold water with the skin is more or less completely balanced by the generation of caloric through the organic changes which are incessantly active in every tissue. Hence the interior of the body, in health, maintains a certain average temperature, or within two or three degrees of it, whatever may be the temperature of the surrounding medium. With the abstraction of caloric all the vital processes are depressed, the skin grows pale and shrivelled, and the internal organs are overloaded with blood, the pulse beats slowly, the secretions are diminished, and the muscles torpid. Taken internally, cool water produces a sense of coolness in the throat and stomach, and afterwards in the rest of the body; but if the water be very cold, and taken in large quantity, it may produce in the stomach severe pains which radiate to the chest and abdomen, and a violent shock to the whole nervous system, which may be expressed by spasm or by collapse, or by both in succession. If these effects are not fatal, reaction with fever is apt to occur. The transient application of cold to the skin is so quickly followed by reaction that the effects seem to be those of direct stimulation; the cutaneous circulation becomes more active, a sense of warmth and gentle perspiration ensue, and through this reflux and flux of the blood, and the excitation of the nervous system, all of the functions are quickened. The local effects of cold water, as distinguished from those of cold applied in other manners, are essentially the same as those which have been described, viz., diminished circulation and calorification, followed by a more or less distinct reaction.

Medical Uses of Cold Water.—According, then, to the circumstances under which it acts, cold water may be refrigerant, excitant, sedative, astringent, tonic, debilitating, or perturbating. It may be used to check febrile and inflammatory processes, to stimulate a torpid and oppressed nervous system, to arrest spasm, to relieve congestion and pain, to abate excessive secretion, hemorrhage, etc. The particular diseases in which it has proved useful are those *continued fevers* in which the temperature is extremely high, provided no intercurrent inflammation complicates them. Cold water in the form of douche, baths, and wet wrappings, have been employed with decided benefit in many cases of *typhus fever*, *scarlet fever*, *variola*, etc.; and the douche or other similar shock with cold water, has proved curative in various forms of *intermittent fever*. The use of cold water as a drink in fevers is prescribed by instinct as well as reason; and the same is true of it in inflammation of the stomach. The application of wet compresses around the inflamed joints in acute articular *rheumatism* has not been followed by the bad consequences which it was supposed would follow from repercussion of the morbid fluxion, and such applications, when made with an alkaline liquid, have often proved extremely salutary. Cold water is one of the best applications for a variety of local inflammations, such as *burns*, *scalds*, *intertrigo*, and the *stings* of insects. Cold is one of the most potent means of arresting *hemorrhage*, whether from the nose, lungs, stomach, bowels, uterus, or from wounds. In such case it should be applied as near as possible to the source of bleeding. In uterine hemorrhage ice and iced water have been introduced into the uterus with complete success, and without injury. *Scrofula*, *chlorosis*, and *anæmia*, are diseases which have some elements in common, chief among which is impoverishment of the blood. Whether this condition be primary or secondary, the use of cold water internally and externally improves nutrition, and thereby tends more or less to moderate or to remove the defects of nutrition upon which the diseases depend. It is in this way—that is, by its direct stimulant and indirectly corroborant action, that cold in the form of baths, and especially salt and surf baths, tends to remedy *nervous exhaustion* produced by mental or physical excess. The state of debility, here as elsewhere, requires that the operation of so powerful an agent should be very cautiously applied. In most of the diseases last referred to, cold water is used as a stimulant, or as an indirect agent for promoting perspiration; but in some others its aid is sought for its direct and continuous action in repressing vascular action and its consequences. Thus in all cases of *hyperæmia of the brain*, whether arterial or venous, the excitement of the one and the stupor of the other condition, may be mitigated by cold water duly applied to the head. Irrigation by cold water, or the constant application of an ice poultice to the scalp, with the hair closely clipped, and, still more powerful, the cold douche, will often succeed in allaying violent delirium, or restoring consciousness from deep coma. *Insanity*, when acute and accompanied with heat of head, yields to the same method, especially if the body be at the same time immersed in a bath at 95° F., and the daily treatment be continued for several hours at a time. The same method is entirely applicable to the treatment of *mania-à-potu* in violent patients, and to the relief of narcotism in *poisoning by opium*. In *sunstroke* the brain symptoms appear to be due, not only to the excess of blood within the cranium, but also to the excessive heat of the blood itself, which is denoted by a temperature of the skin of 109° to 111° F. Cold water and ice frictions appear to be the most successful, as they are plainly the most natural, remedies for this fatal affection.

Most of the spasmodic affections may be treated by cold water. *Chorea* is particularly benefited by it when the patient is not unduly terrified by its application. A very cold douche bath limited to the spine is one of the most efficient forms of this method; but cold bathing in general, and above all sea bathing, is of great value. *Hysteria* is favorably modified by cold bathing, as by all influences that strengthen the system generally and the nervous functions in particular. *Convulsions* of whatever sort, attended with a fulness of the cerebral bloodvessels, should be treated by cold applications to the head and the nape of the neck; even *epilepsy* has been favorably affected by the use of ice-bags to the cervical spine; and *tetanus*, of the idiopathic form, has been repeatedly cured in ancient and in modern times by cold affusions. Even traumatic tetanus has got well under the direct application of ice to the spine. Among diseases of the digestive organs amenable to treatment by cold water is *constipation*, as the oldest and most recent records demonstrate. It has often been employed successfully by causing the patient to walk upon a cold stone pavement, to have cold water dashed over the limbs, to have it applied to the abdomen by means of wet compresses, while copious draughts of the same liquid were taken. The last-mentioned methods have been successfully employed to overcome the obstinate constipation of *lead colic*.

In surgery the applications of cold water are important and numerous. It is the most convenient as well as the most efficient remedy for *contusions*, including those which a joint has been subjected to by its *dislocation*, or the soft parts by *fractures* of bones, etc. The full benefit of the treatment is best secured by its earliest possible application after the injury, for then it prevents the excessive exudations which embarrass and retard the cure. The utility and the mode of action of the remedy is just the same in the treatment of *wounds* which are not likely to unite directly or by the first intention; and, indeed, even these heal more readily under its use, provided that the severed surfaces are maintained in close apposition, while contused and lacerated wounds whose union is usually hindered by inflammation, close all the more readily when this process is abated by cold water. The repressive action of cold water is well illustrated in its power of preventing the development of local non-traumatic inflammations, such as *boils*, *carbuncles*, *whitlows*, *acute orchitis*, etc. In all of these affections, if steadily maintained, it arrests their development; but its intermittent application is useless, or worse. *Ulcers*, especially of an indolent and ill-conditioned sort, are often cured by cold and moisture combined, by which the nutrition of the part is rendered more active and normal. The water may be applied on compresses, by washing, and above all by the douche. The two former are the most appropriate for irritable, and the last for indolent ulcers. The repressive power of cold water is well exhibited in the treatment by it of *burns* and *scalds;* provided that it be applied immediately after the injury and steadily kept in operation, it will tend to prevent ulterior changes of tissue dependent upon inflammation. The more extensive the injury the less appropriate does this method become. The strangulation of *hernia* is often due to a distension of the bloodvessels of the tumor, and in so far its reduction may be facilitated by whatever tends to disgorge the swelling of its blood. Cold water has proved efficient for this purpose in many cases. Even ice and freezing mixtures have been applied with the same object, but they are not free from the danger of producing mortification. In like manner certain *venous dilatations* have been diminished, particularly those of the rectum, the uterus, and the penis. No better palliative for *hemorrhoids* exists than frequent ablutions with cold water, especially after stool.

The internal use of cold water requires to be cautiously guarded; the risk of drinking it too freely when the system is exhausted by heat has been pointed out; it is not readily absorbed from the stomach in other atonic states of this organ, and if taken during or too near a meal, it is very apt to interfere with digestion. It should not be used freely during pulmonary and especially bronchial inflammations, nor in diarrhœa. It is better tolerated and is often salutary in acute *dysentery.* Baths at a lower temperature than 50° F. are unsafe for children and old persons at all seasons; and when serious disease exists of any organ essential to life, the temperature should not be lower than 75°. In any case cold baths should be of very short duration, and active exercise used during and after their use. If local applications of cold water occasion chilliness they should not be continued. Cold baths should not be used immediately after a meal, nor when the air is chilly, nor when the mind is distressed. Early morning baths are invigorating, but cold baths before bedtime are of great utility in summer by rendering sleep more sound and refreshing. In cold bathing the head should always be wetted before the rest of the body, and after the bath the skin should be stimulated by rubbing it with coarse cloths.

Local cold baths, applied to the head, the pelvis, and the feet, are employed to relieve congestion and stimulate the circulation in these parts, and thus prevent or remove the effects of vascular stagnation. Their sedative or their stimulant operation will be determined by their duration, the temperature of the water, the manipulations employed at the same time, etc. Cold water is often employed by *irrigation*, that is, by directing a stream of it over some portion of the body; in an *epithem* or mass of lint, sponge, or other porous material kept saturated with the liquid, or by means of pounded ice, which is sometimes mixed with nitrate of potassium and chloride of ammonium, in order to form a freezing mixture; by *ablution*, which consists in applying cold water, with more or less friction, to the surface of the body, in order to allay the heat of skin and promote diaphoresis in febrile states, etc.; by *affusion*, in which large quantities of cold water are poured over the body previously washed or not with hot water and soap, by which means the functions of the skin are quickened, and sometimes a salutary crisis is brought about. The *douche* is a form of affusion in which a continuous stream of water falls from a height upon the body, adding a mechanical stimulus to that produced by the cold water; the *shower-bath* is a modification of the same method, in which the stimulus is very gentle, and therefore adapted to persons who are comparatively feeble. The so-called *hydropathic* measures, which consist essentially in enveloping the body in wet wrappings, which are in turn surrounded by dry ones, while the patient drinks abundantly of cold water, have for their object the production of profuse perspiration, by means of which the blood may become purged of deleterious matters circulating with it. The purification may become general, or be made local by restricting the application of wet compresses to the ailing parts. This last-named method is of very general application, and is one of the most useful in all injuries of joints and other local injuries, as well as in almost every variety of internal inflammation, including those of the joints, lungs, and abdominal and pelvic viscera. The sweats produced by local as well as by general wet applications have sometimes an offensive smell, which probably shows that effete and therefore deleterious substances are eliminated by means of them.

Physiological Action and Medical Uses of Warm Water.—Water of a higher temperature than that of the body may be applied in the form of vapor or of liquid. A vapor bath at 120° F. may increase the pulse-rate to 145 or more, rendering the respiration difficult, and even causing hæmoptysis, producing fulness of the head, congestion of the brain, and even apoplexy. The more fully charged is the atmosphere with moisture, the greater is the suffering of the system in proportion to the elevation of the temperature, because the less is the loss of caloric by radiation; under the same circumstances, however, the body rapidly loses weight by perspiration. The internal secretions, and the urine particularly, are notably diminished. These conditions are carried to an extreme limit in the Russian vapor bath, and are intensified by other methods of stimulating the skin, such as violent frictions and flaggellation with softened rods. It has been found that a person unaccustomed to such baths may lose nearly a pound in weight by the operation of a single one. For domestic and medical purposes a vapor bath may be constructed by merely surrounding the patient, seated in a chair, with a tent of blanket or other impermeable stuff, and introducing steam within the inclosure. The head need not be included in the covering. Very soon active diaphoresis will commence. The vapor of warm water may also be diffused throughout an apartment by boiling a kettle or other convenient vessel, or by slaking lime in the neighborhood of the patient. The latter expedient is to be recommended in cases of *membranous croup*; the others are usually employed in the treatment of acute and chronic muscular *rheumatism*, in chronic articular rheumatism and *gout*, and in cases of *paralysis* that require muscular stimulation. This vapor bath is also beneficial in *dropsy*, especially in that produced by cold, and in the scarlatinous form; in cases of *eruptive fevers*, in which the eruption is tardy or imperfect; in all chronic *diseases of the skin*, in which the integument is torpid, dry, and hard; and in cases of profuse *sweating* due to a relaxed state of the skin.

As the capacity of water for caloric is three thousand times greater than that of air, the former is capable of producing the phenomena of heat much more energetically than the latter. When water warmer than the body (99° to 113° F.) is swallowed, it excites a local and diffusive warmth, quickens the pulse, and increases the perspiration and urine. The hotter the water the more decided are these effects. The *warm bath* (100° to 105°) tends to check exhalation from the parts of the body immersed, but increases it from the surface exposed to the air; but before this effect takes place the exposed parts become congested, and a sense of fulness and discomfort is experienced in the head and face. The skin grows red, the pulse and respiration are quickened. Sweating follows the bath, especially if encouraged by warm bed-clothing, and there is a general sense of relaxation, and usually an inclination to sleep. The local action of water, of the temperature mentioned, is to relax the tissues and allow the blood to accumulate in them, thereby tending to withdraw it from remoter parts. Hence the utility of this measure in relieving *congestions* of the brain and other internal organs, and in relieving *pain*, *muscular spasm*, and *fever*. The greater the surface exposed to the action of the bath the more efficient is its operation, particularly in relaxing spasm and allaying internal pain, as is familiarly exhibited by the efficacy of this agent in cases of *dislocations of joints*, in *spasm* of the gall ducts, ureters, intestines, uterus, etc. If the body, after the action of a hot bath, is subjected to the sudden contact of cold water, a reaction occurs which is usually accompanied with profuse perspiration.

The general warm bath is an important hygienic instrument by means of which the skin is cleansed of its accumulation of effete secretions, and its activity is augmented. It is also an almost indispensable agent in modifying the nutrition of the skin, and thereby promoting the cure of many cutaneous diseases in their chronic forms. It is one of the most efficient agents in the treatment of chronic *rheumatism*, especially in the form of sulphurous mineral waters. It is an important adjuvant in all the forms of *albuminuria* and of *diabetes*. Prolonged warm baths are most efficient auxiliaries in all excito-motor derangements, but especially in the different forms of *convulsion* and muscular *spasm*, and also in *insanity* of nearly every type. In certain forms of *paralysis*, and especially in rheumatic paraplegia, its efficiency is sometimes remarkable. Its stimulant and revulsive operation is valuable in various intestinal disorders, especially in *cholera infantum* and *acute dysentery*. Its depurative action is frequently available in *scrofula*, *chlorosis*, and constitutional *syphilis*. The hot bath tends to relieve extreme muscular exhaustion, and is available in cases of apparent death from *asphyxia*, in *strangulation*, and *intoxication*, and when the new-born child fails to breathe, or does so imperfectly, owing to debility and not to cerebral congestion.

Partial warm baths are applied to the feet, the hips, and sometimes to the hands. Warm foot-baths (at about 98° to 100° F.) draw the blood away from the brain and thereby promote sleep and relieve pain and congestion of the head and of the trunk. It is very efficient in arresting the formation of *coryza*, *sore throat*, *pulmonary catarrh*, *laryngitis*, especially of the spasmodic form, and muscular *rheumatism*, and in promoting the *menstrual flow*. If its temperature is high enough to produce a painful impression on the skin, it stimulates the whole system, and is more apt to occasion a sense of fulness than relief, and to prevent sleep instead of promoting it. The warm hip-bath is used at about the same temperature (98° to 101° F.), and is especially adapted to allay painful *abdominal* and *pelvic disorders*, such as *biliary*, *renal*, and *uterine colic*, and *strangury*, to relieve *retention of urine*, and bring on retarded *menses* and the *hemorrhoidal flow*. Fomentations with warm water, by means of cloths, sponges, spongio-piline, poultices, etc., may be regarded as partial warm baths, and are used to relieve the tension of the skin in local phlegmonous inflammations, and at the same time, by increasing the amount of blood in the part, to promote suppuration. Such fomentations of the mamma favor the *secretion of milk*, and, through the sympathy of these glands with the uterine system, sometimes excite the *menstrual flow*. This last effect has been secured by prolonged injections of warm water into the vagina, which are also useful in recalling suppressed *lochia* and allaying pain in the pelvis. Enemas of warm water are habitually used to evacuate the bowels. Warm sand or mud baths are often employed at thermal springs in the treatment of chronic *rheumatism*, *gout*, general *dropsy*, etc. Water, so hot that its contact can just be borne without scalding, is sometimes used to prevent certain local inflammations in debilitated parts such as *panaris*, *frost-bite*, the effects of *local contusions*, etc.; to arrest local *perspirations* and general *colliquative sweats*, and to check *capillary hemorrhage*. Boiling water may be employed to produce a powerful stimulant or revulsive action, as in cases of *asphyxia* and prolonged *syncope*. Its use requires great caution, and is not so safe as the application of a hammer or similar metallic instrument previously immersed in boiling water.

AQUÆ MEDICATÆ.—MEDICATED WATERS.

Aquæ destillatæ, *Aquæ stillatitiæ*.—*Distilled waters*, E.; *Eaux distillées*, *Hydrolats*, Fr.; *Destillirte Wässer*, G.

Preparation and Properties.—The above names are applied to waters which have been impregnated with volatile substances. All odorous plants and parts of plants impart their odor, and to a certain extent also their taste, to water which is distilled therefrom. This is due to a considerable extent to the volatile oils passing over with the vapor of water; but, in many instances, the flavor of such distilled waters differs more or less from that of the aqueous solutions of the corresponding volatile oils, and we must therefore assume that besides the volatile oils, other volatile compounds, acids, and probably ethers, pass over and remain dissolved in the water, whereby the flavor is modified and nearly always becomes more agreeable. In preparing medicated waters, distillation should be resorted to whenever practicable.

The drugs are preferably used in the fresh state, if they can be thus obtained, since during the drying process more or less of the volatile constituents are lost by evaporation, and, in common with the others, often modified in composition. In some cases where the oil-cells are well protected, as in cinnamon bark, or the oil is produced only by contact with water, as in bitter almonds, the material may be preserved in the dry state for a long time without deterioration. In all cases where the oil-cells are not situated on the surface, as in many leaves, the drug should be suitably comminuted, so that it may be easily penetrated by the hot water, and the oil-cells ruptured.

In distilling medicated water over a naked fire, great care should be taken to prevent the material from being burned, otherwise an empyreumatic odor and taste will be imparted to the distillate. This is accomplished by placing the drug upon a diaphragm or placing within the still another vessel perforated on the sides and bottom, so that the vapors will pass through it without unnecessary obstruction. If steam is used, the danger of burning is avoided; in this case, a jet of steam may be conducted to the bottom of the still, the contents of which are thereby heated to the boiling point. If dry material is used, allowance must be made for its swelling on becoming thoroughly permeated by the water, as it might otherwise fill the still and pass into the condenser. Some materials when boiled in water foam considerably, and portions of the decoction are then apt to be carried over mechanically, rendering the distillate colored and otherwise impure. This tendency to foam over will be lessened by adding to the contents of the retort a small quantity of a fixed oil.

The rapidity with which medicated waters are distilled, is of importance, since it has a considerable influence on their flavor and stability. In all cases the waters should be rapidly and thoroughly cooled in the condenser, to prevent the action of the hot water, and of the acids which are sometimes present, upon the tin, and to avoid changes in the volatile oil which, in its finely-divided condition, are apt to occur. Waters which have been insufficiently cooled, very frequently become ropy in keeping. It is advisable, therefore, to distil them slowly and cool the condenser well with a sufficient supply of water.

A peculiar odor is observed in some waters immediately after they have been distilled from tin vessels or condensed in tin worms, but not when glass vessels have been used. If the waters are exposed to the air in loosely closed vessels for a few days, this still-odor disappears, and the natural odor of the water becomes apparent.

Distilled waters which, like orange-flower water, are not completely saturated with volatile oil, are advantageously prepared of double or triple the officinal strength, either by distilling off only one-half or one-third of the necessary quantity of water, or by having recourse to the process of cohobation, in which case the proper quantity of water is distilled off, and a second or third time distilled from fresh portions of the same material. When wanted for use they are diluted with distilled water in the proper proportion.

Distilled waters are best preserved in well-corked bottles, which should be completely filled and protected from the light. Exposed to air and light, they gradually turn sour, and lose their agreeable odor.

The U. S. Pharmacopœia allows most medicated waters to be prepared by dissolving the volatile oil in distilled water. To facilitate the solution the oils are finely divided by triturating them with carbonate of magnesium, a minute quantity of which is always dissolved, and the acids which may be contained in the oils are neutralized. In some cases, as in cinnamon-water, a yellow or brownish color is also produced. One of the most important objections to the use of magnesia or magnesium carbonate, is found in the action upon the salts of poisonous alkaloids and metals which are decomposed thereby, with the precipitation of the alkaloids or metallic oxides, unless some acid be added to neutralize the magnesia (T. H. Powers, 1833). Other substances, which are completely insoluble in water, have been recommended for this purpose, such as powdered silica, kaolin, glass, pumice-stone, paper pulp, and purified animal charcoal. G. G. Percival recommends the dissolving of the volatile oils directly in hot distilled water, and filtering after cooling, whereby a strong and otherwise pure medicated water is obtained.

Tests for Purity.—Medicated waters should evaporate in a clean porcelain capsule without leaving any appreciable residue. The water should not acquire a brown or black color by sulphuretted hydrogen or sulphydrate of ammonium (metals), or yield with the latter a white sediment, after having been previously rendered alkaline by the addition of ammonia (zinc).

AQUA ACIDI CARBOLICI, *U. S.*—Carbolic Acid Water.

Eau phéniqué, Fr.; *Carbolsäure-Wasser*, G.

Preparation.—Take of Glycerite of Carbolic Acid ten fluidrachms; Distilled Water a sufficient quantity. Mix the glycerite of carbolic acid with a sufficient quantity of distilled water to make the mixture measure a pint. *U. S.*

The glycerite dissolves readily in the water, yielding a transparent liquid having the odor of carbolic acid.

Medical Uses.—The object of this preparation is to furnish a perfect solution of carbolic acid of determinate strength. One pint of it contains about two fluidrachms of carbolic acid. It may be given internally in the dose of from half a fluidrachm to one fluidrachm. It is a convenient preparation for use in atomization, as a gargle, and as a wash in various cutaneous diseases.

AQUA ACIDI CARBONICI, *U. S.*—Carbonic Acid Water.

Aqua acidula simplicior, F. P.—*Eau gazeuse simple*, Fr.; *Kohlensäure-Wasser*, G.

Preparation.—By means of a proper apparatus, impregnate Water, contained in a suitable receiver, with a quantity of Carbonic Acid equal to five times the bulk of the Water.

Carbonic acid water should not be allowed to be in contact with copper or lead, either in the apparatus in which it is produced, the tubes by which it is transferred, or the vessels containing it.

Carbonic acid may be obtained from bicarbonate of sodium or from marble by means of dilute sulphuric acid. *U. S.*

This water is very extensively prepared in the United States and sold under the names of *soda water* and *mineral water*. Several apparatus have been constructed and patented for the convenient preparation of carbonic acid gas and for charging the water with this gas under pressure. They consist of a generator, a strong copper vessel into which the powdered marble, whiting or sodium bicarbonate is introduced with some water, and which connects with another copper vessel containing the sulphuric acid, which is admitted in small quantities. The gas is first passed through a vessel containing water, to deprive it of impurities, and then to the bottom of the fountain, as the receiving vessel is called, containing the requisite quantity of water. The fountains are made either of cast iron, well protected on the inside by enamel, or of copper lined with block-tin; or stoneware fountains, secured by iron bands, are employed. The water, which is usually charged with from 8 to 10 times its volume of carbonic acid gas, is drawn off through block-tin pipes, which pass through a chamber containing ice.

Properties.—Carbonic acid water has an agreeable acidulous and refreshing taste, and effervesces strongly. It produces white precipitates with lime and baryta water, and acts upon iron, lead, and copper, which metals are gradually dissolved; tin and silver are less affected; hence the importance of preventing the water from coming in contact with other metals except the last two mentioned.

Tests of Purity.—Carbonic acid water should not be discolored by sulphuretted hydrogen, or ammonia, and yield no precipitate with sulphate of sodium or with ferrocyanide of potassium.

Physiological Action and Medical Uses.—The action of this water depends upon the free carbonic acid contained in it. It produces an agreeable titillation of the mouth and fauces, and an analogous impression upon the stomach, which gives it an advantage over simple water in quenching thirst. Whether it be owing to a stimulant action or to a slightly anæsthetic influence it certainly aids in causing the stomach to retain what it might otherwise reject, as is shown in the familiar and popular habit of using it as a vehicle for magnesia and various saline medicines. It possibly promotes the diaphoretic action of the effervescing draught, and is perhaps more diuretic than simple water. The anæsthetic action of carbonic acid water has been resorted to for the palliation of pain in cases of uterine, vaginal, rectal, and other forms of *cancer*. The advantages of the fermenting poultice are due to the carbonic acid which it exhales.

AQUA AMMONIÆ, *U. S.*—WATER (SOLUTION) OF AMMONIA.

Liquor ammoniæ, Br.; *Liquor ammonii caustici*, P. G.; *Spiritus salis ammoniaci causticus*, *Ammonia aqua soluta.*—*Ammoniaque liquide*, *Eau* (*Solution*, *Liqueur*) *d'ammoniaque*, Fr.: *Salmiakgeist*, *Aetzammoniak*, *Ammoniak-Flüssigkeit*, G.

An aqueous solution of ammonia having the specific gravity 0.959 (*Br.*), 0.960 (*U. S.*, *P. G.*).

AQUA AMMONIÆ FORTIOR, *U. S.*—STRONGER WATER OF AMMONIA.

Liquor ammoniæ fortior, Br.—*Strong solution of ammonia*, E.; *Eau d'ammoniaque forte*, Fr.; *Starker Salmiakgeist*, G.

An aqueous solution of ammonia of the specific gravity 0.891 (*Br.*), 0.900 (*U. S.*).

Formula of ammonia gas NH_3. Molecular weight 17.

Production.—Ammonia is produced during the putrefaction of all organisms and of many organic compounds containing nitrogen; it exists in the air and in the soil in the free state, but mostly in combination with acids, in the air as carbonate and nitrite. Ammoniacal salts are met with in most plants and animals. The products of the dry distillation of many nitrogenated compounds contain ammonia, and it is from such a source, namely, from the so-called gas liquor, a by-product of the manufacture of illuminating gas, that ammoniacal salts are principally obtained. (See Ammonii Chloridium and Ammonii Sulphas.)

Preparation. 1. Ammonia Water.—Take of Chloride of Ammonium in small pieces, Lime, each twelve troyounces; Water six pints; Distilled Water a sufficient quantity. Pour a pint of the water upon the lime, in a convenient vessel; and, after it has slaked, stir the mixture so as to bring it to the consistence of a smooth paste. Then add the remainder of the water, and mix the whole thoroughly together. Decant the milky liquid from the gritty sediment into a glass retort, of the capacity of sixteen pints, and add the chloride of ammonium. Place the retort on a sand-bath, and adapt to it a washing bottle, previously connected with a two-pint bottle, by means of a glass tube, reaching nearly to the bottom of the bottle, containing a pint of distilled water. Surround the bottle with ice-cold water and apply heat, gradually increased, until ammonia ceases to come over. Remove the liquid from the bottle, and add to it sufficient distilled water to raise its specific gravity to 0.960. Lastly, keep the liquid in small bottles, well-stopped. *U. S.*

According to the British Pharmacopœia, one pint of strong solution of ammonia is mixed with two pints of distilled water.

2. Stronger Solution of Ammonia.—Take of Chloride of Ammonium in coarse powder three pounds; Slaked Lime four pounds; and Distilled Water thirty-two fluidounces. Mix the lime with the chloride of ammonium, and introduce the mixture into an iron bottle placed in a metal pot surrounded by sand. Connect the iron tube, which screws air-tight into the bottle in the usual manner, by corks, glass tubes, and caoutchouc collars, with a Woulf's bottle capable of holding a pint; connect this with a second Woulf's bottle of the same size; the second bottle with a matrass of the capacity of three pints in which twenty-two ounces of the distilled water are placed, and the matrass, by means of a tube bent twice at right angles, with an ordinary bottle containing the remaining ten ounces of distilled water. Bottles 1 and 2 are empty, and the latter and the matrass which contains the twenty-two ounces of distilled water are furnished each with a siphon safety-tube charged with a very short column of mercury. The heat of a fire, which should be very gradually raised, is now to be applied to the metal pot, and continued until bubbles of condensible gas cease to escape from the extremity of the glass tube which dips into the water of the matrass. The process being terminated the matrass will contain about forty-three fluidounces of strong solution of ammonia.

Bottles 1 and 2 will now include, the first about sixteen, the second about ten fluidounces of a colored ammoniacal liquid. Place this in a flask closed by a cork, which should be perforated by a siphon safety-tube containing a little mercury, and also by a second tube bent twice at right angles, and made to pass to the bottom to the terminal bottle used in the preceding process. Apply heat to the flask until the colored liquid it contains is reduced to three-fourths of its original bulk. The product now contained in the terminal bottle will be nearly of the strength of solution of ammonia, and may be made exactly so by the addition of the proper quantity of distilled water, or of strong solution of ammonia. *Br.*

When ammonium salts are treated with the hydrate of a metal of the alkalies or alkaline earths, the corresponding salts of the metals are formed, and ammonia and water are set free. In both the above processes chloride of ammonium and hydrate of calcium are used, the reaction resulting in the production of calcium chloride, ammonia and water, as follows: $2NH_4Cl+Ca2HO$ yields $CaCl_2+2NH_3+2H_2O$. But while the two processes are identical as far as the chemical reaction is concerned, they differ very considerably in the manipulation. In the U. S. process the materials react upon each other in the presence of much water, resulting, even at the ordinary temperature, in the liberation of much ammonia, and permitting the completion of the process, including the disengagement of the ammonia, at the boiling temperature and in glass retorts. It is important to heat the mixture gradually, so that much of the gas may be given off before the boiling temperature is reached. A rapid heating is apt to cause the extrication of the gas with such violence that the contents of the retort will boil over.

In the British process the materials act upon each other in the dry state, requiring a higher heat, and, in consequence thereof, the employment of an iron retort. This process is mostly followed in the preparation of ammonia on the large scale, when sulphate of ammonium is often substituted for the chloride, on account of the cheapness of the former salt. The dry process necessitates greater care in the purification of the gas, which is indicated already by the dark color which the liquid in the wash-bottle acquires. The impurities in the gas are chiefly decomposition products resulting from the impurities contained in the ammonia salt and lime. Although the latter is used in excess, carbonate of ammonium may form either from carbonate of calcium, possibly present, or from the decomposition of organic matter. If the wash-bottle is charged with milk of lime, the organic decomposition products are better retained, and any carbonate of ammonium contained in the gas will be decomposed, yielding ammonia and carbonate of calcium. In preparing ammonia on the large scale, it is advantageous to connect the wash-bottle with a series of stoneware receivers, shaped like Woulf's bottles, so that the gas which is not absorbed in the first, will pass into the second receiver, and so on.

The employment of a considerable excess of hydrate of calcium has been found advantageous to insure the complete decomposition of the ammonium salt. On account of this excess the residue in the retort will contain a basic calcium chloride having the composition $CaCl_2.3CaO$, which, after having been filtered from the lime, may be neutralized by hydrochloric acid and evaporated to dryness, to be utilized as chloride of calcium.

On the large scale, ammonia water is usually made with common water; the natural impurities of which it contains, together frequently with notable quantities of iron derived from the iron delivery tubes employed. Chemically pure ammonia water may be obtained from this by heating it, or preferably the commercial stronger ammonia water, in a glass flask or retort, and conducting the gas, a considerable amount of which is evolved below the boiling point of water, by means of glass tubes, into some distilled water.

Gaseous ammonia is obtained by passing the gaseous products in the above processes over dry potassa or calcium chloride.

Properties. 1. GASEOUS AMMONIA.—Ammonia is a colorless gas, having a strong penetrating odor and acrid alkaline taste. It has the specific gravity 0.593. Below 40° it condenses into a colorless liquid, much lighter than water, which boils a few degrees above this temperature, and crystallizes when placed in a mixture of solid carbonic acid and ether.

2. AMMONIA WATER.—The aqueous solutions of ammonia constitute colorless, transparent liquids, possessing the odor and taste of the gas, being lighter than distilled water, and having a lower freezing point than this liquid. It imparts a brown color to turmeric paper, a blue color to red litmus paper, and a green color to the juice of violet flowers. Ammonia neutralizes all acids, forming salts, which are mostly colorless and crystallizable, and possess a sharp saline taste. The solutions of most ammonium salts, when evaporated, lose a portion of the ammonia; 52.3 grains of strong solution of ammonia require for neutralization 1000 grain measures of the volumetric solution of oxalic acid.

The following table gives the specific gravities of ammonia waters of different strength at 14° C. (57.2° F.), as ascertained by Carius, 1856.

Per ct. NH_3.	Specific gravity.	Per ct. NH_3.	Specific gravity.	Per ct. NH_3.	Specific gravity.	Per ct. NH_3.	Specific gravity.	Per ct. NH_3.	Specific gravity.	Per ct. NH_3.	Specific gravity.
36	0.8844	30	0.8976	24	0.9133	18	0.9314	12	0.9520	6	0.9749
35	0.8864	29	0.9001	23	0.9162	17	0 9347	11	0.9556	5	0.9790
34	0.8885	28	0.9026	22	0.9191	16	0 9380	10	0.9593	4	0.9831
33	0.8907	27	0.9052	21	0.9221	15	0.9414	9	0.9631	3	0.9873
32	0.8929	26	0.9078	20	0.9251	14	0.9449	8	0.9670	2	0.9915
31	0.8953	25	0.9106	19	0.9283	13	0.9484	7	0.9709	1	0.9959

It will be observed from this table that the officinal ammonia water contains 10 per cent., and the stronger solution 30 (*U. S.*), and 33 per cent. (*Br.*) of ammonia gas.

Tests.—The solutions of ammonium salts yield orange-colored crystalline precipitates with platinum chloride, and if not too diluted, white ones with tartaric acid or acid tartrate of sodium. The most delicate tests for ammonia are those of *Einbrodt* (1852) and of *Nessler* (1856). The former is an aqueous solution of corrosive sublimate, rendered slightly alkaline by the addition of a minute quantity of potassium carbonate. The test is to be applied to an alkaline solution, or if the solution has an acid reaction, it should be rendered faintly alkaline by the addition of potassa or soda, when the test-liquid will produce a white cloudiness if only $\frac{1}{500000}$ ammonia is contained in the solution.

Nessler's reagent is essentially a solution of iodohydrargyrate of potassium made either by saturating a solution of potassium iodide with mercuric iodide, and adding a little potassa, or by the following process: to a hot concentrated solution of 50 grams of potassium iodide, a hot solution of mercuric chloride is added until a permanent precipitate is produced; the solution is filtered, a concentrated solution of 200 grams of potassium hydrate is added, and the mixture diluted to one liter, when 5 cc. of cold saturated solution of corrosive sublimate is added. The clear solution gives, with solutions of ammonia or ammoniacal salts, a brown-red precipitate, or if very dilute, an orange coloration. It may be used for the quantitative determination of minute quantities of ammonia, by diluting the liquid so far that with Nessler's solution only a slight coloration is produced, which is compared with that obtained from a solution of ammonium chloride of known strength, by diluting the latter until the same coloration is produced with the test liquid.

Tests of Purity.—Water of ammonia should evaporate at the temperature of boiling water without leaving any residue (salts). It does not yield a precipitate with lime-water (carbonate), with oxalate of ammonium (calcium), or either before or after neutralizing with nitric acid, with sulphuretted hydrogen. After acidulation with nitric acid it is not precipitated by nitrate of silver (chloride, etc.), or nitrate of barium (sulphate).

Pharmaceutical Uses and Preparations.—Ammonia water is extensively employed as a precipitant in the manufacture of most alkaloids, of phosphate of calcium, hydrate of iron, and purified chloride of ammonium; it is used for nearly neutralizing solutions in preparing digitalin and subcarbonate and subnitrate of bismuth, and as a solvent for impurities in the process for santonin. Combined with citric acid as ammonium citrate, it acts as a solvent for certain salts of iron and bismuth, which are insoluble in water; it is employed in the preparation of benzoate, phosphate, and citrate of ammonium and of hydrargyrum ammoniatum, and forms an ingredient in the following officinal preparations:—

1. *Stronger ammonia water:* Linimentum camphoræ comp.; Spiritus ammoniæ aromaticus; Spir. ammon. fœtidus; Tinct. opii ammoniata, *Br.*

2. *Ammonia water:* Linimentum ammoniæ, *U. S.*, *Br.;* Linim. hydrargyri, *Br.;* Spir. ammon. aromat., *U. S.;* Tinct. quiniæ ammoniata, *Br.*

Physiological Action.—The vapor of ammonia causes plants to fade and shrivel, and asphyxiates animals immersed in it. Caustic water of ammonia given to animals occasions distress, frequent pulse and respiration, prostration, and rigid spasm before death. The gastro-intestinal mucous membrane is injected, softened, and covered with bloody mucus, while the blood in the vessels coagulates imperfectly, and the corpuscles are disintegrated. It does not appear to increase the alkalinity of the blood or of the secretions. On the contrary, it is found in the urine oxidized. Applied to the human skin caustic ammonia excites a sense of warmth and then a burning pain, followed by more or less vesication; or if the application be excessive and prolonged, by gangrene of the part. Blisters caused by ammonia are very painful and slow to heal. Ammoniacal vapors in contact with the eye occasion severe pain and inflammation. Inhaled through the nose they produce sneezing, lachrymation, and burning. In the air-passages they occasion violent irritation, unless greatly diluted, and if inhaled during a state of insensibility fatal asphyxia may result. The passage of the vapor through the mouth under such circumstances may produce severe inflammation of its lining membrane. Internally its physiological action upon the healthy system is slight and transient, but in states of nervous exhaustion it is very prompt and distinct. A sense of tension in the temples, enlivening of the feelings, a consciousness of increased strength, greater warmth of the skin, an augmented secretion of sweat, urine, and bronchial mucus, are among its most sensible effects, which are not, as in the case of alcohol, followed by a corresponding depression. The effects of large doses are not uniform. Sometimes death follows in a few minutes with symptoms of cauterization of the fauces and larynx, sometimes later with those of gastro-enteritis, accompanied or not with delirium, stupor, and spasm; and after death may be found inflammation and œdema of the fauces and larnyx, sometimes of the bronchia also, and generally of the œsophagus, stomach, and small intestine. In other cases, in spite of large doses of the poison and violent symptoms denoting local irritation and nervous exhaustion, the patients recover, although it may be after a long time.

Medical Uses.—*Externally* ammonia is extensively employed both as an ingredient of stimulating liniments and as a caustic. Under the first-named form it is a very popular palliative for the pains of muscular *rheumatism*, *neuralgia*, *muscular spasm*, etc., and for relieving external *congestions*, particularly of the larynx, lungs, throat, and bowels. In the latter its greatest utility is limited to the first period of the attack. In neuralgia its caustic is more important than its stimulant action, and is best secured by vesicating the skin wherever the affected nerve is found to be tender, either at its point of emergence from bones, muscles, etc., or where it is ultimately distributed to the skin. The vesication must be superficial for superficial nerves, and deeper for profound ones. It is best effected by saturating a disk of cloth with the ammonia, applying it accurately to the skin, and holding it there covered with some solid substance until vesication has been accomplished. A salt of morphia dissolved in the ammonia used, renders the relief more certain. *Amenorrhœa* has been successfully treated by vaginal injections of a weak solution of ammonia; and the same is true of vaginal *leucorrhœa*. Other cases in which the local substitutive irritation of ammonia is available, are a tendency to *amaurosis* from exhaustion of the retina, in which case the vapor may be cautiously allowed to come in contact with the conjunctiva; superficial *burns* and *frost-bite;* and a general exhaustion or depression of the nervous system in *low fevers*, when a weak solution of ammonia in hot water may be applied by sponging to the whole skin. Ammonia enters into most of the liniments and washes that are used to prevent the *hair* from falling out, or to stimulate its growth. *Vulvar pruritus* is said to be benefited by vaginal injections consisting of half a fluidrachm or more of stronger water of ammonia in half a pint of common water. This may possibly have been true of pruritus depending upon amenorrhœa; but the remedy is useless in most of the other forms, except as a very transient palliative.

By inhalation the vapor of ammonia has been used to arrest the development of catarrhal affections of the throat and air-passages (*bronchitis*, *coryza*, and *pharyngitis*). It is recommended to employ a weak solution. The most successful application of this method is, perhaps, to chronic dryness of the pharynx and to chronic hoarseness. It has been used as an antidote to *chlorine* and to *bromine*. *Acidity* of the stomach from feeble digestion is benefited by this medicine, and so is the *tympanites* which is often associated with it. In two affections in which spasm of the larynx is more or less prominent as a symptom, *whooping-cough* and *epilepsy*, the inhalation of ammoniacal fumes has been known to delay or to prevent the paroxysm. The same means are popularly employed to relieve *syncope* from all causes, and also the various conditions which lead to it and to which nervous women are subject. Hence it is the basis of most of the "smelling salts." It may be cautiously used in all cases of suspended animation, whether from syncope or *asphyxia*. It is, if promptly employed, an antidote to *hydrocyanic acid* and to *alcoholic intoxication*. Locally applied, it instantaneously relieves the pain of the stings and bites of *bees*, *wasps*, *spiders*, *mosquitoes*, etc., and a large amount of evidence exists to prove its antidotal power against the bites of *serpents*, both when administered by the stomach and when injected into the veins. The latter method is alleged to be by far the most efficient. The median-cephalic vein is the one generally selected for the operation, and from five to twenty drops of strong solution of ammonia in a fluidrachm of water are thrown into the vein with a hypodermic syringe. The clinical facts relied upon for establishing the efficacy of the method are numerous, but the experiments on animals by Fontana in the last century and by some recent observers gave only negative results. Ammonia has been administered in large doses for the purpose of causing *resolution of fibrin* in the right side of the heart and in the great vessels. In three out of four cases the treatment was successful. It is found experimentally that ammonia mixed with blood preserves it fresh and fluid for a long time (Richardson).

Administration.—The dose of water of ammonia is from ten to thirty drops, largely diluted. The stronger preparation is for external use. It may be applied to the skin on some porous tissue saturated with it, and covered with an impermeable substance. In from three to ten minutes the desired effect may be expected. Gondret's paste is formed by adding concentrated water of ammonia to a mixture of melted lard and tallow. It may be applied in a disk-shaped layer an inch or two in diameter. It is apt to cauterize the skin too deeply. As a rubefacient, ammonia is generally associated with oil or some unctuous substance, and should be applied with gentle friction to the skin.

As an *antidote*, any mild vegetable acid (vinegar, lemon-juice) may be employed to neutralize the uncombined ammonia in the system. The local irritant effects require demulcent and protective remedies.

AQUA AMYGDALÆ AMARÆ, *U. S.*—BITTER ALMOND WATER.

Aqua amygdalarum amararum, P. G.—*Eau d'amandes amères*, Fr.; *Bittermandelwasser*, G.

Preparation.—Take of Oil of Bitter Almond sixteen minims; Carbonate of Magnesium sixty grains; Distilled Water two pints. Rub the oil, first with the carbonate of magnesium, and then with the water gradually added, and filter through paper. *U. S.*

Made by this process, bitter almond water is a very unreliable preparation, owing to the variable amount of hydrocyanic acid contained in the oil of bitter almonds. The following will yield a water of definite strength in hydrocyanic acid, and since in this form the latter is scarcely prone to decomposition, such, or a similar preparation, deserves to take the place of the officinal hydrocyanic acid, and of the present bitter almond water. (See *Amer. Journal of Pharmacy*, 1874, p. 217.)

Take of Bitter Almonds twelve parts; Common Water eighty parts; Alcohol two parts. Bruise the almonds, and express as much fixed oil as possible without the aid of heat. Powder the presscake and mix it thoroughly with the water, add the alcohol, and distil off ten parts, or so much that one thousand parts of the well-mixed distillate contain one part of hydrocyanic acid.

Thus prepared bitter almond water is somewhat opaque, and has a strong odor of hydrocyanic acid and oil of bitter almonds, the latter remaining after the hydrocyanic acid has been removed by means of nitrate of silver. *P. G.*

In making bitter almond water by the latter process, the fixed oil is removed because it hinders the reaction between the amygdalin and emulsin, to complete which maceration of the expressed almonds with water for about ten or twelve hours is advisable, at a temperature of about 30° or 35° C. (86° or 95° F.). The almond mixture is then placed upon a perforated diaphragm, and heat applied to the still. When the requisite quantity of water has distilled over, 1000 grains of the distillate are precipitated by nitrate of silver, in the presence of a little nitric acid. The precipitate, when washed and dried, should weigh exactly five grains; if it weighs more, the distillate must be diluted with distilled water; should it weigh less, which may happen if the almond powder has not been macerated with water, or if the bitter almonds have been mixed with sweet almonds, it is best to redistil the water, adding if necessary some common water to the retort, and recovering a quantity calculated beforehand from the weight of the precipitate.

This has exactly one-twentieth the strength of the diluted hydrocyanic acid, but is much stronger than the bitter almond water (*U. S.*), the latter corresponding perhaps better with the *Aqua amygdalarum amararum diluta* (vel *Aqua cerasorum*), which the German Pharmacopœia prepares by mixing one part of the above almond water with nineteen parts of distilled water. If the oil of bitter almonds has been previously deprived of its hydrocyanic acid, the bitter almond water prepared from it will possess no virtues, except for imparting flavor.

Medical Action and Uses.—This uncertain, and unsafe because uncertain, preparation is not officinal in the British Pharmacopœia. If hydrocyanic acid must be given internally, it may be administered with least risk in the form of cyanide of potassium.

AQUA ANETHI, *Br.*—DILL WATER.

Eau d'aneth, Fr.; *Dillwasser*, G.

Preparation.—Take of Dill Fruit bruised one pound; Water two gallons. Distil one imperial gallon (=10 pounds). *Br.*

The water, which is at first slightly milky, if prepared by this process, possesses the odor and taste of dill fruit.

Medical Uses.—Dill water has no advantage over anise water in taste or action, which it in all respects resembles. It is seldom used in this country.

AQUA ANISI, *U. S.*—ANISE WATER.

Eau d'anis, Fr.; *Aniswasser*, G.

Preparation.—Take Oil of Anise half a fluidrachm; Carbonate of Magnesium sixty grains; Distilled Water two pints. Rub the oil, first with the carbonate of magnesium, and then with the water gradually added, and filter through paper.

Anise water may also be prepared by mixing ten troyounces of anise, in powder No. 20, with sixteen pints of water, and distilling eight pints. *U. S.*

Of the two processes the latter is to be preferred; it yields a water having a more pleasant odor and taste than that made from the oil.

Medical Action and Uses.—Anise water is an agreeable and useful vehicle for medicines intended to expel *flatus*, and to allay *colic* and the pain of laborious digestion. It is often used to mitigate the *griping* of senna, rhubarb, jalap, and other purgatives, and as a suitable vehicle for magnesia. It is thought, also, to be an appropriate excipient for expectorant medicines. *Dose*, a fluidrachm and upwards.

AQUA AURANTII FLORUM, *U. S.*—ORANGE-FLOWER WATER.

Aqua aurantii floris, Br.; *Aqua florum naphæ.—Eau* (*Hydrolat*) *distillée de fleurs d'oranger*, *Eau de naphe*, Fr.; *Orangenblüthenwasser*, G.

Preparation.—Take of recent Orange Flowers forty-eight troyounces; Water sixteen pints. Mix them, and, by means of steam, distil eight pints. *U. S.*

The French Codex directs the distillation, by means of steam, of twice the weight of the fresh orange flowers used. Thus prepared, it is called in commerce *double orange-flower water;* and if it is diluted with its own weight of distilled water, it is known as *simple orange-flower water.* The so-called *triple* and *quadruple orange-flower waters* are also met with in commerce; the former being obtained by distilling three parts, the latter by distilling two parts of water from two parts of fresh orange flowers.

This water cannot be imitated in its agreeable odor and pleasant taste by preparing it from the oil of orange flowers (neroli). As distilled from the flowers, it possibly contains some volatile ethers, which are not contained in the volatile oil. The Pharmacopœia process, however, is of practical value only to those pharmacists who are fortunate enough to be able to procure the recent flowers. Occasionally, commercial orange-flower water has separated mucilaginous flocks, which may be removed by agitation with powdered kaolin and filtration. If it has acquired an acid reaction, it is advisable to distil it over magnesia.

Pharmaceutical Uses.—It forms the base of Syrup. aurantii flor., *U. S.*, *Br.*, and the flavoring constituent of Trochisci santonini, *U. S.*

Medical Action and Uses.—Orange-flower water is more remarkable for its delicate and refreshing perfume than for any active medicinal properties. It forms a pleasant flavoring agent for many potions, and may be prescribed for nervous persons during attacks of neuralgic *headache*, *palpitation* of the heart, and a variety of minor *hysteroidal* disorders, the offspring of indolence and self-indulgence.

AQUA CAMPHORÆ, *U. S.*, *Br.*—CAMPHOR WATER.

Aqua camphorata.—Eau camphrée, Fr.; *Kampferwasser*, G.

Preparation.—Take of Camphor one hundred and twenty grains; Alcohol forty minims; Carbonate of Magnesium half a troyounce; Distilled Water two pints. Rub the camphor first with the alcohol, then with the carbonate of magnesium, and lastly with the water, gradually added; then filter through paper. *U. S.*

Take of Camphor broken in pieces half an ounce; Distilled Water one gallon. Inclose the camphor in a muslin bag, and attach this to one end of a glass rod, by means of which it may be kept at the bottom of a bottle containing the distilled water, the other end of the rod terminating just below the stopper of the bottle. Having thus put the camphor into the water, close the mouth of the bottle, macerate for at least two days, and then pour off the solution when it is required. *Br.*

Of the two preparations, that of the U. S. contains, according to G. F. H. Markoe (1865), two grains of camphor in the fluidounce; that of the British only half a grain. W. B. Addington suggested (1873) that a still stronger camphor water may be obtained by dissolving the camphor in a small quantity of alcohol before triturating with the magnesium carbonate, by which means it is very finely divided. If very cold water is used, a larger quantity of camphor is dissolved than can be retained in solution at the ordinary temperature, the excess crystallizing out, leaving, after filtration, a saturated aqueous solution of camphor (R. Rother, 1871).

Medical Action and Uses.—The proportion of one grain of camphor which is contained in each dose of half a fluidounce of this preparation is not sufficient to develop the more potent effects of the drug, yet quite enough to sustain the nervous system in those states of exhaustion and prostration into which it is apt to fall in *low fevers*, on the one hand, and in states of *nervous debility* and disorder, on the other. Its anodyne and antispasmodic influence is shown in mild attacks of *neuralgia*, of nervous *headache*, of *colic*, of *dysmenorrhœa* depending upon an irritable state of the uterus; in *after-pains*, in *hiccup*, and in nervous *palpitation of the heart.* The average dose is about a tablespoonful, which may be repeated at intervals of an hour or two.

AQUA CARUI, *Br.*—CARAWAY WATER.

Aqua carvi.—Eau distillée de carvi, Fr.; *Kümmelwasser*, G.

Preparation.—Take of Caraway Fruit bruised one pound (avoirdupois); Water twenty pounds. Distil ten pounds (avoirdupois) (one gallon imperial). *Br.*

This water has the flavor of the fruit in a marked degree.

Medical Uses.—The properties of caraway water are almost identical with those of anise water; it may be given in the dose of a fluidrachm or more.

AQUA CHLORINII, *U. S.*—CHLORINE WATER.

Liquor chlori, Br.; *Aqua chlorata*, P. G.; *Aqua chlori*, *Chlorum solutum*, *Aqua oxymuriatica.—Solution of chlorine*, E.; *Eau chlorée*, *Chlore liquide*, Fr.; *Chlorwasser*, G.

Symbol of chlorine Cl. Atomicity univalent. Atomic weight 35.5.

Preparation.—Take of Black Oxide of Manganese in powder No. 60 half a troyounce; Muriatic Acid three troyounces; Water four fluidounces; Distilled

Water twenty fluidounces. Introduce the oxide into a flask; add the acid previously diluted with two fluidounces of the water, and apply a gentle heat. Conduct the generated chlorine, by suitable tubes, through the remainder of the water, contained in a small intermediate vessel, to the bottom of a four-pint bottle containing the distilled water, and loosely stopped with cotton. When the air has been entirely displaced by the gas, disconnect the bottle from the apparatus, and, having inserted the stopper, agitate the contents, loosening the stopper from time to time, until the gas ceases to be absorbed. Lastly, pour the chlorine water into a bottle, of just sufficient capacity to hold it, stop it securely, and keep it in a cool place, protected from the light. *U. S.*

This process is identical with that of the British Pharmacopœia, except as to weights and measures, but both aim at a saturated solution of chlorine in water, with the simplest manipulation. In following the Pharmacopœia the best corks should be used for the generating flask and wash-bottle, since porous corks are readily penetrated and destroyed by chlorine gas. This gas is generated by the action of muriatic acid upon binoxide of manganese, chloride of manganium, chlorine and water being produced. MnO_2+4HCl yields $MnCl_2+Cl_2+2H_2O$. If the undiluted acid of the Pharmacopœia is employed, the evolution of chlorine gas will commence without heat being applied, until it has continued for some time. Diluted as directed, the application of heat is necessary from the beginning. A strong heat should not be used in the beginning, since muriatic acid gas would be carried over into the wash-bottle. The loss of acid may be entirely avoided if the oxide of manganese is used in small lumps instead of in powder, and in sufficient quantity, so as not to be covered by the acid. Although chlorine is soluble in water to a considerable extent, it does not dissolve very readily, hence gas bubbles will soon pass through the water, without being much diminished in size. The Pharmacopœias direct the use of receiving bottles which are but partially filled with water. The atmosphere in the upper part of the bottle will gradually be displaced by the heavier chlorine, and when the latter begins to escape from the mouth of the bottle, this is disconnected from the apparatus, loosely corked, and agitated, when the gas will be absorbed. The bottle, which should be protected from the light, is then replaced and the operation repeated until no further diminution of the pressure is observed in the bottle on being gently agitated when filled with chlorine. The British Pharmacopœia directs the agitation of the bottle only after the evolution of chlorine gas has ceased; much of the gas may be lost by not repeating the agitation several times.

The temperature best suited for dissolving the chlorine in water is 10° C. (50° F.). Near the freezing point of water a solid chlorine hydrate, $Cl.5H_2O$, is formed, which is less soluble in water than the gas. At the temperature indicated, water dissolves, according to Schönfeld, 2.585 times its volume of gas, the solubility being gradually lessened as the temperature rises. When the operation is finished, it is well to pour the chlorine water at once into small glass-stoppered vials, which should be completely filled and kept in a cool and dark place. The stoppers should be secured by twine, or, as suggested by Hager, by bladder which has been previously coated with a mixture of collodion and paraffin.

During the preparation and handling of chlorine water, the operator should be careful not to inhale the gas on account of its irritating and poisonous properties. Should its effects be perceived, it is advisable to carefully inhale a little sulphydrate of ammonium, which is decomposed by the chlorine into chloride chloride of ammonium and sulphur. It should, however, be cautiously used, since an excess of this gas is likewise poisonous. A little ammonia, sufficiently diluted, may also be taken with advantage.

Properties.—Chlorine water is a clear greenish-yellow liquid possessing the suffocating odor of chlorine, and separating crystals of chlorine hydrate when cooled to the freezing point of water. It instantly discharges the color of a diluted solution of indigo, and bleaches vegetable coloring matters generally. Exposed to light it is decomposed into hydrochloric acid and oxygen. It is a powerful oxidizing agent, and this property serves to readily ascertain its strength. A fluidounce of it, mixed with a solution of 10 grains of pure ferrous sulphate, does not produce a blue precipitate with ferridcyanide of potassium, indicating that the salt has been completely oxidized to ferric sulphate, and proving that the water contains 0.3 per cent. chlorine. The German Pharmacopœia requires 100 parts of chlorine water to oxidize 3 parts of the iron salt, indicating nearly 0.4 per cent. chlorine. The test of the British Pharmacopœia indicates a strength of 0.6 per cent. It is applied as follows: A solution of 20 grains of iodide of potassium in an ounce of water yields, with 439 grains (1 fluidounce) of chlorine water, a deep red-colored liquid, which requires for the discharge of its color 750 grain measures of the volumetric solution of hyposulphite of sodium, corresponding to 2.66 grains of chlorine.

Tests of Purity.—Chlorine water should evaporate without leaving any residue. Agitated with an excess of mercury until the odor of chlorine has disappeared, the remaining liquid reddens litmus paper but slightly, if at all (hydrochloric acid).

Physiological Action and Medical Uses.—The action of chlorine water in large doses and internally is that of an irritant poison. In a diluted state it acts locally as a stimulant and disinfectant, and its absorption is supposed to quicken all the functions and purify the blood in typhoid forms of disease depending upon an animal poison generated within the system or absorbed from without. It is highly probable that this view of its operation is derived chiefly from its power of neutralizing the foul odors of decomposition. Clinical reports of its effects in zymotic diseases demonstrate the incapacity of the reporters to observe and judge, rather than the virtues possessed by the medicine. When the existing types of the several diseases are considered, their inherent tendency to recovery or to death, the share in the results to which other medicines were equally with this one entitled, and the partial exclusion by its use of more active and therefore hazardous remedies, it is difficult to accept the positive and laudatory accounts of its virtues as representing even an approach to truth. We believe, therefore, that the efficacy of chlorine in *typhus fever*, in *scarlet fever*, in *diphtheria*, in *smallpox*, etc., is wholly undemonstrated, except as to its being a palliative of certain local and subordinate symptoms, such as *putrid angina* and a burning heat of the skin. In all forms of *sore throat* attended with fetid discharges, and an ulcerated or torpid condition of the mucous membrane, washes and gargles of chlorine water may be used with the same advantage as other stimulant disinfectants. A like statement may be made regarding other forms of disease in which the intestinal discharges are peculiarly fetid, as in certain cases of *typhoid fever* and typhoid types of *dysentery*, *smallpox*, etc. Chlorine water is to be commended as a wash or dressing for all forms of *sores* which have a fetid discharge, even for *cancerous* ulcers, and as a lotion for the skin when the crusts formed by *smallpox* pustules become offensive. Chlorinated water has been reputed to have the power of preventing the infection of *syphilis* and of *puerperal fever*, in the one case by its use in washing the genitals after impure coition, and in the other by washing the hands of accoucheurs after attendance upon cases of the disease. Supposing the alleged effect to be real, which is by no means proven, it is not quite clear that an equally diligent use of soap would not have been followed by an equal degree of immunity.

The *dose* of chlorine water is from one to four fluidrachms largely diluted. For inhalation, when atomized, a solution of from five to ten drops in water may be used. *Andidotes:* after emesis with warm water, albumen in the form of milk, white of egg, veal-broth, etc., flour and water, or lime-water.

AQUA CHLOROFORMI, *Br. Add.*—CHLOROFORM WATER.

Eau de chloroforme, Fr.; *Chloroformwasser*, G.

Preparation.—Take of Chloroform one fluidrachm; Distilled Water twenty-five fluidounces. Put them into a two pint stoppered bottle and shake them together until the chloroform is entirely dissolved in the water. *Br. Add.*

A fluidounce represents about 2 minims of chloroform.

Medical Uses.—The dose prescribed by the British Pharmacopœia is from half a fluidounce to two fluidounces. The former contains about one minim of chloroform. The spirit of chloroform (British Pharmacopœia) is recommended to be given in doses of which the least also contains one minim of chloroform. It is difficult to conceive a case in which the latter preparation duly diluted would not be preferable to the former. Either preparation may, however, be used to relieve slight *colic* and other minor pains in the abdomen.

AQUA CINNAMOMI, *U. S.*, *Br.*—CINNAMON WATER.

Eau de cannelle, Fr.; *Einfaches Zimmtwasser*, G.

Preparation.—Take of Oil of Cinnamon half a fluidrachm; Carbonate of Magnesium sixty grains; Distilled Water two pints. Rub the oil first with the carbonate of magnesium and then with the water, gradually added, and filter through paper.

Cinnamon water may also be prepared by mixing eighteen troyounces of cinnamon, in powder No. 20, with sixteen pints of water, and distilling eight pints. *U. S.*

The British Pharmacopœia directs the distillation of one imperial gallon (10 pounds) of cinnamon water from 20 ounces of bruised Ceylon cinnamon; or in the proportion of eight parts of water from one part of bark. The German Pharmacopœia orders ten parts, but directs the use of Chinese cinnamon. A stronger cinnamon water is ordered by the same authority under the name of *Aqua cinnamomi spirituosa* (*s. vinosa*), which is made by distilling five parts from a mixture of ten parts of water, one part of alcohol, specific gravity 0.892, and one part of Chinese cinnamon.

Properties.—Cinnamon water made with magnesia has a yellowish color, unless carbonic acid gas is passed through it, or a small quantity of some other acid is added. Made from the oil, it has the odor and a somewhat harsh taste of cinnamon; but, if distilled from the bark, its odor is more fragrant and its taste decidedly sweet. In contact with the air, the volatile oil is oxidized, and crystals of cinnamic acid and small particles of a brownish resin are frequently separated.

Off. Prep.—Mistura cretæ, *U. S.*, *Br.*; Mist. guaiaci, Mist. spiritus vini gallici, *Br.*

Medical Action and Uses.—Cinnamon water possesses the stimulant and carminative properties of the bark from which it is derived, but is seldom used except as a vehicle for other medicines with which it can co-operate. It is most commonly employed in mixtures for flatulent *colic* and *diarrhœa;* for the latter affection as a vehicle for chalk, astringents, and opiates.

AQUA CREASOTI, *U. S.*—CREASOTE WATER.

Eau creosotée, Fr.; *Kreosotwasser*, G.

Preparation.—Take of Creasote a fluidrachm; Distilled Water a pint. Mix them, and agitate the mixture until the creasote is dissolved; then filter through paper. *U. S.*

Medical Uses.—This preparation contains in every two fluidrachms nearly one minim of creasote, and is a convenient form of that medicine for all the cases in which it should be given diluted, and also as a topical application in *leucorrhœa*, *gleet*, *burns*, *chilblains*, *ulcers* (especially such as are attended with a too abundant, thin, or fetid discharge), *gangrene*, and various cutaneous eruptions, particularly *prurigo*, *eczema*, *sycosis*, etc. *Dose*, from one to four fluidrachms.

AQUA FŒNICULI, *U. S.*, *Br.*—FENNEL WATER.

Eau de fenouil, Fr.; *Fenchelwasser*, G.

Preparation.—Take of Oil of Fennel half a fluidrachm; Carbonate of Magnesium sixty grains; Distilled Water two pints. Rub the oil first with the carbonate of magnesium, and then with the water gradually added, and filter through paper.

Fennel water may also be prepared by mixing eighteen troyounces of fennel in coarse powder with sixteen pints of water, and distilling eight pints. *U. S.*

According to the British Pharmacopœia we are directed to distil from one pound of fennel ten pounds; according to the U. S. Pharmacopœia nearly seven pounds; and according to the German Pharmacopœia thirty pounds of fennel water. If a good fennel is employed, the last-mentioned separates a portion of oil on standing, and is therefore a saturated solution.

Medical Action and Uses.—Fennel water is stimulant and carminative, and, like its associates, is used as a vehicle for medicines intended to correct acidity and relieve flatulence and colic. *Dose*, one drachm or more according to the age of the patient and the degree of the derangement.

AQUA LAUROCERASI, *Br.*—CHERRY LAUREL WATER.

Eau distillée de laurier-cerise, Fr.; *Kirschlorbeerwasser*, G.

Preparation.—Take of Fresh Leaves of Cherry Laurel one pound; Water two and a half pints (fifty ounces). Chop the leaves, crush them in a mortar, and macerate them in the water for twenty-four hours; then distil one pint (twenty ounces) of liquid. Shake the product, filter through paper, and preserve it in a stoppered bottle. *Br.*

The distillate contains oil of bitter almonds and hydrocyanic acid, and is similar to bitter-almond water; but the Pharmacopœia does not indicate its strength in hydrocyanic acid. The German Pharmacopœia requires it to be of the same strength as bitter-almond water.

Medical Action and Uses.—This preparation has no virtues which it does not owe exclusively to the hydrocyanic acid it contains. Like all distilled waters its strength is very uncertain, and it is altogether less eligible than a definite solution of hydrocyanic acid, or of oil of bitter almonds in water, not only because its strength is variable, but because the inequality of its effects may lead to disastrous results. The dose is stated to be from five to thirty minims, very cautiously administered.

AQUA MENTHÆ PIPERITÆ, *U. S.*, *Br.*—PEPPERMINT WATER.

Eau de menthe poivrée, Fr.; *Pfeffermünzwasser*, G.

Preparation.—Take of Oil of Peppermint half a fluidrachm; Carbonate of Magnesium sixty grains; Distilled Water two pints. Rub the oil, first with the carbonate of magnesium, and then with the water, gradually added, and filter through paper.

Peppermint water may also be prepared by mixing eighteen troyounces of peppermint with sixteen pints of water, and distilling eight pints. *U. S.*

Take of Oil of Peppermint one and a half fluidrachms; Water one and a half gallons; distil one gallon (ten pounds). *Br.*

P. G. distils ten parts of water from one part of the herb; *Fr. Cod.* one part from one part of the fresh herb.

Off. Prep.—Mistura ferri aromatica. *Br.*

Medical Action and Uses.—Peppermint water is used as a vehicle for many medicines which are unpleasant to the taste, or which occasion nausea or griping. It is the most common domestic remedy for flatulent *colic*, and in hot water is frequently resorted to for relief from the pains of *dysmenorrhœa.* Like other diffusible and aromatic stimulants, it palliates *headache*, *palpitation*, *hiccup*, etc., produced by laborious digestion. *Dose*, half a fluidounce or more.

AQUA MENTHÆ VIRIDIS, *U. S.*, *Br.*—SPEARMINT WATER.

Eau de menthe verte, Fr.

Preparation.—Take of Oil of Spearmint half a fluidrachm; Carbonate of Magnesium sixty grains; Distilled Water two pints. Rub the oil, first with the carbonate of magnesium, and then with the water, gradually added, and filter through paper.

Spearmint water may also be prepared by mixing eighteen troyounces of spearmint with sixteen pints of water, and distilling eight pints. *U. S.*

Take of Oil of Spearmint one and a half fluidrachms; Water one and a half gallon. Distil one gallon (ten pounds). *Br.*

On the continent of Europe curled-mint water is used instead.

Medical Action and Uses.—Spearmint water has the same virtues as peppermint water, but is much milder in its action. It is particularly appropriate in cases of infantile *colic*, when it may be prescribed with a little bicarbonate of sodium or with magnesia in doses of a teaspoonful. The average *dose* for an adult is a tablespoonful.

AQUA PIMENTÆ, *Br.*—PIMENTO WATER.

Eau de piment de la Jamaique, Fr.; *Nelkenpfeffer-Wasser*, G.

Preparation.—Take of Pimento, bruised, fourteen ounces; Water two gallons. Distil one gallon (ten pounds). *Br.*

On standing it separates a brownish resin.

Medical Action and Uses.—Pimento water is a stimulant carminative. Its effects are less transient than those of fennel and anise water, for example, and more like those produced by an infusion of cloves. *Dose*, half an ounce or more, for an adult.

AQUA ROSÆ, *U. S.*, *Br.*—ROSE WATER.

Eau distillée de rose, Fr.; *Rosenwasser*, G.

Preparation.—Take of recent Pale Rose forty-eight troyounces; Water sixteen pints. Mix them, and distil eight pints.

When it is desirable to keep the rose for some time before distilling, it may be preserved by being well mixed with half its weight of chloride of sodium. *U. S.*

This is in the proportion of two parts of fresh petals to five parts of distillate. *Br.* and *Fr. Cod.* direct the distillate to be equal in weight to the petals; *P. G.* obtains five parts of water from one part of fresh petals.

Off. Prep.—Rose water is an ingredient of Confectio rosæ, *U. S.*; Mistura ferri composita, *U. S. Br.*; Trochisci bismuthi, *Br.*; Unguentum aquæ rosæ, *U. S.*

Medical Uses.—Rose water has no strictly medicinal virtues. It is an agreeable excipient for collyria, urethral injections, and lotions.

AQUA SAMBUCI, *Br.*—ELDERFLOWER WATER.

Eau distillée de sureau, Fr.; *Fliederblumen-(Hollunderblüthen-) Wasser*, G.

Preparation.—Take of Fresh Elder Flowers, separated from the stalks, ten pounds (or an equivalent quantity of the flowers preserved while fresh with common salt); Water two gallons. Distil one gallon (ten pounds). *Br.*

On standing, it is inclined to separate a mucilaginous sediment, which must be removed by filtration.

Medical Uses.—Elderflower water is used in England as an agreeable excipient for medicines. It possesses no definite virtues. *Dose*, an ounce or more.

AQUÆ MINERALES.—MINERAL WATERS.

Eaux minérales, *Eaux médicinales naturelles*, Fr.; *Mineralwässer*, G.

These are spring waters which are charged with certain gases or salts to such a degree that they are unfit for ordinary use, and exert a peculiar operation on the economy.

The following summary gives the composition of a few of the most important mineral waters, which may be divided into the following classes:—

1. SULPHURETTED WATERS contain sulphides and sulphuretted hydrogen, in consequence of which they possess a more or less fetid odor.

Baréges.—The *Source de l'entrée* contains in 10,000 parts: 0.360 sodium sulphide, 0.219 sodium chloride, 0.240 alkaline carbonates, 0.300 sodium sulphate, and traces of iodine and organic matter. (*Henry.*)

Baden (Austria), *Leopoldsquelle.*—10,000 parts contain 0.065 sodium carbonate, 0.800 calcium carbonate, 1.780 sodium sulphate, 3.467 calcium sulphate, 0.610 potassium sulphate, 0.700 magnesium chloride, 0.030 silica, 0.013 magnesium sulphate, 1.705 sodium chloride, 1340.19 c. c. carbonic acid, 2836.09 nitrogen, 335.19 oxygen, and 232.73 sulphuretted hydrogen. (*Keller.*)

Harrowgate, Old Sulphur Well.—10,000 parts contain 0.26 calcium sulphate, 1.75 calcium carbonate, 11.55 calcium chloride, 7.86 magnesium chloride, 9.14 potassium chloride, 122.38 sodium chloride, 2.19 sodium sulphide, 0.03 silica, and traces of fluoride, bromide, iodide, and carbonate of sodium, calcium, ammonium, iron, and manganese, and organic matter. Also the following gases in one imper. gallon: 22 cubic inches carbonic acid, 5.3 sulphuretted hydrogen, 5.8 carburetted hydrogen, and 2.9 nitrogen. (*A. W. Hofmann.*)

Massena, St. Regis.—One U. S. gallon contains 79.692 grains sodium chloride, 0.508 potassium chloride, 29.927 magnesium chloride, 0.673 magnesium bromide, 4.852 calcium bicarbonate, 0.488 ferrous bicarbonate, 60.931 calcium sulphate, 3.501 sodium sulphate, 1.320 sodium phosphate, 4.205 sodium hyposulphite, 1.405 sodium sulphide, 11.176 sodium silicate, and organic matter; total 198.678 grains and 5.307 cubic inches of sulphuretted hydrogen. (*F. F. Mayer.*)

2. ALKALINE WATERS.—Carbonate of sodium predominates, and free carbonic acid is often present in considerable quantity.

Ems, Kränchen.—10,000 parts contain the following carbonates: 13.651 of sodium, 1.559 of calcium, 1.292 of magnesium, 0.016 of iron, 0.007 of manganese, 0.001 of barium, 9.224 sodium chloride, 0.004 phosphate of aluminium, 0.494 silica, traces of iodide of sodium and carbonate of lithium, and 9991 c. c. carbonic acid. (*Fresenius.*)

Vichy, Source Lucas.—10,000 parts contain the following bicarbonates: 50.04 of sodium, 2.82 of potassium, 2.75 of magnesium, 0.05 of strontium, 5.45 of calcium, and 0.04 of iron, 2.91 sodium sulphate, 0.70 sodium phosphate, 0.02 sodium arseniate, 5.18 sodium chloride, 0.50 silica, and 17.51 carbonic acid. (*Bouquet.*)

The water of the Grande Grille spring has nearly the same composition, but contains only 9.08 parts of carbonic acid.

Gettysburg.—One imperial gallon contains 46.05 grains bicarbonate of sodium with lithium, 76.05 magnesium bicarbonate, 81.00 calcium bicarbonate, 53.20 calcium sulphate, 10.00 silica, with traces of potassium and iron chlorides and phosphate; total, 266.30 grains. (*Mayer.*)

3. SALINE WATERS contain various salts of alkalies and alkaline earths, occasionally bromides and iodides.

Bath, King's Spring.—10,000 parts contain 11.425 calcium sulphate, 0.662 potassium sulphate, 2.744 sodium sulphate, 1.259 calcium carbonate, 0.047 magnesium carbonate, 0.152 ferrous carbonate, 1.802 sodium chloride, 2.081 magnesium chloride, 0.425 silica, with traces of lithia, manganese, and iodine; carbonic acid not determined. (*Merck and Galloway.*)

Cheltenham, Royal Old Wells.—10,000 parts contain 34.202 sodium chloride, 1.141 magnesium chloride, 13.541 sodium sulphate, 0.970 magnesium carbonate, 2.433 calcium carbonate, 0.436 magnesium bromide, 0.069 magnesium iodide, 0.381 silica, 1.473 crenic acid, 2.574 organic matter, and 92 c. c. carbonic acid. (*Abel and Rowney.*)

Seidlitz.—16 ounces contain 104 grains sulphate, 3 grains carbonate, and 3 grains chloride of magnesium, 8 grains carbonate and 8 grains sulphate of calcium; total, 126 grains. (*Naumann.*)

4. ACIDULOUS SALINE WATERS contain various salts and are sparkling from the large amount of carbonic acid contained in them.

Selters.—Sixteen ounces contain 0.248 grain sodium sulphate, 16.285 sodium chloride, 5.855 sodium carbonate, 1.595 magnesium carbonate, 1.867 calcium carbonate, 0.154 ferrous carbonate, 0.281 sodium phosphate, 0.289 silica, 31 cubic inches carbonic acid. (*Bischof.*)

Pyrmont, Hauptquelle.—160 ounces contain the following sulphates: 0.023 grain of barium, 0.280 of strontium, 60.897 of calcium, 1.266 of potassium, 3.220 of sodium, and 34.813 of magnesium; the following chlorides: 12.202 of sodium, 0.161 of ammonium, and 0.076 of lithium; the following bicarbonates: 86.832 of calcium, 6.160 of magnesium, 5.919 of iron, and 0.344 of manganium; 0.001 sodium iodide, 0.007 sodium bromide, 0.012 sodium nitrate, 0.006 aluminium phosphate, 0.004 calcium phosphate, 2.441 silica, 183.956 grains carbonic acid, and a trace of sulphuretted hydrogen. (*Fresenius.*)

Saratoga, Empire Spring.—One U. S. gallon contains 506.63 grains sodium chloride, 4.292 potassium chloride, 0.266 sodium bromide, 0.006 sodium iodide, 2.769 potassium sulphate, 0.023 sodium phosphate, 1.458 silica, 0.418 alumina, with the following bicarbonates: 42.953 of magnesium, 109.656 of calcium, 2.080 of lithium, 9.022 of sodium, 0.070 of barium, 0.793 of iron and trace of strontium; also traces of calcium fluoride, borax and organic matters; total 680.436 grains, and 344.67 cubic inches carbonic acid. (*Chandler and Cairns.*)

Kissingen, Rakoczy.—16 ounces contain 0.242 grains ferrous carbonate, 0.131 magnesium carbonate, 8.148 calcium carbonate, 0.043 calcium phosphate, 0.099 silica, 2.990 calcium sulphate, 44.713 sodium chloride, 4.509 magnesium sulphate, 2.203 potassium chloride, 2.333 magnesium chloride, 0.064 sodium bromide, 0.071 sodium nitrate, 0.153 lithium chloride, 0.007 ammonium carbonate, total 65.706 grains, and 41.77 cubic inches of carbonic acid. (*Liebig.*)

5. Chalybeate Waters.—This name is applied to those mineral waters which contain iron in sufficient quantity to impart to them a ferruginous taste. The iron is present either as sulphate or frequently as ferrous carbonate, held in solution by excess of carbonic acid, sulphuretted hydrogen being also occasionally present. Iron being found in several of the waters named before, in larger quantities than mere traces, it is evident that the classification must be somewhat arbitrary.

Homburg, Stahlbrunnen.—16 ounces contain 0.937 ferrous carbonate, 7.534 calcium carbonate, 10.667 calcium chloride, 5.330 magnesium chloride, 79.864 sodium chloride, 0.176 potassium sulphate, 0.146 calcium sulphate, 0.315 silica, total 104.969 grains and 46.90 cubic inches carbonic acid. (*Liebig.*)

Spa, Source du Pouhon.—10,000 parts contain the following bicarbonates: 1.266 of sodium, 0.105 of potassium, 1.730 of calcium, 1.674 of magnesium, and 0.714 of iron; 0.203 sodium sulphate, 0.256 sodium chloride, 0.629 silica, 21.409 carbonic acid. (*Plateau.*)

Pyrmont, Trinkquelle.—16 ounces contain 0.490 ferrous carbonate, 1.126 magnesium chloride, 0.323 magnesium carbonate, 0.048 manganium carbonate, 5.988 calcium carbonate, 0.014 aluminium phosphate, 0.496 silica, and the following sulphates: 2.697 of magnesium, 7.221 of calcium, 0.020 of strontium, 0.009 of lithium, 0.042 of potassium, and 2.145 of sodium; total, 20.619 grains and 1.68 volumes of carbonic acid. (*Struve.*)

Cheltenham (chalybeate).—1000 parts contain 0.066 ferrous carbonate, 0.159 calcium carbonate, 0.735 calcium chloride, 0.484 magnesium chloride, 0.390 potassium chloride, 2.262 sodium chloride, 0.020 silica, 0.040 organic matter; total, 4.156. One gallon contains also 19.5 cubic inches carbonic acid and 5 cubic inches carburetted hydrogen. (*A. W. Hofmann.*)

Church Hill Alum Water.—One U. S. gallon contains 24.991 grains ferrous sulphate, 51.270 ferric sulphate (neutral), 83.355 ferric sulphate (one-third basic), 72.928 aluminium sulphate, 86.064 magnesium sulphate, 88.836 calcium sulphate, 0.643 ammonium sulphate, 2.444 potassium sulphate, 1.943 sodium sulphate, 4.627 sodium chloride, 10.429 silica, and a trace of phosphoric acid; total, 427.530 grains. (*J. C. Booth.*)

Artificial mineral waters have been used in Europe for many years, and have more recently been introduced into the United States. It is not known how nearly they represent the natural waters. We append here a few formulas which have been recommended as yielding tolerably good substitutes for the springs named.

Baden (chalybeate).—Chloride of sodium 28 grains, chloride of magnesium two grains, chloride of calcium 13 grains, sulphate of sodium 11.5 grains, tartrate of iron and potassium $\frac{1}{3}$ grain, water 21 fluidounces, dissolve and impregnate with carbonic acid gas. (*Soubeiran.*)

Carlsbad.—Sulphate of sodium 54 grains, sulphate of magnesium $5\frac{1}{4}$ grains, carbonate of sodium $36\frac{3}{4}$ grains, chloride of sodium 7 grains, chloride of calcium 7 grains, tartrate of potassium and iron $\frac{1}{8}$ grain, water 21 fluidounces; proceed as before. (*Soubeiran.*)

Seidlitz.—Sulphate of magnesium 7½ drachms, water 22 fluidounces; proceed as before, or

Dissolve 7½ drachms sulphate of magnesium and 1 drachm of bicarbonate of sodium in 22 fluidounces of water, add 1 drachm of crystallized tartaric acid, and cork the bottle well. (*Fr. Cod.*)

Sulphur Water (to imitate *Baréges*, *St. Sauveur*, etc.).—Crystallized sulphide of sodium and chloride of sodium 2 grains, water previously boiled to deprive it of air 22 fluidounces; dissolve. (*Fr. Cod.*)

Vichy.—Carbonate of sodium 112 grains, carbonate of potassium 2½ grains, sulphate of magnesium 5 grains, fused chloride of calcium 4½ grains, chloride of sodium 1¼ grains, arseniate of sodium $\frac{1}{22}$ grain, powdered iron $\frac{1}{65}$ grain, water 21 fluidounces; dissolve and impregnate with carbonic acid gas. (*Lefort.*)

Physiological Action.—The use of spring waters more or less impregnated with substances imbibed by them in the bowels of the earth has existed in all ages. Like very many other useful medicines, a knowledge of their virtues was very probably learned from an observation of the instinctive use of them by the lower animals. Tradition runs that some of the most famous of German springs owed their reputation originally to their use by sick animals, and that others were eagerly visited by the kine at certain seasons of the year. It is certain that our own Saratoga, which is now annually crowded by gay votaries of fashion as well as by the dejected victims of a morbid civilization, was for centuries resorted to by the aboriginal savages for the cure of their infirmities. In ancient Greece temples were in many places erected near mineral springs whose waters were used under the direction of the priests, who were thus among the earliest physicians, and who taught that hygiene and medicine must go hand in hand, and that faith has no small share in the cure of disease. But the "scientific medicine" of the present day treats the human body as if it were so much brute matter to be subjected to analytical and synthetical reagents for the purpose of evolving definite results; the true physician, on the other hand, never neglects the vital and psychical elements of man, and sagaciously enlists in behalf of his patients all the powers of external nature as well as the quickening influences of faith and hope. Formerly, mineral waters could be made use of by those persons only who were able to visit the springs; but now they are carried in bottles to great distances, and even across the ocean, for those who require them; their saline residue, after evaporation of the water, has equally become an article of commerce; and chemical ingenuity has imitated the solid constituents of the most important springs, without, however, securing the effects produced by the natural combinations.

Attempts to explain the action of medicines exclusively by scientific methods have not resulted satisfactorily. Upon this subject we are entirely in accord with Trousseau, who addressed his clinical class in these words: "Distrust medical theories that originate in the laboratory. Although chemistry may be the handmaid of medicine, she goes beyond her sphere when she applies the conclusions of the laboratory to the treatment of the sick. Chemistry stands no nearer to medicine because she teaches us how to prepare or to analyze medicines, than she does to the art of painting because she prepares the painter's colors. . . . Say what the chemists may, mineral waters do not operate alone by means of their predominant mineral constituent. It is associated with many others which they have demonstrated, and probably with others still that have escaped their research; and nature has done for this element what we attempt every day to do in pharmacy when we seek to enhance or to mitigate the power of a medicine by associating it with others." Then, referring to the well-known fact that the therapeutical reputation and efficacy of mineral waters do not depend upon the amount of their mineral constituents, this sagacious teacher in substance observed: "The malarial cachexia, for instance, is wonderfully modified by springs whose mineral elements really elude discovery, and are far less than those which impregnate the drinking water of Paris; and certain intractable dyspeptic disorders are cured by them in a manner which I neither can nor seek to explain. Under their salutary influence the appetite revives, the constitution becomes reorganized; patients affected with dropsy or visceral engorgements arrive at Plombières or Bigorre in a deplorable condition, and after a single season have been greatly improved and often most unexpectedly cured." Even anciently it was understood that the medicinal virtues of a spring do not depend altogether upon the degree of its mineralization, for Pliny refers to the Paduan waters as having neither taste nor smell. It would, however, be unjust to these natural medicines to suppose that they are not, on the whole, valuable in proportion to their mineralization; indeed, we may go further, and measure and define their value by the proportion of their predominant ingredient, be it saline, alkaline, sulphurous, or chalybeate; for if we subtract this one element, the special virtues of the water vanish. On the other hand, it is notorious that the medicinal use of such elements isolated from their natural associations no longer produce the effects of the original mineral waters. In these facts again we perceive the excellency of nature and the insufficiency of self-sufficient art.

There are, indeed, two classes of patients who require the use of very different mineral waters. The first is composed of that large body of invalids in whom there exists no organic change of structure, but whose functions are merely weakened or clogged by the strain of business, the exhaustion of pleasure, sensual excesses in eating or drinking, or, in this country especially, the manifold errors committed in the preparation and consumption of food and the disregard of hygienic rules in the habits of living. The second consists of that smaller but still numerous class of persons who, besides being more or less injured by the causes of ill health just enumerated, have been affected with definite diseases, and especially rheumatism, gout, calculous disorders, cutaneous eruptions, scrofula, syphilis, diabetes, paralysis, uterine disorders, etc. Of these two classes the former are benefited most by a visit to the less mineralized springs, while the latter require a course of active medicinal treatment such as the stronger mineral waters afford. In both classes of patients, but particularly in the first, the action of the waters is only one out of many influences that combine to restore their health. Towards that end a total change of habits is one of the most influential agencies in very many cases. Escape from the anxieties and fatigue of business, the excitement of fashionable life, the mental tension of political and professional pursuits, the worrying annoyances of domestic affairs, endured, perhaps in a large city with all its enervating social duties, its Babel-like sounds, and its polluted atmosphere,—escape from these merely ought to suffice to restore the disturbed balance of health. When we consider how much more probable must this result become when fatigue, anxiety, contention, wearisome routine, and foul air are exchanged for repose and peace in the midst of novel scenes and new associates, and freedom from the onerous conventionalities of fashionable life, different apartments, food, and occupation, it may even seem doubtful whether, after all, some other new residence would not profit the invalid as much as the frequented springs. But there are two reasons against this conclusion: the one is that with many persons relief would be impossible without an exercise of the faith which gives a potency to waters as well as to other remedial agents; and the other is that even the purest of these waters systematically used, especially in conjunction with bathing and regular exercise, do in a greater or less degree depurate the system through the kidneys, bowels, and skin, and by a gentle but sustained action gradually remove the effete products of tissue change from the system, and free the organs from the burdens that oppressed and the poisons that tainted them. Judiciously used under the advice of a competent physician, these almost neutral waters and the milder saline springs are capable in a few weeks of changing the languid, indifferent, pale, and feeble invalid into the lively and energetic leader of the gay crowd. Such rapid transformations are frequently witnessed, especially at the hot springs of Virginia and certain European springs, such as Willbad, Gastein, and Pfeffers, none of which contains any considerable proportion of mineral ingredients. But these waters, whether drunk warm or cold, if they are largely used, act as organic purgatives, and increase materially the total amount of solids, and especially of urea, excreted with the urine, without causing the debility which an equal discharge from the bowels would occasion.

The other class of waters, rich in mineral ingredients, have a more direct relation to certain special forms of disease. Alkaline waters, for example, are particularly adapted to the treatment of gout and rheumatism; sulphurous waters to that of the same diseases and of scaly eruptions of the skin; ferruginous waters to the cure of anæmic disorders; salines to the cure of chronic dyspepsia, constipation, and hemorrhoids, etc. But, as these several waters are classed only according to their predominant ingredient, and each contains several others of real, even if of secondary importance, it is evident, as before intimated, that neither their physiological nor their curative operations can be regarded as the effect of only one of their constituents, although it may happen to be the principal one. Morever, it cannot be assumed that the same water or class of waters has but a single mode of action; for, although it is probably true that alkaline waters cure both gout and rheumatism in virtue of their alkalinity, yet sulphurous waters which cure rheumatism, but do not cure gout, must evidently produce their effect in a different manner. It is evident, therefore, that while it may be possible to determine a certain scientific relation between particular mineral waters and the diseases they generally relieve, we are as far from comprehending their *modus operandi* as we are from understanding the actions of opium, quinia, or colchicum in the several conditions they palliate or cure.

The temperature at which mineral waters are used materially influences their effects, whether they are taken internally or used as baths. Indeed, as above stated, some hot springs, which have for ages maintained their fame, are but faintly, or not at all, mineralized; but there is hardly an instance of a cold spring without active medicinal properties enjoying much credit as a medicine. The operation of warm and hot water is described elsewhere. The highest reputation belongs, perhaps, to those mineral waters which are both hot and strong, and which modify nutrition in every part, and quicken depuration through the bowels, the kidneys, and the skin. The energy with which they act is shown by the occurrence of phenomena which are known as "crises," when they are caused by the internal use of thermal waters, and as the "bath fever," when due to their external application. Both have in common a feverish condition, attended with languor, debility, and lightness of the head, symptoms which appear to be due to a rapid and excessive loss of tissue, for they are identical with the effects of over-fatigue. When this state is induced by bathing, it is usually accompanied with papular, vesicular, or erythematous eruptions upon the skin, which may be ascribed in part to the copious sweating induced, but partly also to the irritating action of the caloric and of the mineral elements of the waters.

It may be proper to add that the use of mineral waters by persons suffering from organic heart disease, obstruction of the glandular portion of the kidneys (Bright's disease), a tendency to cerebral disease, the advanced stages of pulmonary consumption, etc., should be very cautiously advised, and very watchfully conducted.

Medical Uses.—To describe with any detail the application of mineral waters to the cure of diseases is here impossible; we shall only endeavor to sketch an outline of the subject which is deserving of far more attention than it generally receives.

1. *Sulphur Waters.*—Their virtues vary greatly according to the qualities of the waters themselves, and particularly according to their purgative action, and to their internal or external use. That they affect the whole system is proved by the elimination of sulphuretted hydrogen during their use, by which silver articles worn near the skin are blackened. They differ from other mineral waters in having a sedative operation when applied externally, and when their sulphurous element exceeds their saline or calcareous in energy. They are employed in a great variety of disorders, both internally and externally. The more purgative varieties have a great vogue in almost all forms of chronic *dyspepsia*, but especially in those which result from high living, and are attended with congestion of the liver, constipation, and jaundice. In such cases, the non-purgative sulphur waters are more injurious than useful, causing plethora and its consequences. Indeed, the dyspeptic cases held to be profited by these waters are much more so by the non-sulphurous salines. Sulphurous waters, on the other hand, are more useful in chronic *skin diseases*, including eczema, psoriasis, pityriasis, lichen, and acne, and they are most so when used in baths. Indeed, their internal use, apart from special indications, is superfluous. Such an indication may be presented by *scrofula*, especially of the glandular sort, in which a long continued but moderate use of the waters is most profitable. In these affections the baths should be prolonged as much as possible. When *gout* is connected with the above affections, these waters are less serviceable than the saline and alkaline. Probably, in the cure of chronic *rheumatism* more than that of any other disease, sulphur-waters stand pre-eminent; in the muscular forms first, and in the articular less conspicuously. They probably act as diaphoretics and diuretics, and hence as eliminants, when taken internally; while in warm baths, which is the best mode of using them, they both promote elimination, and by their local action remove the pain, swelling, and stiffness of the joints. The hotels at sulphur springs often contain museums of crutches, wheel-chairs, etc., left behind by patients who arrived as cripples and departed with supple limbs. In ancient times, such articles would have formed *en voto* offerings in the temples. As *syphilis* is a specific poison in the system, it might be supposed that the searching operation of sulphur waters, in their several modes of application, would tend to remove it; but such is seldom the result; and, indeed, very often the use of the waters revives the signs of the disease in persons who had been regarded as entirely cured. On the other hand, when there is a cachectic condition present, induced by an excessive mercurial treatment, these waters may greatly contribute to improve the health. *Lead poisoning*, it is well known, in its chronic and constitutional forms, is more successfully treated by sulphur-baths than by any other agent except iodide of potassium. They form a most important adjuvant to the latter medicine. The utility of these waters in *paralysis* will depend upon its nature, as whether it be of central origin with substantial lesions, or due to imperfect nutrition, or else wholly peripheral. In the first they can only be adjuvants, in the other cases they may effect a cure. But it is probable that they act in no other way than by promoting the general health through their internal use, and stimulating the paralyzed muscles externally in the same way as friction, electricity, etc. In paralysis following cerebral or spinal apoplexy, there is great danger in using thermal sulphur waters to excess. Of local diseases for which the waters are useful may be mentioned, first, chronic *pharyngitis*, especially of that granular form which is so often associated with dyspepsia, and was formerly known as "clergyman's sore throat." Saline sulphur waters internally, and applied locally by atomization, are very successful in relieving it. The same may be said of chronic *bronchitis*, especially when it occurs in gouty or rheumatic persons, and with dilatation of the bronchia; and in a less degree of chronic *laryngitis* of the simple form. Yet the tubercular and the syphilitic forms may sometimes be improved by it. Sulphur waters have been much used in diseases of the uterine system, especially in *sterility*, *amenorrhœa*, and *leucor-*

rhœa; but little is to be expected from them in such affections, unless they are used as baths, warm or cold, according to the patient's condition. The feebler sulphur waters, if they contain iron, may be drunk with advantage. Finally, sulphur waters are useful in various *surgical diseases*, but chiefly those of the thermal variety, which operate by their heat rather than by the sulphurous compounds they contain. It may be admitted, however, that the latter elements increase their stimulating power.

2. *Alkaline Waters.*—The dominant part which the chemical reaction of the animal humors plays in vital processes explains the extraordinary potency of alkaline, and in some degree of saline, mineral waters. For the functions of digestion, respiration, etc., depend in a great measure upon the relative amount of acidity or alkalinity of the animal fluids. Alkaline mineral waters, then, may be used so as to neutralize or diminish this acidity, and thereby produce a corresponding change in the physiological action. In point of fact these waters have long been known as the most efficient in chronic gout and rheumatism, and the numerous disorders which depend on them; and the form of *dyspepsia* most successfully treated by them is attended with excessive acidity of the gastro-intestinal secretions, with sour or rancid eructations and regurgitations, flatulent distension of the abdomen, tenderness of the epigastrium, etc., and all the more so if it is connected with a gouty diathesis. The waters are most efficient when they are highly charged with carbonic acid gas. If there is gastric irritability they must be taken in small doses. *Skin diseases* are not favorably influenced by alkaline waters internally or in baths, and the same is true of *scrofula.* Among all the known alkaline springs there is only one which can be regarded as pre-eminently curative in *gout*, and that is at Vichy, in France. The waters are most usefully, as well as conveniently, employed internally, but care must be taken not to drink of them too copiously, lest plethoric phenomena arise, nor to run the risk of impoverishing the blood by using them for too long at a time. In this country there is no alkaline spring, properly so called; the nearest approach to belonging to the category of such springs is made by the St. Louis Spring, Michigan; but its water contains only 7.684 gr. of carbonate of sodium to the pint, while the Grande Grille Spring at Vichy contains nearly three times as much. Moreover the former spring holds carbonate and sulphate of lime in large amount, while the latter contains a very small proportion of the former, and of the latter none at all. *Gastralgia*, occurring paroxysmally, is reputed to be frequently cured by these waters taken hot, and in the intervals between the paroxysms. It may be doubted whether the heat does not act curatively, as much, at least, as the mineral constituents of the water. Certainly solutions of bicarbonate of sodium will not relieve gastralgia, unless great acidity of the stomach is also present. In chronic *rheumatism* (which is the only form of rheumatism in which the medication by alkaline mineral waters can conveniently be tried), whether muscular or articular, alkaline waters are very highly esteemed, but they are chiefly used in warm baths. No doubt can exist in regard to the efficacy of alkaline waters in removing the symptoms of *gall-stones.* Some persons suppose that these concretions are dissolved by the waters; but of this there is no proof whatever. Others believe that the bile itself is rendered more watery by their use. It is certain that the salts of Vichy and of Carlsbad waters, even in this country relieve the symptoms of this affection, provided they are administered in hot water, and so as to represent nearly the strength of the natural springs. In the treatment of acid *urinary concretions* and their effects, alkaline waters are of great value. They operate as diuretics, and also by neutralizing the excessive acidity of the urine. In the former way they often cause a copious discharge of acid sand. By removing the chief cause of irritation in the urinary passages they tend to cure the catarrh which may affect their mucous membrane. The usefulness of alkaline waters in *diabetes* does not admit of any doubt, however difficult it may be to explain their

mode of action. It has been remarked that they are more efficacious when the patient is stout than when he is thin. In favorable examples the progress of the disease may be stayed by them for years.

3. *Alkaline-saline* mineral waters, which form some of the most famous European springs, including those of Carlsbad, are represented in this country chiefly by the Gettysburg Spring, Pa., the St. Louis Spring, Mich., Capon Springs, Va., Sheldon Springs, Vt., and several in California. They are more or less purgative and diuretic, and are used with great advantage in the same diseases for which alkaline waters proper are employed, but especially in chronic *dyspepsia*, disorder of the *liver*, *gout*, *rheumatism*, *gravel*, and morbid *mental* conditions associated with digestive derangements. They are very useful in *uterine* engorgements and *irritability*. They are palliatives of saccharine *diabetes* and of *Bright's disease*, especially those of them which contain a considerable proportion of iron; they have also some repute in the treatment of chronic inflammation of the *pharynx* and *larynx*. According to the purpose for which they are used, the dose should be large or small; the former when a purgative operation is desired, the latter when an alterative action is sought. In the laryngeal and pharyngeal affections named, these waters are very useful in the form of atomized spray.

4. *Acidulous saline* waters are employed in almost the same diseases as the last-mentioned class. Their usefulness is notably increased by the carbonic acid gas with which many of them are charged, and which serves to mask the taste of the sulphates of sodium and magnesium, or of the chloride of sodium, which they contain, and make them more acceptable to the stomach. Their mode of action is through a gradual elimination of the accumulated tissue-waste, and the increased activity which is thereby communicated to the whole glandular system. The most celebrated of American springs of this class are those of Saratoga.

5. *Chalybeate* mineral waters are the best representatives of ferruginous medicines, because they not only enter the system more readily, and therefore improve the blood more rapidly, than artificial preparations of iron, but because the hygienic conditions attending their use are of the most salutary effect. When they contain sulphate of iron (as in the Rockbridge Alum Springs and several others in Virginia), they are especially serviceable in profluvia, as chronic *diarrhœa*, *dysentery*, *bronchorrhœa*, *leucorrhœa*, etc.

ARALIA NUDICAULIS, *U. S.*—FALSE SARSAPARILLA.

Small spikenard, *Shotbush*, E.; *Racine d'aralia nude*, Fr.; *Nackte Aralien wurzel*, G.

The root (rhizome) of Aralia nudicaulis, *Lin.* *Nat. Ord.*—Araliaceæ.

Origin.—It is a perennial plant indigenous to Canada and the United States, where it grows in rich and rocky woodlands as far south as Carolina and Tennessee. The rhizome sends up a single petiole about twelve inches long, and three-parted at the summit, each division bearing five ovate or oval, serrate and subsessile leaflets. The scape is about six inches high, and divided into three or five peduncles, each about two inches long, and bearing a globose umbel of many greenish flowers.

Description.—The rhizome is several feet long, horizontal, with some slender branches, and sparingly beset with a few radicles. The internodes are indistinct, and the undeveloped buds alternate. The dry rhizome is about one-quarter inch in diameter; the few scape-scars are shallow cup-shaped, and approximate at the upper annulated end of the branches; the bark is longitudinally wrinkled, of a somewhat glossy pale brownish-gray color externally, the corky layer being easily removed from the white inner bark, which does not firmly adhere to the cylindrical wood. The latter is about one-eighth inch in diameter, of a yellowish color, and incloses a spongy white amylaceous pith. The rhizome breaks with a short fracture, is somewhat aromatic, and has a mawkish taste.

The *constituents* of the drug are not known.

Allied Species.—The rhizome and roots of Aralia racemosa, *Lin.*, which is indigenous to Canada and a large portion of the United States, are used for similar purposes under the name of *American spikenard.* The rhizome is oblique, four to six inches long, and half as wide; the nodes are approximate, and the stem-scars prominent, about one to one and a half inch in diameter, the older ones deeply concave. The roots are numerous, from twenty to thirty inches long, about one-half inch or more thick near the rhizome, and little branched below. It has a stronger aromatic odor and taste than the preceding.

Medical Action and Uses.—This medicine belongs to the secondary list of drugs, and its name of "false sarsaparilla" denotes the qualities which have been attributed to it, viz., of being stimulant, diaphoretic, and alterative. But the proofs of its virtues are unsatisfactory. It is used in decoction and infusion, both internally and externally.

ARALIA SPINOSA, *U. S.*—ARALIA BARK.

Angelica tree, Toothache bush, Prickly ash, Hercules' club, E.; *Ecorce d'aralia épineuse,* Fr.; *Dornige Aralienrinde,* G.

The bark of Aralia spinosa, *Lin.* *Nat. Ord.*—Araliaceæ.

Origin.—A shrub or low tree which is indigenous to the Southern States, and cultivated further north. It grows to the height of twelve or, in favorable locations, thirty feet; the leaves, which are crowded near the summit, are often from four to six feet in length and bi- or tripinnate, with ovate-pointed serrate and sessile leaflets, which are glaucous beneath. All parts of it are medicinal, but the bark alone is officinal.

Description.—The bark is in thin quills or curved pieces, the inner surface of which is nearly smooth, and yellowish; the outer surface gray, scarcely fissured, smooth, or with slight longitudinal ridges, and beset with slender prickles in transverse rows, or marked with some short transverse ledges. The layer beneath the thin cork is green or brownish-green; the inner bark whitish, composed of concentric layers, and breaks with rather tough but nearly smooth fracture. The bark has a slight aromatic odor, and a bitterish, pungent, and acrid taste.

Constituents.—The aromatic, bitter, and acrid principles of aralia bark are unknown.

Medical Action and Uses.—This species of aralia is thought to be more stimulating than A. nudicaulis, but its uses are nearly the same. In S. Carolina it is said to be implicitly relied upon by the negroes as an antidote to the *rattlesnake's bite.* The bark is used for this purpose both internally and externally.

ARAROBA.—GOA POWDER.

Chrysarobin, E.; *Poudre de Goa,* Fr.; *Goa pulver,* G.

Origin.—A paper by Dr. Da Silva Lima (1875) furnishes strong evidence that the Goa powder of East Indian pharmacy really comes from Brazil, where it is known as araroba, or arariba, and, in some provinces, as *po' de Bahia.* It occurs in the wood of a leguminous tree, probably a species of Cæsalpinia. E. M. Holmes has found the red wood to be very similar to that of *Cæs. echinata*, Lam., and Martius mentions in his "Materia Medica of Brazil" that the name araroba is also given to two species of *Centrolobium* (C. robustum and C. tomentosum). The powder seems to be produced in the cavities formed by the decaying wood-fibre. Hitherto it was largely exported from Brazil to Portugal, whence it appears to have been shipped to the Portuguese colonies in Africa and Asia.

Description.—Araroba occurs in commerce as a rough powder or in small irregular pieces; it is originally of a light-yellow color, but becomes darker on exposure to light and moisture, acquiring a dull-ochrey, pale-brown, or even umber-brown color. It has a bitter taste. When carefully heated it yields a moss-like sublimate, which is colored red by alkalies.

Constituents.—Examined by Prof. Attfield (1875) it leaves only .43 per cent. of ash. Boiling water dissolves from it about 7 per cent., the solution being free from starch, but containing some gum, a glucoside precipitable by lead acetate, and a bitter principle precipitated by lead subacetate. From the remaining araroba benzol dissolves over 80 per cent. of chrysophanic acid (see page 39), and alcohol afterwards takes up 2 per cent. of resin, leaving 5½ per cent. of red wood fibre.

Pharmaceutical Uses.—Da Silva Lima has proposed an *ointment* of araroba composed of 2 to 4 grams araroba, 1 to 2 grams acetic acid, and 30 grams of benzoated lard; also a *vinegar* made by digesting for a week 25 grams of araroba in 100 grams of dilute acetic acid; when used the latter preparation may be mixed with glycerin. B. Squire prefers to prepare the ointment from chrysophanic acid by dissolving it with the requisite amount of lard in the smallest quantity of benzol, using a beaker placed in a water-bath and transferring the solution to an evaporating dish, stirring it briskly until the solvent has evaporated.

Medical History.—In British India, in 1874, attention was called to a secret medicine known as Goa powder and Po' de Bahia, and which was found to be very efficacious in certain chronic diseases of the skin. Investigation proved that it was esteemed in Brazil as a remedy for various cutaneous affections, and especially for herpes circinatus, chloasma, and intertrigo.

Physiological Action.—It is stated that the irritating effects of araroba on the skin and mucous membranes are such that the workmen employed in cutting up and pounding it are obliged to protect their faces, nostrils, and throats against its dust. Gaskoin relates that in treating ringworm of the scalp he first wetted the part thoroughly with a little lemon-juice or carbolic acid water, and for a few minutes rubbed in the powder, after which the face was apt to become swollen and covered with an ugly brown stain, accompanied by considerable inflammation. This effect has been observed mainly in children. In some cases, although the ointment was applied to the hairy scalp only, the whole face, neck, and shoulders became stained of a dark purple-gray, a color which was speedily cast off by desquamation. It results, however, from experiments made by Mr. Squire that the Goa powder, and chrysophanic acid also, applied dry, in solution, or in ointment to the sound skin occasioned no irritation whatever, nor any effect beyond a transient stain, and that it may be used to a raw surface without any other effects than a beneficial stimulation.

Medical Uses.—The use of the Goa powder in *ringworm of the scalp* is thus described by Dr. Fayrer: A few grains of the powder are dissolved in common vinegar or lemon-juice to about the consistence of cream, and with it the eruption is painted over as well as a little distance beyond its margin. It causes no pain at first, but in the course of a few hours there is a sensation of a dull, heavy nature, the eruption becoming white, while the surrounding skin is stained of a dark color. The sense of uneasiness soon passes away, the integument resumes its natural color, and all traces of the disease disappear at the same time. In chronic cases the process of cure is necessarily more gradual. Da Silva Lima has verified these statements, and also tested the virtues of the application in an obstinate case of *mentagra*, in which he twice a day applied to the roots of the affected hairs, by means of a camel's hair pencil, an ointment composed of twenty grains of araroba powder, ten drops of acetic acid, and an ounce of benzoin ointment. Mr. Squire describes a case of general psoriasis which was treated with one part of the Goa powder to three of lard, frictions being made twice a day for six successive days. In that time the disease, which had lasted a long while, was nearly cured without irritation of any kind, but on the seventh day an erythematous state of the skin arose which did not subside for two or three days. The same reporter commends the remedy in *chronic lichen*, advising, however, a weaker ointment than the one just mentioned; and has proved its efficacy in contagious or parasitic *ringworm*, for which he employed an ointment of chrysophanic acid.

Administration.—According to the original method Goa powder is made into a paste with a little vinegar or lemon-juice, and smeared over the eruption once a day for several days. But a preferable form of the medicine is an ointment made with from ten to forty grains of the powder, ten drops of acetic acid, and an ounce of lard. A tincture of the drug has been used, and is applied with a brush. Most of those who have experimented with the Goa powder prefer to it an ointment made with from ten to sixty grains of chrysophanic acid and an ounce of lard melted together in an oil-bath.

ARECA, *Br. Add.*—ARECA NUT.

Semen Arecæ.—*Betel-nut*, E.; *Noix d'arec*, Fr.; *Arekanüsse*, *Betelnüsse*, G.

The seed of Areca Catechu, *Lin.*, the Betel-nut tree. Bentley and Trimen, Med. Plants, 276.

Nat. Ord.—Palmæ.

Origin.—This elegant palm, which attains a height of about 50 feet, is indigenous to the East Indies and the East Indian Islands, and is extensively cultivated there and in the Philippine Islands. The orange-colored fruit is of about the size and shape of a hen's egg, and contains under a fibrous pericarp a single seed.

Description.—The seed, which is the so-called areca or betel-nut, is about an inch in length, roundish-conical in shape, and somewhat depressed at the base. It is of a brown color externally, with numerous reddish veins originating at the hilum, and forming a network which penetrates into the white albumen; the small embryo is situated near the base of the seed. Areca nuts are heavy, very hard, and have, when recently broken, a feeble, somewhat cheese-like odor, and an astringent and slightly acrid taste.

Constituents.—Areca nuts contain about 14 per. cent. of fixed oil, which is solid at the ordinary temperature, and about the same amount of a red tannin which resembles catechu-tannic acid in producing a green and afterwards a brown color with ferric salts. Catechin is not present. The nuts yield 2.26 per cent. of ashes containing ferric oxide and magnesium phosphate (Flückiger and Hanbury). The aqueous extract of these seeds yields a kind of catechu.

Medical Uses.—Areca is astringent, and is chiefly used for the expulsion of *tape-worms*. From two to three drachms, powdered, and mixed with syrup, are stated to be the proper dose. Before being used to destroy these parasites in man, it was largely employed for a similar purpose in dogs.

ARGEMONE.—Prickly Poppy.

Argémone, F.; *Stachelmohn*, G.

Argemone Mexicana, *Lin.* *Nat. Ord.*—Papaveraceæ.

Description.—This annual is indigenous to Mexico and the West Indies, but has been introduced and naturalized in most tropical and subtropical countries. It is about two feet high, has alternate sessile, sinuate-lobed leaves with prickly teeth and white spots, and yellow flowers about $1\frac{1}{2}$ inches in diameter, with 6 petals and many stamens. The ovate prickly capsule is about an inch thick, crowned with the nearly sessile radiate stigmas, and contains numerous blackish finely-pitted seeds. The plant has a bitter and acrid taste, and when wounded exudes a yellowish milky juice.

Constituents.—Charbonnier (1868) has found a small proportion of morphia in the leaves and capsules. The seeds yielded him 36.2 per cent. of a drying fixed oil of a light-yellow color, and bland taste. O. Frölich (1871) obtained from the oil a pretty hard soda-soap, and found in the soap liquor butyric, valerianic, acetic, and a little benzoic acid. According to Flückiger (1871), the oil has the spec. grav. .919 at 16.5° C. (61.8° F.), remains clear at —6° C. (21.2° F.), dries slowly and incompletely, is not soluble in 6 vols. of 90 per cent. alcohol, as stated by Charbonnier, and has a mild purgative effect in doses of 4 or 5 grains.

Medical Action and Uses.—The principal quality of this plant appears to be its acrimony, in which, as well as in the physical properties of its inspissated juice, it resembles gamboge. In Mexico and in Java its fresh juice is applied to *warts* and indolent *ulcers*, and in *psorophthalmia* and *opacities of the cornea.* The fresh leaves are also bruised and used as a dressing for ulcers. The juice is employed as a hydragogue cathartic in *dropsy.* Some narcotic virtue has been ascribed to the seeds, which are said to be used for smoking when mixed with tobacco. But while one authority describes them as suitable, like opium, for checking diarrhœa, another compares them to ipecacuanha, a third holds them to be purgative, and a fourth as purgative and anodyne also. The oil, derived by expression from the seeds, is reported to purge in the dose of thirty drops. An infusion of the herb is stated to be used in Mexico as a sudorific.

ARGENTI CYANIDUM, *U. S.*—Cyanide of Silver.

Argentum cyanatum.—*Cyanure d'argent*, Fr.; *Cyansilber*, G.
Formula $AgCN = AgCy$. Molecular weight 134.

Preparation.—Take of Nitrate of Silver, Ferrocyanide of Potassium, each two troyounces; Sulphuric Acid a troyounce and a half; Distilled Water a sufficient quantity. Dissolve the nitrate of silver in a pint of distilled water, and pour the solution into a tubulated glass receiver. Dissolve the ferrocyanide of potassium in ten fluidounces of distilled water, and pour the solution into a tubulated retort, previously adapted to the receiver. Having mixed the sulphuric acid with four fluidounces of distilled water, add the mixture to the solution in the retort, and distil, by means of a sand-bath, with a moderate heat, until six fluidounces have passed over, or until the distillate no longer produces a precipitate in the receiver. Lastly, wash the precipitate with distilled water, and dry it. *U. S.*

On distilling ferrocyanide of potassium with sulphuric acid, hydrocyanic acid passes over (see Acidum hydrocyanicum), which reacts with the nitrate of silver, forming nitric acid, and cyanide of silver, which precipitates: $HCy +$

$AgNO_3$ yields $HNO_3 + AgCy$. To avoid loss of silver the distillation should be continued as long as a precipitate is produced in the solution.

Properties.—Cyanide of silver, when dry, forms a white tasteless powder, which gradually turns brown on exposure to the light. When heated, it fuses, giving off one half of its cyanogen, and suffering further decomposition by a higher heat. It is insoluble in diluted acids, but is decomposed by boiling concentrated acids with the evolution of hydrocyanic acid. It is readily soluble in ammonia and hyposulphite of sodium; also in ammonical salts; it forms soluble double salts with the alkaline cyanides. Dilute hydrochloric acid and soluble chlorides decompose it, yielding chloride of silver and hydrocyanic acid, or soluble cyanides.

The only use of this salt in medicine is to serve for the extemporaneous preparation of diluted hydrocyanic acid.

ARGENTI NITRAS, *U. S.*, *Br.*—NITRATE OF SILVER.

Argentum nitricum crystallisatum, P. G.; *Azotas (nitras) argenticus.*—*Azotate d'argent*, *Nitre lunaire*, Fr.; *Salpetersaures Silberoxyd*, *Silbersalpeter*, G.

Formula $AgNO_3$. Molecular weight 170.

Preparation.—Take of Silver in small pieces two troyounces; Nitric Acid two troyounces and a half; Distilled Water a sufficient quantity. Mix the acid with a fluidounce of distilled water in a porcelain capsule, add the silver to the mixture, cover it with an inverted glass funnel, resting within the edge of the capsule, and apply a gentle heat until the metal is dissolved, and red vapors cease to be produced; then remove the funnel, and, increasing the heat, evaporate the solution to dryness. Melt the dry mass, and continue the heat, stirring constantly with a glass rod, until free nitric acid is entirely dissipated. Dissolve the salt, when cold, in six fluidounces of distilled water, allow the insoluble matter to subside, and decant the clear solution. Mix the residue with a fluidounce of distilled water, filter through paper, and, having added the filtrate to the decanted solution, evaporate the liquid until a pellicle begins to form, and set it aside in a warm place to crystallize. Lastly, drain the crystals in a glass funnel until dry, and preserve them in a well-stopped bottle.

By evaporating the mother-water, more crystals may be obtained. *U. S.*

The process of the British Pharmacopœia differs from the foregoing mainly in this, that the solution of purified silver in nitric acid, diluted with water, is evaporated and allowed to crystallize as long as crystals of pure silver nitrate are obtained.

When silver is dissolved in nitric acid, nitrate of silver is formed, and hydrogen set free; the latter reacts with another portion of nitric acid, forming water and nitric oxide, which is a colorless gas, but, on contact with the atmosphere, is oxidized, so as to form red vapors of hyponitric acid. These reactions are explained by the following equations: $6HNO_3 + 3Ag_2$ yields $6AgNO_3 + 3H_2$; $3H_2 + 2HNO_3$ yields $4H_2O + 2NO$; $2NO + O_2$ yields $2NO_2$. The final results of the process under the circumstances stated are, therefore, water, nitrate of silver which remains in solution, and hyponitric acid which escapes. If insufficient heat is applied during the reaction, the nitric oxide generated remains wholly or in part in solution, reducing the excess of nitric acid to nitrous and hyponitric acids.

It will be found of advantage to invert a glass funnel over the mixture, whereby not only some nitric acid, which would otherwise escape, is condensed and flows back into the dish, but the loss of silver solution by sputtering is likewise prevented. Since the best refined silver usually contains minute quantities of other metals, particularly copper, their removal becomes necessary, and is effected either by crystallization (*Br.*), when the impurities, together with some silver, will remain in the mother-liquor; or the solution is evaporated to dryness and the crystalline or granular mass further heated until it is fused and ceases to give off acid vapors. The nitrate of copper and other metals are decomposed by heat before the silver nitrate is affected, and the fused mass acquires a more or less dark-gray color in proportion to the amount of cupric oxide contained in it. The latter, being insoluble in water, is easily removed by dissolving the cooled salt in water and decanting or filtering the solution. Unless the heat has been very carefully regulated, some nitrate of silver will be reduced to nitrite, and contact with organic matter will tend to deoxidize it. It is, therefore, advisable to acidulate the solution with a little nitric acid.

Both processes are applicable in cases where the metallic impurities are small in quantity. If silver coin is used, the first crystallization will not be pure, and if evaporated to dryness and fused, a portion of oxide of silver will be separated. In such a case it is advisable either to treat the first crop of crystals by fusion, or to purify the silver by one of the processes given elsewhere. (See Argentum.)

Properties.—Nitrate of silver exists in colorless shining tabular crystals of the rhombic system, which have a strongly metallic taste, and are freely soluble in water and in four parts of boiling alcohol. They fuse at a temperature of 198° C. (388.4° F.), and decompose at a low red heat, but are permanent in the air and light, except in the presence of organic matter whereby they acquire a dark color. The alcoholic solution, when exposed to the light, is gradually reduced, silver being separated. Muriatic acid produces in the solution a white curdy precipitate of argentic chloride, which is insoluble in dilute nitric acid, but dissolves readily in ammonia. Stains produced by nitrate of silver upon the skin are removed by rubbing them with a strong solution of cyanide of potassium, or by moistening them first with a solution of iodine and afterwards with hyposulphite of sodium.

Nitrate of silver contains no water of crystallization.

Tests.—Ten grains of nitrate of silver dissolved in distilled water, give with hydrochloric acid a precipitate which, after washing and drying, weighs 8.44 grains. (*Br.*) The solution of nitrate of silver, when precipitated by an excess of hydrochloric acid, yields a filtrate which is not colored by hydrosulphuric acid, and, when evaporated, leaves no residue; copper, lead, and alkalies are thus readily detected.

Pharmaceutical Uses.—Nitrate of silver is used in the preparation of the other medicinal compounds of silver and of indelible ink.

INDELIBLE INK is frequently made of nitrate of silver. From the numerous formulas recommended we select the following: Dissolve two drachms of nitrate of silver in seven fluidrachms of distilled water, and add one fluidrachm of mucilage of gum arabic, colored with sap-green or other coloring matter. This ink is used after a mordant which is a solution of carbonate of sodium and gum in water, of the strength of one part of the former to from five to ten of the latter. (*Cooley.*)

One part of silver is dissolved in six of distilled water and six of mucilage of gum. It is to be used with a mordant composed of one part of hypophosphite of sodium, two of gum arabic, and sixteen of distilled water. (*Kuhr.*)

The following indelible inks are used without mordant:—

Eight parts of nitrate of silver and three parts of tartaric acid are triturated together, a little water is then added, and afterwards a sufficient amount of ammonia water to neutralize the free acid and dissolve the tartrate of silver; lastly, a little gum and coloring matter are added. (*Reade.*)

Nitrate of silver and bitartrate of potassium of each eight drachms are rubbed together, and dissolved in four ounces of ammonia water; four drachms of archil, six of white sugar, and ten of powdered gum are added, and when solution has taken place, sufficient water to make the whole measure six fluidounces. (*Redwood.*)

ARGENTI NITRAS FUSA, *U.S.*—FUSED NITRATE OF SILVER.

Argentum nitricum fusum, P. G.; *Lapis infernalis; Azotas (nitras) argenticus fusus.—Lunar caustic*, E.; *Azotate d'argent fondu, Pierre infernale*, Fr.; *Höllenstein, Geschmolzenes Salpetersaures Silberoxyd*, G.

Formula $AgNO_3$ Molecular weight 170.

Preparation.—Take of Nitrate of Silver a convenient quantity. Melt it in a porcelain capsule, and continue the heat cautiously until frothing ceases; then pour the melted salt into suitable silver moulds. *U. S.*

To obtain the nitrate in rods, fuse the crystals in a capsule of thin porcelain or platinum, and pour the melted salt into proper moulds. *Br.*

The reasons for the cautious application of heat when fusing nitrate of silver have been pointed out in the preceding article. The salt being decomposed by nearly all the metals when heated with them, capsules of platinum or of the best porcelain are the only vessels suitable for this operation. When fused it has the appearance of a colorless, transparent, oily liquid, and is then ready to be poured into the moulds, which should be faced with pure silver. Brass moulds are sometimes used, but they are liable to contaminate the product with copper. Steel or porcelain moulds may be used, after they have been rubbed with some powdered French chalk, which prevents the fused salt from adhering to the moulds. If the moulds have been previously warmed to about 40° or 50° C. (104° or 122° F.), the fused salt will not congeal too rapidly. Oiling the moulds should be avoided, lest a reduction of the salt will take place.

Properties.—It is met with in nearly colorless thin cylinders or pointed cones, which, when broken, show a crystalline texture upon the fractured surface. Its solubility, chemical behavior, and composition are the same as of the crystallized nitrate. It is not affected by the light unless it has been partly reduced by too high a heat to nitrite of silver, or been in contact with organic matter; wrapping the sticks in paper, or handling them with the fingers, should therefore be avoided.

Fused nitrate of silver is rather brittle, but the addition of a little chloride of silver renders the sticks more opaque and tough; Dr. Squibb proposed (1858) to add 20 grains of muriatic acid to one ounce of the crystals before fusing them.

The German and some other Pharmacopœias recognize a fused mixture of one part of crystallized nitrate of silver and two parts of nitrate of potassium under the name of *Argentum nitricum cum kali nitrico* (*Argentum nitricum fusum mitigatum, Lapis infernalis nitratus*).

Tests.—The same tests may be applied as for the crystals. Oxide or metallic silver, in very fine division, is occasionally present, either in consequence of too high a heat having been employed, or because the sticks have been in contact with organic matter; it will be left behind as a black powder on treating the sticks with distilled water. A convenient and readily applied test for the purpose of detecting the presence of alkaline salts is the following: a small portion of fused nitrate of silver, rubbed into fine powder with twice its weight of sugar, forms a mixture which, when burned upon a surface of glass or porcelain, leaves a tasteless residue (*U. S.*). The salts of alkalies, if present, will impart a saline or alkaline taste.

Physiological Action. *On Animals.*—Experiments upon animals show that when a solution of nitrate of silver is injected into a vein the symptoms produced are dyspnœa, choking, spasms of the limbs and then of the trunk, signs of vertigo, consisting of inability to stand erect or walk steadily, and finally retching and vomiting, and death by asphyxia. These symptoms, which have usually been attributed to the coagulating action of the salt upon the blood, have been shown not to depend upon that change, which indeed does not occur, but upon a direct paralyzing operation upon the cerebro-spinal centres and upon the heart; but the latter action is subordinate and secondary, and the former is fatal through asphyxia. Experiments with the hyposulphite of silver injected into the cellular tissue have furnished substantially the same results, but with a predominance of nervous phenomena, including debility, torpor, somnolence, impaired muscular coördination, convulsion, spasm, and paralysis, during or subsequent to which, and as a consequence of the muscular disorder, respiration becomes labored, and the lungs are at last engorged. The heart continues to act after the other muscles have become paralyzed. These effects, however, and some resembling them, are met with in animals that have taken silver salts internally; nor is there the slightest analogy between them and the effects of those salts on man, when they have been used for so long a time as thoroughly to impregnate the system. The toxical action of nitrate and albuminate of silver, given internally or hypodermically to animals, is described in the results obtained by Bogoslowsky. The fundamental effect is upon the blood, which grows darker and more liquid; the red corpuscles lose their hæmoglobulin and become transparent and pale, while their lost coloring matter goes to augment that of the bile. The feces increase and grow darker, while the urine is diminished in quantity, its specific gravity is raised, and it contains albumen. The mucous membranes are affected with catarrh, the muscles waste, the blood stagnates in the vessels or transudes through the serous membranes. All of these effects are ascribed to an alteration of nutrition, which is equivalent to fatty degeneration, a lesion like that produced by phosphorus, arsenic, and antimony, and which reduces the organic power of the whole system. But the whole of this description has been discredited (Jacobi). Among the phenomena above described, the most interesting, in a medical sense, would, if the results could be accepted and applied to man, be the primary action of the salts of silver upon the medulla oblongata; for through it might perhaps be explained certain cures of epilepsy which have been attributed to them.

On Man.—Applied to a mucous membrane or to a raw surface, nitrate of silver causes a severe smarting and burning pain, and forms a white pellicle by coagulating the albumen and fibrin of the part, which speedily dry. Upon the sound skin its prolonged application occasions vesication with a surrounding red border, but it does not cause ulceration of the chorion, and the superficial loss of substance is rapidly restored. The cauterized surface, by exposure to the light, gradually turns brown, and even black. Taken internally, by far the larger portion of the salt is discharged as a chloride of silver with the feces, but that a portion also is retained is certain, partly from its therapeutical effects, but more evidently from the peculiar violet discoloration of the exposed portions of the skin produced by its prolonged use, as well as from its detection in the kidneys, choroid plexuses, etc. An analogous stain is sometimes observed on the gums and inner surface of the cheeks. In some cases the internal organs have been found discolored as well as the skin. In the tissues it is stated to exist as an oxide, or as metallic silver. Nitric acid and also iodide of potassium internally are reported to lessen the intensity of the discoloration caused by the absorption of this salt. The external stain may be removed by the cyanide or by the iodide of potassium. Flaxseed mucilage is alleged to have the same effect. It is worthy of notice that in those cases in which discoloration of the skin has been produced by the prolonged use of small doses of the salt, no symptoms whatever occur which can be attributed to its operation.

Doses of one-half a grain occasion no special symptoms, but larger quantities are apt to cause gastric heat, pain, and nausea. But much depends upon whether the stomach contains food or not. In poisonous doses it occasions gastric irritation and diarrhœa as its direct effect, and indirectly loss of consciousness, anæsthesia, convulsions, muscular exhaustion, a faint pulse, and a cold clammy skin; in some cases of chronic poisoning by it a scorbutic condition is alleged to have been observed. Such an effect resembles those produced by this salt in animals, as already narrated. The only fatal cases following the ingestion of nitrate of silver are those in which its long-continued use has ulcerated the stomach, or where a portion of fused nitrate has been arrested in the fauces and caused swelling of the glottis.

Medical Uses. *Internally.*—In various disorders of the *stomach*, including morbid sensibility of that organ from chronic *inflammation*, *neuralgia*, and chronic *ulcer*, the use of nitrate of silver has sometimes relieved pain, checked vomiting and acid eructations, and restored health by promoting healthy digestion. The difficult diagnosis of the nature of such cases renders the application of the remedy uncertain, but its benefits are sometimes striking. *Diarrhœa*, whether dependent upon debility of the intestine or upon ulceration due to tuberculosis, or chronic dysentery, or prolonged typhoid fever, is favorably modified by nitrate of silver. In *dysentery*, which is either subacute or has not entirely passed into the chronic stage, enemata containing the salt are to be preferred. For these purposes about a quarter of a grain may be given by the mouth in pill, and a grain by the rectum in solution. Even in Asiatic *cholera* the medicine may be advantageously exhibited both by mouth and rectum. There is some evidence of its utility in chronic *jaundice* from accumulation of thick bile in the ducts. Its sedative action upon the heart, demonstrated by experiments upon animals, receives a confirmation from the experience which shows it to be a palliative of abnormal action of the *heart* in organic as well as functional disease of that organ. In like manner its action upon the lungs is illustrated by its beneficial effects in some cases of *bronchitis* with mucopurulent expectoration and hectic fever. But its efficacy in nervous diseases is still more evident in the apparent cures of *epilepsy* attributed to its use. The special forms of the disease which it most favorably influences are undetermined. It must be given for a long time, commencing with doses of one-quarter of a grain three times a day, and gradually increased. Every three or four weeks its administration should be suspended for a few days, in order to diminish the risk of staining the skin. Since the introduction of the bromides this medicine has, like many other anti-epileptic remedies, been almost entirely neglected. In that form of paralysis known as *locomotor ataxia*, nitrate of silver was reported to have effected cures; but a close scrutiny of the matter showed that the cases cured were not examples of this disease, but of *congestion of the cord*, generally associated with rheumatism, but sometimes resulting from concussion. In not a few instances this salt, in doses of from one-tenth to one-fifth of a grain several times a day, effected cures when other methods had failed.

Locally.—Lunar caustic has been extensively employed in the treatment of *diphtheritic exudations* of all kinds, in diphtheria, croup, etc., and there is no doubt that it sometimes appears to modify favorably the affected surfaces, and to prevent the increase and extension of false membranes. In the case of laryngeal croup it was at one time the custom to introduce into the larynx a strong solution of the salt (40 grains to the ounce of water) by means of a sponge or brush; but more recently an atomized solution of the same strength has been substituted. In pharyngeal diphtheria, in which the existence and condition of the false membrane are more demonstrable, as well as the influence of treatment upon it, the tendency of opinion among the most judicious physicians is less favorable than formerly to any form of local cauterization. It is alleged, and our own observation leads us to believe, that this method, which was at one time regarded as essential, is often injurious by the irritation it causes and the extension of the deposit which follows its use. In laryngeal *croup* the results of the treatment appear to be more favorable; but it must not be forgotten that the diagnosis of the disease from simple laryngitis is often obscure, and also that the immediate dependence of life upon the freedom of the larynx and trachea from obstruction, must modify the conclusions arrived at in regard to the laryngeal as compared with the pharyngeal affection. The advantages of nitrate of silver in *chronic ulceration* and simple inflammation of the larynx and trachea are unequivocal. It exerts here the same stimulant and protective influence that it does over similar lesions elsewhere, and thus promotes the restoration of the parts to health as far as possible. As ulcers of the larynx are never primary, but always dependent upon a diathetic influence (tubercle, syphilis, cancer), a cure of them by local treatment alone is not to be expected; but this method is invaluable for the relief it affords to suffering by palliating the symptoms which the local lesions occasion. In *simple chronic laryngitis* the same treatment may suffice for a permanent cure. Many cases of *aphonia* depending upon this affection may thus be permanently cured. The stimulant action of solutions of nitrate of silver, applied by sponge, brush, syringe, or atomizer, is most efficient in the various forms of simple laryngitis, and also in nervous aphonia, and in *whooping-cough.* In the last-mentioned affection the pharynx as well as the larynx should be impressed by means of an atomized solution of the salt.

If, in any case, it is possible to prevent *tonsillitis* from passing into *quinsy,* this end may be most securely reached by the application of lunar caustic freely to the swollen gland. But the termination in suppuration can never, in a particular case, be predicted with certainty. It sometimes happens, also, that this use of the caustic appears to promote and not to hinder suppuration. Local vesication by means of a saturated solution of the crystallized salt, or with the fused nitrate, is an efficient means of treating various local ailments. It may be used over the superficial portions of nerves in various *neuralgiæ;* superficially, also, over *lymphatic vessels* and *glands* in the first stage of inflammation; *paronychia* and other forms of local inflammation, such as *abscesses,* may be treated in the same way. It has been used to blister the brow in *iritis.* It has been also applied hypodermically in *sciatica.* The substitutive action of nitrate of silver is pre-eminently useful in *ophthalmia* or *conjunctivitis.* In different degrees of strength, it may arrest the development of a mild inflammation, or so modify the membrane as to cure the most chronic forms of this affection. In treating *ulcers* of the *cornea,* care should be taken lest the undissolved or precipitated salt should permanently stain the structure and form an obstacle to distinct vision. *Blepharitis,* or inflammation of the follicles of the edges of the lids, is said to be well treated with an ointment of nitrate of silver (gr. iij to ℥j), but it is better to touch the parts with a strong solution of the salt, and then cover them with simple ointment. Fused nitrate of silver, in the form of a fine point, is an efficient means of arresting hemorrhage from *leech-bites.* This caustic has been used with advantage in treating punctured and lacerated *wounds,* and especially *poisoned* wounds. In the former case, it produces a protective film, and in the latter, probably tends to destroy the virus. Its stimulant and protective actions combined make it a useful application to *ulcers,* and especially to those of an indolent character, and these, as well as its action upon the specific virus of *chancres,* render it a valuable agent in their first stage. It is generally held that if induration have already taken place, this treatment will not prevent constitutional infection; but some maintain that it is useless, no matter how early it is employed. A similar ectrotic method has been used to prevent pitting in *smallpox,* and often with apparent success. The application of a strong solution of the salt during the papular, or early in the vesicular, stage, sometimes arrests the development of the pocks. A similar method has been practised in *zona, herpes,* and *intertrigo,* but in the last-named affection, the solution should be weak (gr. v to f℥j). It is a useful application to *sore nipples;* the caustic pencil may be applied to the fissures or ulcers, or the part may be enveloped with lint wet with a weak solution.

Burns, if superficial, may be treated in a similar manner, or merely brushed over with a strong solution of the nitrate, and then closely enveloped in lint or carded cotton. The same method has been much employed in *erysipelas*, when it affects the face alone, and also when it involves the scalp. A strong solution is to be preferred, and the earlier in the attack it is used the more apt are its effects to be beneficial. It must, however, be remembered that erysipelas of the face is not merely a local inflammation. Nitrate of silver is of great value in treating several diseases with purulent discharges, as *otorrhœa*, *gonorrhœa*, and *leucorrhœa*. In the second of these affections it should be cautiously used, at least in the male, during the acute stage; too strong a solution has been known to cause violent inflammation of the urethra and bladder, orchitis, etc. It is the best application in gonorrhœa of the glans penis, or *balanitis;* if the prepuce cannot be withdrawn, a solution of the salt may be injected. It should be of the strength of gr. xx–xxx to f℥j, and a similar one may be used for gonorrhœa in the female, and for leucorrhœa. If the latter affection has its source in the neck or body of the uterus, the solution, or the solid caustic, may be introduced into that organ. But this is an operation attended with serious risks, unless performed with the utmost caution. It has been successfully employed to cure *amenorrhœa* from uterine torpor; a solution of one or two grains to the ounce being injected into the cavity of the uterus.

A similar solution injected into the bladder has been found efficient in the treatment of *vesical catarrh*. *Ascarides* of the rectum are said to be destroyed by injections of nitrate of silver, containing about three grains of the salt to an ounce of water. *Strictures of the urethra* are habitually treated with the solid nitrate applied by means of the caustic-holder of Lallemand. This method is most applicable to linear and to spasmodic strictures. The same treatment, applied to the prostatic portion of the urethra, has been much in vogue as a remedy for *involuntary seminal emissions*, and is often efficient where these discharges depend upon debility, and, therefore, morbid excitability of the sexual organs, induced by prolonged self-abuse. Nitrate of silver may assist in removing *corns* after the hardened and thickened cuticle has been removed by prolonged maceration in warm water or by a poultice. As often as the blackened lamina exfoliates, the operation should be repeated.

Administration.—By the mouth, nitrate of silver is nearly always given in a pill, which should be made with some bitter vegetable extract, but not with bread-crumb, which contains salt. But even such precautions do not long prevent its decomposition. It should be administered when the pills are freshly made and the stomach is empty, in order to delay this result. Such, at least, is the usual direction; but it is pretty certain that, under no circumstances, is the nitrate of silver absorbed unchanged. The dose is from one-quarter of a grain to one grain three times a day. A convenient mode of preserving fused nitrate of silver is to dip the stick into melted sealing-wax, which gives it a coating that protects it from the air and prevents its staining the fingers. A tougher preparation than the fused nitrate is prepared by mixing with the latter a portion of oxide of silver. The stick of lunar caustic may be pointed by rotating it upon a hot silver coin. The stain of nitrate of silver upon the skin, clothing, etc., may be removed by a solution of cyanide, and somewhat less perfectly by a solution of iodide, of potassium. Or the stain may be moistened with tincture of iodine, and then with ammonia, and the colorless residue removed with water. The proper *antidote* to nitrate of silver in the stomach is common salt largely diluted, so as to decompose the nitrate and induce vomiting. The resulting irritation may be allayed by milk, which should also serve for food until the stomach is restored. The excessive action of the nitrate upon the fauces, vagina, skin, etc., may also be checked by salt and water.

ARGENTI OXIDUM, *U. S.*, *Br.*—OXIDE OF SILVER.

Argentum oxydatum.—Argentic oxide, E.; *Oxyde d'argent*, Fr.; *Silberoxyd*, G.

Formula Ag_2O. Molecular weight 232.

Preparation.—Take of Nitrate of Silver four troyounces; Distilled Water half a pint; Solution of Potassa a pint and a half, or a sufficient quantity. Dissolve the nitrate of silver in the water, and to the solution add solution of potassa so long as it produces a precipitate. Wash this repeatedly with water until the washings are nearly tasteless. Lastly, dry the precipitate, and keep it in a well-stopped bottle, protected from the light. *U. S.*

Take of Nitrate of Silver in crystals half an ounce; Solution of Lime seventy fluidounces; Distilled Water ten fluidounces. Dissolve the nitrate of silver in four ounces of the distilled water, and, having poured the solution into a bottle containing the solution of lime, shake the mixture well and set it aside to allow the deposit to settle. Draw off the supernatant liquid, collect the deposit on a filter, wash it with the remainder of the distilled water, and dry it at a heat not exceeding 100° C. (212° F.). Keep it in a stoppered bottle. *Br.*

Both Pharmacopœias prepare the oxide from the nitrate of silver, which is decomposed by potassa or lime, yielding oxide of silver, water, and nitrate of potassium or calcium: $2AgNO_3 + 2HKO$ yields $Ag_2O + H_2O + 2KNO_3$; and $2AgNO_3 + Ca2HO$ yields $Ag_2O + H_2O + Ca2NO_3$. It is important that the alkaline solutions should be free from chlorides, which would precipitate a portion of the metal as chloride of silver, and the presence of carbonate in the potassa solution will cause the oxide to be contaminated with carbonate of silver. Solution of soda may be substituted for the potassa solution in the above formula. Oxide of silver may be likewise obtained, according to Gregory, by boiling recently precipitated moist chloride of silver with an excess of potassa solution, specific gravity 1.25 to 1.3, until a portion of the sediment is completely soluble in diluted nitric acid. To prevent the chloride from caking together, Mohr recommends the diffusion of it in some water and the adding of it gradually to the boiling potassa solution.

Properties.—Prepared by the Pharmacopœia processes, oxide of silver is an olive-brown or blackish powder. Obtained by Gregory's process, it is black or bluish-black. It is slightly soluble in 3000 parts (Bineau) of water, the solution having a metallic taste. It is slowly decomposed by the light, and rapidly and completely by heating it to 300° C. (572° F.) into silver and oxygen. Oxide of silver is soluble in ammonia, also in solution of nitrate of barium, and yields with solutions of chlorides, bromides, and iodides the corresponding silver salts. It reacts with acids, forming salts, many of which are colorless or white, and become dark colored on exposure to light, some only in the presence of organic matter. Many metals, like zinc, lead, iron, copper, etc., precipitate metallic silver from the solutions of its salts, and a similar reaction takes place with phosphorus, phosphorous acid, many organic compounds, and deoxidizing agents.

The most characteristic reactions of solutions of silver salts are obtained with chromate of potassium, which produces a deep purplish-red precipitate soluble in nitric acid. Chlorides and cyanides yield white curdy precipitates insoluble in dilute nitric acid, soluble in ammonia and cyanide of potassium; bromides give a yellowish-white precipitate little soluble in ammonia; and with iodides a yellowish precipitate is obtained which is nearly insoluble in ammonia. The lemon-yellow precipitate obtained with orthophosphate of sodium is readily soluble in ammonia and nitric acid.

Tests.—Oxide of silver is completely dissolved without effervescence in dilute nitric acid, and the solution when precipitated by an excess of muriatic acid yields a filtrate which leaves no residue on evaporation to dryness. 29 grains of the oxide, when heated to redness, leave a residue of metallic silver weighing 27 grains.

Medical Action and Uses.—Oxide of silver appears to possess the virtues which belong to the nitrate, but in a much less degree. It is slightly caustic, and its prolonged internal use occasions a purplish color of the skin. It was at one time supposed to possess a peculiar power over passive *hemorrhages*, particularly from the uterus; but it is not to be compared with several salts of iron or even with certain vegetable astringents in this respect. Owing to its less caustic qualities it may possibly be preferable to the nitrate in *gastralgia*, simple *gastric ulcer*, and painful *dyspepsia* depending upon irritability of the mucous membrane of the stomach. In all local affections which call for a mild stimulant and astringent, such as *catarrhal affections* of the nostrils, throat, larynx, vagina, urethra, etc., a weak solution of the nitrate of silver is greatly to be preferred. *Dose*, from half a grain to two grains two or three times a day, incorporated with a vegetable extract. An ointment is used containing from forty to eighty grains of the oxide to an ounce of lard.

ARGENTUM, *U. S.*—SILVER.

Argentum purificatum, Br.—*Refined silver*, E.; *Argent*, *Argent raffiné*, Fr.; *Silber*, *Raffinirtes Silber*, G.

Symbol Ag. Atomicity univalent. Atomic weight 108.

Origin.—This metal is found pure, and in combination with various metals, and with sulphur, chlorine, bromine, iodine, etc.; the richest silver ores being in Germany, Norway, Peru, Mexico, and the Western United States.

Preparation.—The extraction of the metal is effected by different processes, the details varying considerably with the richness and the composition of the ore. The process of *amalgamation* is based upon the formation of an alloy between metallic mercury and silver. The finely powdered ore is intimately mixed with chloride of sodium, and then roasted, when the mass contains, besides metallic silver, its chloride; the latter being converted to the metallic state by agitation in a revolving cylinder with water and iron. Mercury is now added, and the agitation continued, when the silver, gold, and copper unite with the mercury, the amalgam being obtained by subsidence and washing, and afterwards separated into a liquid and solid portion by subjecting it to pressure in strong linen or leather bags. By distilling the solid portion, the mercury is evaporated off and recovered, while the silver remains behind, containing copper and gold.

In the process of *cupellation*, the galena containing silver is first reduced, and the metallic lead allowed to cool slowly, when almost pure lead crystallizes, and is removed by means of a ladle, or by carefully draining off the liquid portion, which is rich in silver. It is exposed to a red heat, and air directed upon it by means of a blast, whereby the lead is oxidized, and the litharge blown off, leaving silver containing some lead. This is now transferred to a dish made of bone-ashes, and heated to redness, the plumbic oxide formed is absorbed by the porous vessel, and finally, almost chemically pure silver is left.

Many modifications of these and some other processes are employed, the silver obtained on the large scale always retaining a small portion of other metals.

Chemically pure silver is obtained in various ways from the chloride, which is readily prepared free from other chlorides by precipitating the solution in nitric acid with hydrochloric acid, and washing it thoroughly with water. The chloride of silver is then reduced by boiling it with glucose and carbonate of sodium; the powdered silver thus obtained is well washed with acetic acid and water, and then fused. Or, the chloride is mixed with acidulated water, and a rod of zinc introduced, the silver being afterwards fused with borax and saltpetre. Or, the chloride is mixed with a mixture of carbonate of sodium and potassium, and heated, whereby silver, alkaline chlorides, carbonic acid, and oxygen are formed. $2AgCl + KNaCO_3$ yields $Ag_2 + KCl + NaCl + CO_2 + O$.

Properties.—Silver is a brilliant white metal, very ductile and malleable, having the specific gravity 10.47 when obtained by fusion; the pressed and the distilled silver have a density of 10.57. It does not oxidize in contact with the air at a red or white heat, and distils at the heat of the oxyhydrogen blast. It tarnishes superficially through the sulphuretted hydrogen contained in the atmosphere, and dissolves completely in diluted nitric acid.

Tests.—The solution of chemically pure silver in hot diluted nitric acid, when precipitated by muriatic acid, yields a filtrate, which is not darkened by hydrosulphuric acid, and on evaporation to dryness leaves no residue.

Pharmaceutical Uses.—Metallic silver is not used medicinally; it is employed for making the officinal silver compounds, and in the form of silver-leaf serves occasionally as a coating for pills.

Medical Uses.—In its metallic form silver possesses no direct medicinal virtues. Its ductility, malleability, and slight susceptibility of oxidation fit it peculiarly for a vast number of uses in surgery.

ARMORACIÆ RADIX, *Br.*—HORSERADISH ROOT.

Raifort sauvage, Moutarde des moines; Radis de cheval, Fr.; *Meerrettig*, G.

The fresh root of Cochlearia armoracia, *Lin.*; s. Armoracia (Cochlearia, *Lam.*) rusticana, *Gærtn.*; s. Arm. sativa, *Hell.* Bentley and Trimen, Med. Plants, 21.

Nat. Ord.—Cruciferæ, Siliquosæ.

Origin.—This perennial plant is indigenous to the eastern part of Europe, and cultivated in Western Europe and North America, where it has been naturalized. It has large oblong crenate or sometimes pinnatifid root-leaves on long channelled petioles, lanceolate stem-leaves, and a long racemose inflorescence; the flowers are white, and the ascending pods roundish.

Description.—The root attains a length of from 1 to 2½ feet, and a thickness of one-half to one inch; it is cylindrical in shape, and crowned with several annulated heads. It is covered with a light yellowish-brown corky layer, and breaks with a short fracture, exhibiting the fleshy white interior. The bark is thin, contains a number of yellow resin-cells, and is separated by a dark-colored cambium line from the meditullium, in which the radiate arrangement of the vascular bundles and medullary rays, and frequently also the circles of annual growth are easily discernible. A large central pith is found in the head. In its unbroken state it is nearly inodorous, but when broken or bruised it has a very pungent odor, and a sharp acrid taste. It is employed in the fresh state only.

Constituents.—The volatile oil to which the odor and taste of horseradish are due has the same chemical composition as oil of mustard, $CSN.C_3H_5$, though it differs from it somewhat in odor; the crude oil, of which about $\frac{1}{20}$ per cent. of the weight of the fresh root is obtained, is of a light yellow color, the rectified is nearly colorless, of 1.01 spec. grav., and becomes dark colored by age. It does not pre-exist in the root, but according to Boutron and Frémy (1840) is formed in a manner similar to that of the volatile oil of mustard. Besides the volatile oil, Gutret (1792) ascertained the presence of some bitter resin, extractive, sugar, starch, gum, albumen, acetates, and other salts, 12.5 per cent. of lignin, and 78.1 per cent. of water.

Off. Prep.—Spiritus armoraciæ compositus, *Br.*

Medical Action.—Horseradish, in the fresh state or pickled, has a very pungent and acrid taste, and irritates the fauces and the nostrils and causes a flow of tears. It is a familiar condiment, especially for beef. It excites a sense of warmth in the stomach, stimulates the appetite, and promotes digestion. In excessive doses it occasions burning at the epigastrium, nausea, and vomiting. It augments the urine and probably the perspiration also, and gives to the former a peculiar odor. Externally applied it reddens and sometimes blisters the skin. These qualities depend upon its volatile oil, which has at first a sweetish and then an extremely acrid taste, a pungent and very diffusive odor.

Uses.—Horseradish has had great renown as a remedy for *scurvy*, and the resemblance of its taste to that of scurvy grass (*Cochlearia officinalis*) is noteworthy. The disease is much less common now than when anti-scorbutics were in vogue, and when this medicine ranked high among them. In the treatment of *dropsy* it has been replaced by more potent drugs. Nevertheless it deserves its reputation as a diuretic in all forms of cardiac, renal, hepatic, and splenic dropsy which are characterized by a feeble, atonic condition of the system. It is advantageous as a condiment in many cases of *dyspepsia* with feeble appetite, oppression after eating, and flatulence, and in cases of gastric debility attended with *vomiting*, even when incited by reflex irritation. As a local irritant it is sometimes used to relieve *toothache*, to stimulate the *fauces*, to correct relaxed states of the mucous membrane, and to remove the hoarseness produced by congestion of the *larynx*. For these purposes it may be employed as a masticatory, or a strong infusion may be applied as a gargle. It may be resorted to as a counter-irritant in all the cases in which mustard is appropriate, to arouse sensibility, to relieve pain, excite motility, etc. A mixture of the juice with vinegar has been used to remove *freckles* and *tan*. The compound spirit of horseradish is a convenient addition to diuretic infusions and mixtures. An infusion may be made with an ounce each of fresh-grated horseradish and bruised mustard-seed in a pint of hot water, macerated for two hours. A wineglassful may be taken three or four times a day.

ARNICA, *U. S.*—ARNICA FLOWERS.

Flores arnicæ, P. G.—*Fleurs d'arnique*, Fr.; *Wohlverleihblüthen*, *Arnikablüthen*, G.

The flowers of Arnica montana, *Lin.*

ARNICÆ RADIX, *Br.*—ARNICA ROOT.

Racine d'arnique, Fr.; *Arnikawurzel*, G.

The dried rhizome and rootlets of Arnica montana, *Lin.*

Nat. Ord.—Compositæ, Senecionideæ. Woodville, t. 17; Bentley and Trimen, Med. Plants, 158.

Origin.—This species of arnica is indigenous to Europe, growing upon the mountains of Switzerland and Germany, and further north in the plains. It is likewise met with in Northern Asia and in the northwestern part of America. It bears a tuft of ovate or oblong obtuse radical leaves with a nearly entire and ciliate margin, and produces a stem about 10 to 12 inches high, with a few lanceolate leaves and a few branches, each of which bears one flower.

Description. 1. THE RHIZOME.—It is horizontal, somewhat contorted, two or three inches long, and one-eighth inch or less in diameter, longitudinally wrinkled, uneven, and rough from the scars of the decayed stems and leaves. Its color externally is dark-brown; the whitish bark has about one-eighth the diameter of the rhizome, and contains a circle of brown-yellow resin cells. The yellowish wood forms broad wedge-shaped bundles and incloses a large central pith. The rootlets issue from the lower side of the rhizome, are 2 to 3 inches long, thin and fragile, and consist of a thick bark and a thin cylindrical cord of yellowish wood, which is surrounded by a circle of resin cells.

Arnica root is collected in the spring, and is occasionally found in the market with the radical leaves, which should be removed when used for medicinal purposes. It has a faintly aromatic odor, and a rather persistent acrid taste.

2. THE FLOWERS.—The heads, which are from one to two inches in diameter, are surrounded by an involucre consisting of a double row of imbricated equal and hairy scales. The flat and chaffy receptacle is about one-quarter inch in diameter, and bears 15 to 20 pistillate bright-yellow and parallel-veined ligulate ray florets about an inch in length, and many perfect tubular five-toothed disk florets. The brown and hairy akenes are slender and spindle-shaped, and crowned by a pappus consisting of a single row of denticulate hairs. Their odor is feebly aromatic, and their taste acrid and bitter. Several Pharmacopœias, like the German, direct the removal of the involucre. The flowers, and more particularly the receptacle, are often attacked by the black larvæ of the arnica fly, Trypeta arnicæ, which must be removed. The powder of arnica flowers is irritant and sternutatory.

Constituents.—Besides gum, wax, and salts, the root and flowers contain two different volatile oils. The dry root yields about one-half per cent. of volatile oil, which has nearly the density of water, and isobutyric and other volatile acids. The name of *arnicin* has been applied to different principles found in the root and flowers. Pavesi's arnicin (1859), obtained by the process for preparing santonin, is a dark-yellow sticky resin of a disagreeable bitter taste, which is not freely soluble in alcohol and ether, but readily in alkalies, from which solutions it is again precipitated by acids. Bastick's arnicin (1851) was obtained by exhausting the flowers with alcohol acidulated with sulphuric acid, treating the tincture with an excess of lime, adding to the filtrate sufficient sulphuric acid, evaporating, diluting with water, filtering, neutralizing with carbonate of potassium, again filtering, treating the liquid with excess of carbonate of potassium, and agitating with ether, on the evaporation of which arnicina is left. It is stated to have a bitter taste and alkaline reaction, and to yield with acids crystallizable salts. The arnicin of Walz (1861) is a golden-yellow amorphous acrid mass, which is slightly soluble in water, and soluble in alkaline liquids, in alcohol, and in ether. It may be prepared from the flowers, which contain it in larger proportion than the root, by passing the tincture through animal charcoal, evaporating, treating the residue with ether, which dissolves arnicin and fat, the former of which is afterwards dissolved by alcohol of 0.85 specific gravity. It is also obtained by precipitating the watery decoction with tannin, exhausting the precipitate with alcohol, and removing the tannin by oxide of lead, and the lead by sulphuretted hydrogen. By decomposition with alkalies and acids, resin, oil and a volatile acid have been obtained.

Arnica root and flowers appear also to contain several resins, at least one of which is insoluble in ether and has an acrid taste. The root contains 10 per cent. of inulin, according to Dragendorff (1870).

Adulterations and Substitutions.—The flowers are said to be occasionally adulterated with other yellow composite flowers, but are easily distinguished by the characters given above. The same is the case with the rhizomes and roots of other compositæ which are said to be occasionally collected by mistake for arnica root; there is no difficulty in distinguishing the latter from the root of Geum urbanum, noticed as an adulteration by E. M. Holmes (1874).

Pharmaceutical Uses and Preparations.—The flowers are employed in preparing Extract. arnicæ alcoh. and Tinct. arnicæ, *U. S.* Tinct. arnicæ, *Br.*, is made from the root.

Physiological Action. *On Animals.*—Experiments upon horses, in which an infusion of arnica was administered by the stomach or by the veins, proved this preparation to be a direct stimulant of the arterial and nervous systems of these animals, increasing the temperature and the secretion of urine; but its secondary effects consist of muscular tremors, depression, debility, and apparently anæsthesia. These effects are, however, transient.

On Man.—The local action both of the root and the flowers of arnica is irritant; but that of the flowers is the more powerful. Internally, a strong infusion irritates the throat and stomach, occasions a burning pain in the stomach, tends to excite vomiting, increases the frequency of the heart's action, the respiration, and the secretions of the skin, bronchia, and kidneys; and occasions headache, giddiness, inability to stand or walk, and disturbed sleep. These symptoms are followed by depression and exhaustion. After excessive doses the phenomena of stimulation are not observed, but in their stead vomiting, purging, giddiness, oppression, debility, cold extremities, frequent pulse, dilated pupils, muscular spasms, and collapse, with infrequent pulse. The nauseant properties are said to belong to the flowers rather than to the root.

Medical Uses.—The conclusions respecting the operation of arnica to be drawn from the foregoing phenomena are essentially the same as those which its use as a medicine indicates. Its vogue has always been greatest in the treatment of affections that require stimulation. Especially has it been reputed to be an efficient stimulant in all diseases presenting the *typhoid state*, in the continued fevers which most frequently assume that condition, and in the various inflammations which it may characterize. As a disease which partakes of both natures, and which often presents the typhoid type, *dysentery* may be mentioned, and in it arnica is said to have been an efficient remedy under such circumstances. Its stimulant local action has been thought sufficiently powerful to suggest its use in liniments and tinctures applied by friction to paralyzed muscles. In Germany this action has long been popularly employed for the relief of local *paralyses*, *bruises*, *sprains*, *abrasions*, slight *wounds*, etc.; whence its name *Fallkraut*, which may be translated *accident-plant*. It is alleged that only the infusion or decoction, and not the tincture, should be used for these purposes, a statement which popular experience would seem to contradict. Frictions with the tincture need not, however, prevent the more permanent influence of fomentations made with the flowers steeped in water or vinegar. Powdered arnica flowers are said to limit the progress of *mortification*. The watery preparations are, however, more suitable for internal use in the cases above alluded to of febrile disease, and also in those of exhaustion from shock; but their use should not prevent the more serviceable employment of alcoholic stimulants. The *dose* of the powdered root may be stated to be from ten to thirty grains. A decoction may be made with 120 grains of the root in nine fluidounces of water reduced by boiling to six fluidounces. Of this the dose is a tablespoonful or more every two hours. An infusion is made of a drachm, and from that to an ounce, of the flowers, in six fluidounces of water. *Dose*, a tablespoonful or more.

ARNOTTA.—ANNOTTA.

Orellana, Orleana.—Rocou, Terre de la Nouvelle-Orléans, F.; *Orlean,* G.

A coloring matter obtained from the seeds of Bixa orellana, *Lin.*
Nat. Ord.—Bixaceæ.

Origin and Preparation.—This medium-sized tree is indigenous to tropical America, and produces roundish, heart-shaped or subreniform capsules, containing numerous obovate, angular, whitish seeds, which are covered by a dark-red pulp. The seeds are soaked, or allowed to ferment in water, rubbed between the hands and upon a sieve, crushed, and finally completely mashed, and again washed with water. The coloring matter subsides, and is formed into cakes; the water likewise contains a coloring matter. See paper by Th. Peckolt, in *Amer. Journ. Pharm.*, 1859, p. 360. About 160,000 pounds of annotta cake and seed are annually imported into this country.

Description.—Annotta, also called *annatto*, exists in cakes which are either plastic or hard, of a nearly blood-red color, becoming red-brown on exposure, of a peculiar odor, and disagreeable saline and bitter taste. It is nearly insoluble in water, but colors it yellow, and dissolves almost completely in alcohol, ether, fixed oil and alkalies, with an orange-red or dark-red color.

Constituents.—According to the investigations of John, Kerndt (1849), Piccard (1861), Mylius (1864), and W. Stein (1867), annotta contains a yellow coloring matter soluble in water, and bright red *bixin*, which is not freely soluble in cold alcohol and ether, but readily in alkalies. Strong sulphuric acid colors it blue; nitric acid produces a yellow body of a musk-like odor. Its composition is, according to Stein $C_{15}H_{18}O_4$, according to Etti (1878) $C_{23}H_{34}O_5$. Annotta contains also a fatty acid, a turpentine-like body, and various other compounds. A. E. Ebert (1868) obtained from the air-dry seeds 5.15 per cent. of ash, the chief constituents of which are potassa, silica, and phosphoric acid.

Uses.—It is to some extent employed as a dyestuff for silk and other fabrics, for the coloring of plasters and ointments, as well as of butter and cheese. For butter-coloring annotta is digested with alcohol until completely disintegrated, and then heated with four or five times its weight of olive or other bland oil; for *cheese-coloring* a little turmeric is added.

Adulterations with ochre, brickdust, sand, gypsum, and the like, are discovered by their insolubility in hot alcohol.

ARSENICI IODIDUM, *U. S.*—IODIDE OF ARSENIC.

Arsenicum (Arsenum) jodatum.—Iodure d'arsenic, Fr.; *Arsenikjodür,* G.
Formula AsI_3. Molecular weight 456.

Preparation.—Take of Arsenic sixty grains; Iodine three hundred grains. Rub the arsenic in a mortar until reduced to a fine powder; then add the iodine, and rub them together until they are thoroughly mixed. Put the mixture into a small flask or test-tube, loosely stopped, and heat it very gently until liquefaction occurs. Then incline the vessel in different directions, in order that any portion of the iodine, which may have condensed on its surface, may be returned into the melted mass. Lastly, pour the melted iodide on a porcelain slab, and, when it is cold, break it into pieces, and keep it in a well-stopped bottle. *U. S.*

The union of the two elements is readily effected by the aid of heat, but it is difficult to produce in this way a uniform chemical compound, which, according to Berzelius, is obtained on subjecting the mechanical mixture to sublimation from a retort, the body of which is completely imbedded in sand. The officinal product, however, is sufficiently pure for medicinal purposes. It may be prepared in an ordinary prescription vial, placed in a sand-bath; after the fused mass has cooled, the vial is broken to obtain the compound; loss of iodine is thereby avoided.

Properties.—Obtained by fusion, iodide of arsenic is a glossy orange-red crystalline mass; if made by sublimation it appears in shining brick-red scales. It is soluble in boiling alcohol, crystallizing on cooling, dissolves completely in water, and volatilizes by heat without leaving any residue.

Off. Prep.—Liq. hydrargyri et arsenici iodidi. *U. S.*

Medical Action and Uses.—The action of this medicine in small doses may be called alterative; in large doses it is an irritant poison.

The continued use of from one-sixteenth to one-twelfth of a grain twice a day occasions perspiration, with dryness of the throat and intestine; sometimes headache is complained of, but neuralgic pain in the head, if it has previously existed, may disappear. At one time it was supposed on very good authority to possess the power of preventing the development of *scirrhous tumors* of the breast, but continued observation has not confirmed the belief, although it has shown that when such tumors affect persons of a feeble and cachectic constitution their progress may be retarded by the improvement of the general health under the use of this medicine. Its influence upon certain *cutaneous diseases* is more demonstrable, particularly upon psoriasis, lepra, chronic eczema, and tinea capitis; but as identical results are obtained from arsenic alone, the influence of the iodine in the combination is very questionable. The quantity of iodine in the small dose of the compound administered (one-twentieth to one-quarter of a grain) is too minute to be considered efficient. Indeed, most of the benefits said to have been derived from it were in reality obtained from mixtures of Fowler's arsenical solution with iodide of potassium in true medicinal doses. The *dose* of iodide of arsenic should at first not exceed one-twentieth of a grain three times a day, and it should gradually be increased until derangement of the stomach or dryness of the throat denotes its full effect. It is best given in solution. An ointment containing three grains of the iodide to an ounce of lard, has been used as a local application in the diseases above mentioned. Where the skin is broken it should not be employed.

ARSENICUM, *U. S.*—ARSENIC.

Arsenum, *Arsenium.*—*Arsenic*, Fr.; *Arsenik*, G.

Symbol As. Atomicity trivalent and quinquivalent. Atomic weight 75.

Origin and Preparation.—Arsenic, which is classed by some chemists with the metals, by others with the non-metallic elements, is widely diffused in nature, but is found usually in small quantities. It exists in the uncombined state as *native arsenic*, known also under the name of *cobaltum* or *flystone;* but more frequently in combination with sulphur and sulphides, as *red orpiment* or *realgar*, As_2S_2; *yellow orpiment*, As_2S_3; *arsenical pyrites* or *mispickel*, $FeS_2.FeAs_2$; *cobalt-glance*, $CoS_2.CoAs_2$; *tin-white cobalt*, $CoAs_2$; and in other minerals.

On heating arsenical pyrites in earthen cylinders, most of the arsenic volatilizes and is collected in iron receivers where it congeals. It is obtained on a small scale by mixing arsenious acid with half its weight of powdered charcoal, introducing the mixture into a crucible, covering it with a layer of granular charcoal two or three inches thick, and cementing over the crucible in an inverted position another one having a small hole drilled through the bottom; on heating the crucible the arsenious acid is reduced to arsenic, which sublimes, carbonic oxide escaping: $As_2O_3 + C_3$ yields $As_2 + 3CO$.

Properties.—It is a brittle steel-gray mass having a bright metallic lustre, gradually changing on exposure to the air to a grayish-black color devoid of gloss. Its specific gravity is 5.88 to 5.96. Heated in a sealed tube it fuses, but if heated in the open air it volatilizes without melting, at a temperature of 180° C. (356° F.), a portion of it being oxidized to arsenious acid. When immersed in water, the air dissolved in the latter oxidizes a portion to arsenious acid, which explains the use of cobaltum as a fly poison. Metallic arsenic dissolves on heating in some fixed oils, and unites readily with most of the metals, with sulphur, chlorine, iodine, and other elements.

For tests and the detection of arsenic see Acidum arseniosum.

Off. Prep.—Arsenici iodidum, *U. S.*, is the only preparation made from metallic arsenic; a larger number are prepared from arsenious acid.

Sulphides of Arsenic.—Three of these compounds are known; only two, however, are of practical importance.

REALGAR OR RED ORPIMENT, As_2S_2, is a mineral which consists of handsome orange-red scales. It is made by fusing together 5 parts of arsenious acid and 3 parts of sulphur, when sulphurous acid gas is given off. It burns with a blue flame, but, when mixed with potassium nitrate, with a brilliant white flame; a mixture for fire-works and signal lights consists of red orpiment 2 parts, sulphur 7 parts, nitrate of potassium 24 to 26 parts.

ORPIMENT, KING'S YELLOW, or AURIPIGMENTUM, As_2S_3, is likewise a mineral, crystallizes in prisms or scales, and is artificially obtained by fusing together 5 parts of arsenious acid with 4 to 5 parts of sulphur. It was formerly much employed as a pigment, at present it is used in fire-works, and occasionally, mixed with considerable lime, as a depilatory.

ARUM.—INDIAN TURNIP.

Gouet à trois feuilles, Fr.; *Dreiblättriger Aron*, G.

The tuber of Arisæma (Arum, *Lin.*), triphyllum, *Torr.*

Nat. Ord.—Araceæ.

Origin.—The plant is indigenous to North America, produces one or two leaves, which are divided into three elliptical-ovate acuminate leaflets, and a green or dark purple spathe which is convolute at the base, bent hood-like at the apex, and incloses the club-shaped spadix, having the flowers sessile at the base. The fruit is a scarlet berry.

Description.—The tuber is of a depressed globular shape, with a flat and rugose base, and slightly conical above. The numerous simple rootlets are attached to the upper half of the tuber, leaving the base free. It is of a brown-gray color externally, and internally, white, with scattered vascular bundles. It is inodorous, and has a burning acrid taste, which it retains, to some extent, for a long time, if carefully dried and preserved.

The tuberous rhizome of the European Arum maculatum, *Lin.*, is similar in appearance, but of an oblong shape, and larger than the former; in commerce it is usually found in transverse slices or pieces, which are of a mealy aspect.

Constituents.—The two tubers are most likely similar in composition, but their acrid principle has not been obtained in an isolated state. The European arum has been analyzed by Buchholz and Enz, and the American by D. S. Jones, who proved the presence of starch, sugar, gum, fat and extractive, besides the volatile acrid principle, which is soluble in ether.

Medical Action and Uses.—The juice of the fresh plant applied to the skin may cause vesication, and when a portion of the corm is chewed, it leaves in the mouth and fauces a burning and acrid taste. The acrid principle, however, is dissipated by drying and by heat. In a partially dry state the corm has been used to relieve *flatulence* and *colic*, and as a remedy for chronic *bronchitis;* but its virtues are not very decided. Its powder made into a paste with honey or syrup has been used for *aphthous* sores of the mouth; and an ointment made by stewing the fresh root with lard has been applied to *ringworm* and other local cutaneous affections. The *dose* of the powder is stated to be ten grains or more. It may be administered in honey or syrup.

ASARUM, *U. S.*—WILD GINGER.

Radix asari canadensis.—*Canada snakeroot*, E.; *Asaret du Canada*, Fr.; *Canadische Haselwurzel*, G.

The root (rhizome with rootlets) of Asarum canadense, *Lin.*

Nat. Ord.—Aristolochiaceæ.

Origin.—The plant is indigenous to North America, existing in rich woodlands as far south as South Carolina, but is more frequent in the States further north, and in Canada. The creeping rhizome sends up a very short stem, bearing at its summit two broad reniform leaves upon petioles about 6 or 8 inches in length, from the fork of which a single brownish-purple nodding flower is produced.

Description.—The rhizome is from 3 to 6 inches long, and about $\frac{1}{8}$ inch thick, somewhat bent and curved, and with few branches. It is finely wrinkled longitudinally, the internodes are about half an inch or more in length, the nodes often of a jointed appearance from the remnants of leaves and beset with several thin nearly simple radicles 2 or 3 inches in length. Externally the color is deep purplish-brown, internally whitish. The bark is about one-sixth the diameter of the rhizome, the wood is in wedge-shaped bundles, forming an interrupted circle, and inclosing a large pith. It has an aromatic odor, and a warm, pungent, and bitterish taste.

Wild ginger resembles *asarabacca*, the rhizome and rootlets of Asarum europæum, *Lin.*; the latter, however, is always thinner, about $\frac{1}{16}$ inch in diameter, and usually quadrangular in the dry state.

Constituents.—Wild ginger contains a yellowish volatile oil, and an acrid bitter resin to which its medicinal properties are probably due. Van Gorder (1876) obtained two per cent. of aromatic volatile oil and a neutral resin, having a different agreeable odor, and a pungent, warm, and lasting taste. It also contains starch, gum, fixed oil, coloring matter, and salts. The impure bitter principle of asarabacca has been named *asarin*, and the camphor-like body has been called *asaron* and *asarit*, which appear to be chemically identical, differing only in the latter separating from the watery distillate in fine crystals, while asaron or asarum camphor separates first in an oily condition before it crystallizes. It is inodorous and tasteless, has the composition, $C_{20}H_{26}O_5$, and volatilizes with the production of irritating vapors. It possibly exists also in wild ginger.

Medical Action and Uses.—Canada snakeroot is an aromatic and tonic stimulant. In hot infusion it is diaphoretic; it palliates *colic*, and is sometimes used as a stimulant in low forms of *febrile disease*, as a substitute for serpentaria. An infusion may be made with half an ounce of the root and a pint of boiling water, and given in doses of a wineglassful. The European species of asarum is not officinal. It is much more irritating than the native plant, producing violent vomiting and purging. The powder of its root is employed as an errhine.

ASCLEPIAS INCARNATA, *U. S.*—FLESH-COLORED ASCLEPIAS.

Swamp milkweed, E.; *Racine d'asclépiade incarnate*, Fr.; *Fleischfarbige Schwalbenwurzel*, G.

The root (rhizome and rootlets) of Asclepias incarnata, *Lin.*

Nat. Ord.—Asclepiadaceæ.

Origin.—The plant is indigenous to Canada and the United States as far south as South Carolina. It grows in wet grounds, and consists of a smoothish or pubescent stem about 3 feet high, bearing petiolate oblong-lanceolate and acute leaves, umbels of rose-purplish flowers, and smooth pods. The variety named *pulchra* has shorter petioles and broader hairy leaves.

Description.—The rhizome is nearly globular, an inch or less in diameter, above with several more or less elongated branches, bearing the scars of the over-ground stems and frequently remnants of the same. Externally the color is yellowish-brown; internally whitish. The bark is thin, and covers a firm wood having fine medullary rays. The rhizome is surrounded on all sides with nearly simple light-brownish rootlets about 4 to 6 inches long, having a thick, white bark and a thin, ligneous cord in the centre. In the fresh state the rhizome has a somewhat heavy odor, which is but slightly apparent after drying; the taste is sweetish, somewhat acrid, and afterwards bitter.

Constituents.—Examined by Jos. Y. Taylor (1875), the root contains a trace of volatile oil, two acrid resins, an alkaloid which was not obtained in the pure state, fixed oil, albumen, pectin, starch, glucose, and yields 8.25 per cent. of ashes.

ASCLEPIAS SYRIACA, *U. S.*—MILKWEED.

Common silkweed, *Wild cotton*, E.; *Racine d'asclépiade à la soie*, *Herbe à la ouate*, Fr.; *Schwalbenwurzel*, *Seidenpflanze*, G.

The rhizome of Asclepias syriaca, *Lin.*, s. Asc. cornuti, *Decaisne.*

Nat. Ord.—Asclepiadaceæ.

Origin.—The rather stout and smoothish stem of this common plant, which is indigenous to Canada and the United States, is about 3 or 4 feet high, nearly simple, and bears oval-oblong acute and shortly petiolate opposite leaves, which are about 6 to 8 inches long, and three or four axillary umbels near the summit of the stem, with numerous sweet-scented, light greenish-purple flowers. It grows along roadsides and in waste places.

Description.—The rhizome is horizontal, a foot or more in length, slightly branched, one-quarter of an inch and more thick; externally grayish-brown, finely wrinkled longitudinally, beset with few simple rootlets or marked with their scars, but often tuberculated or knotty from undeveloped branches or stem-scars. When dry it breaks with a short fracture, exhibiting a thin, white bark and a soft, porous, yellowish wood dissected by broad medullary rays. It is without odor, and has a bitterish unpleasant taste.

Constituents.—The root has not been analyzed, but it is likely that the milk-juice contained in it has the same constituents as the milk-juice of the plant, in which John found caoutchouc and resin, and from which List separated (1849) a white, crystalline, tasteless principle, *asclepion*, having the composition $C_{20}H_{34}O_3$; it is obtained by exhausting the congealed milk-juice with ether. Sultz found (1845) in 80 parts of the milk-juice 69 water, $3\frac{1}{2}$ wax and fat, 5 caoutchouc, $\frac{1}{2}$ gum, and 2 sugar and salts.

ASCLEPIAS TUBEROSA, *U. S.*—PLEURISY ROOT.

Butterfly-weed, E.; *Racine d'asclépiade tubereuse*, Fr.; *Knollige Schwalbenwurzel*, G.

The root of Asclepias tuberosa, *Lin.* *Nat. Ord.*—Asclepiadaceæ.

Origin.—This perennial plant is a native of the United States, south to Georgia and west to Texas, and grows in sandy fields. The large fusiform, tuberous root sends up several rather weak and branching hirsute stems, with alternate lanceolate or lance-linear leaves and a terminal corymb of numerous umbels, the flowers being of a handsome bright orange-red color.

Description.—The root is usually found in the market in pieces from 1 to 6 inches in length, and half an inch to an inch or more thick. The head is irregular, knotty, and slightly but closely annulated, and, like the longitudinally wrinkled root, externally of a brownish-orange color, and white or yellowish-white within. It has an irregular, tough fracture, a very thin bark—composed of an outer brownish and an inner white layer—and a distinctly striate meditullium composed of yellowish ligneous and large white medullary rays. It is inodorous, and has a bitterish, slightly acrid taste. When long kept it acquires a gray color externally and internally.

Constituents.—Besides the starch, which is present in considerable proportion, the root contains, according to Elam Rhoads (1861), tannin, albumen, pectin, gum, two resins—one soluble, the other insoluble in ether—fixed oil, an odorous volatile fatty matter, and a peculiar principle possessing the taste of the root, which is precipitated by tannin from the concentrated infusion. This precipitate, if decomposed by oxide of lead and exhausted by alcohol, yields it as a yellowish-white powder, which is soluble in alcohol, ether, and much water.

Medical Action and Uses.—The qualities of the three species of asclepias are practically identical; but those of *A. tuberosa* are best known. Like many other medicines, it has been alleged to possess specific powers in the cure of particular diseases; but a comparison of the reports concerning it show that it is one of the numerous class of vegetable products which under certain conditions act as emetics and even purgatives, and more commonly as sudorifics, expectorants, carminatives, and anodynes. Being an irritant, it has not escaped being ranked as a cholagogue. *A. syriaca* is said to be diuretic. Its general qualities account for its having been regarded as a valuable diaphoretic in the forming stage of *fevers*. It is, however, thought to produce sweating, not by stimulating, but by lowering the action of the heart. The same characteristics render it useful in acute *rheumatism*, *bronchitis*, *pneumonia*, and *pleurisy*, so far as sedation of the nervous and circulatory systems can do so, that is, by lessening local congestions. The "pleurisy" it is credited with relieving was most probably muscular rheumatism of the walls of the chest. Flatulent *colic* and *dyspepsia* are affections to which it has been regarded as peculiarly appropriate. The milky juice of A. syriaca applied to the skin soon becomes a tough, adhesive pellicle, and has been used to coat recent *wounds* and superficial *ulcers* and promote their cicatrization. The *dose* of the powdered root is from twenty to sixty grains. A decoction is made with an ounce of the root to a quart of water, and is given in doses of four fluidounces every two hours as a diaphoretic. A fluid extract has also been prepared.

ASPARAGUS.—ASPARAGUS.

Asperge, Fr.; *Spargel*, G.

Asparagus officinalis, *Lin.* *Nat. Ord.*—Liliaceæ, Asparagineæ.

Origin and Description.—This herbaceous perennial is indigenous to Europe, and is extensively cultivated. Its stem is four or five feet high, has the thread-like leaves (branchlets, *Gray*), clustered in the axil of a short, ovate sheathing bract (leaf, *Gray*), and small, greenish, axillary, nodding flowers, producing red berries. The following parts have been medicinally employed:—

1. ASPARAGI RADIX consists of a short horizontal rhizome, about three-quarters of an inch thick, on the upper side marked by stem-scars, and below by numerous long, whitish, nearly simple roots, which, on drying, become deeply wrinkled longitudinally. It is inodorous, and has an insipid sweetish taste.

2. ASPARAGI TURIONES, the well-known young shoots, which are used as food.

Constituents.—Examined by Dulong, the root was found to contain yellow resin, sugar, gum, albumen, chlorides, phosphates, malates, and acetates. Vauquelin and Robiquet (1805) discovered *asparagin* in the shoots, which has since been found in many other plants (see p. 139). Reinsch (1870) found in the berries considerable grape-sugar and *spargancin*, an orange-red sublimable coloring matter, soluble in ether and crystallizing in scales. The seeds contain fixed oil, aromatic resin, crystallizable sugar, and a crystallizable bitter principle, *spargin.*

Pharmaceutical Uses.—SYRUPUS ASPARAGI, which is employed in France, is prepared by dissolving 190 parts of sugar in 100 parts of the clarified juice of asparagus shoots.

The tubers of *Asparagus ascendens*, *racemosus*, and *sarmentosus*, Lin., are employed in India like salep.

Medical Uses.—The offensive odor given to the urine of persons who eat the young asparagus plant is well known; some attribute to it a diuretic virtue which there is no reason to accept; others have reported that it may cause urethritis; and one, at least, that it renders the urine saccharine. If any part of the plant is diuretic, it is probably the root. It has no true medicinal virtues.

ASSAFŒTIDA, *U. S.*, *Br.*—ASAFŒTIDA.

Asafœtida, P. G.; *Gummi-resina Asafœtida.*—*Ase fétide*, Fr.; *Stinkasant*, *Teufelsdreck*, G.

A gum resin obtained, by incision, from the living root of Narthex assafœtida, *Falconer*, and of Scorodosma fœtidum, *Bunge*, s. Ferula scorodosma, *Bentl.* Bentley & Trimen, Med. Plants, 127.

Nat. Ord.—Umbelliferæ.

Origin.—Both plants are large perennial herbs. Narthex is indigenous to Cashmir, and produces a stem 8 to 10 feet high, which is considerably branched and bears large bipinnate leaves with large, sheathing, inflated petioles, the upper of which are destitute of laminæ, and a large flat fruit with a winged margin. Scorodosma is found in the barren regions between the Sea of Aral and the Persian Gulf south to Luristan. Its stem is from 5 to 7 feet high, and has but few bipinnate leaves, which are very much smaller than the large radical leaves. The numerous umbels are crowded at the summit of the stem; and the flat and winged fruit has very inconspicuous vittæ.

Collection.—Asafœtida is obtained from the roots of both plants, which attain a considerable size, being several inches in thickness. In April, after the leaves commence to wither, a pit about six inches wide and six inches deep is dug around the root, so as to bare its upper portion, which is protected against the sun by a layer of leaves and earth and left in this condition for about forty days. Near the latter end of May the covering is removed, a slice of the root is cut off and the exuded juice scraped off on the third day. The cutting of the root, which is in the mean time sheltered from the sun, is repeated twice, after which the root remains undisturbed for a week, when the same operation is repeated, and a much thicker milk juice is obtained. After another rest of several weeks the root, early in July, is again cut, and this operation is continued until the root is exhausted.

This is substantially the account of Kämpfer, who witnessed the collection of asafœtida in Laristan in 1687. Dr. H. W. Bellew gives a similar account of the collection of asafœtida, which he observed in 1857 near Kandahar; but it differs from the former account in the statement that the newly-sprouted radical leaves and the withered stem of the previous year are cut off from the root, in the upper bare part of which deep incisions are made where the milk-juice concretes in tears, or, if very abundant, flows into the trench dug around the root.

Commerce.—Asafœtida enters commerce by way of Bombay, to which port it is shipped from Persia and from Afghanistan, the Afghanistan drug being probably derived from Narthex, and the Persian from Scorodosma. It comes packed in skins and in boxes, the purest kind, which is called *hing*, being often soft, but gradually becomes hard and translucent, and of a yellowish-brown or golden-yellow color. The brown variety, which comes principally from Abushaher and Bunder Abbas, is, according to W. Dymock (1875), the produce of Ferula alliacea, *Boissier*. The yellow variety is brought from Kandahar and is principally consumed in Northern India. The inferior qualities of asafœtida, the *hingra* of the Bombay market, are more or less adulterated at the place of collection, and constitute the varieties which are found in the European and American markets. The transparent *hing* may probably be obtained from the stem. In the fiscal year 1866–1867, 51,869 pounds of asafœtida were imported into the United States against 163,000 pounds in 1876–1877.

Description.—Occasionally asafœtida is met with in a fluid or semifluid condition of a uniformly whitish color, which gradually becomes darker. Mostly, however, it forms masses of larger or smaller opaque tears of a white color internally, which are imbedded in a yellowish- or brownish-gray sticky mass, in which gypsum, sand, and other earthy admixtures are found. It has a strong garlicky odor, and an alliaceous, acrid, and bitter taste. The white tears break with a conchoidal fracture, and the surface acquires in a few hours a bright pink color, which changes gradually to brown. When triturated with water they readily form a milk-white emulsion. Rubbed with strong sulphuric acid, then diluted with water and neutralized with an alkali, a slightly colored liquid is obtained which exhibits a bluish fluorescence. Exposed to cold, asafœtida becomes quite brittle and readily pulverizable, and when broken into small pieces and dried for a week or two over unslaked lime in a close box, it may likewise be powdered on cool days. The powder should be preserved in paper bags kept over lime, when it will retain its pulverulent condition (Hager).

A very impure asafœtida is occasionally met with, which consists altogether of earthy matter mixed with a very small proportion of the milk-juice. For medicinal uses asafœtida consisting of well-defined and large tears, and containing but little of the intervening sticky mass, should be selected.

Constituents.—The odor is due to a volatile oil, which is present to the amount of from 3 to 4½ per cent., and is a mixture of several sulphurets of ferulyl or laseryl, C_6H_{11}. It is of a light yellow color, and becomes darker on exposure to the air, acquiring at the same time an acid reaction and changing in odor. The gum amounts to between 20 and 30 per cent., and from 45 to 65 per cent. of the asafœtida is resin, a small portion of which is insoluble in ether. It contains *ferulaic acid*, $C_{10}H_{10}O_4$, which was obtained by Hlasiwetz and Barth (1866), in iridescent needles soluble in boiling water, and yielding, when fused with potassa, among other products oxalic and protocatechuic acids. Asafœtida contains also malic, formic, acetic, and valerianic acids, and yields on dry distillation a small quantity of umbelliferon.

Impurities.—Besides the earthy admixtures mentioned above, pieces of a translucent gum are sometimes found in asafœtida; they do not yield an emulsion with water. The amount of earthy admixtures in commercial asafœtida of good appearance sometimes reaches 40 per cent.

Off. Prep.—Emplast. assafœtidæ, *U. S.;* Enema assafœtidæ, *Br.;* Mistura assafœtidæ, *U. S.;* Pilulæ aloes et assafœtidæ, *U. S.*, *Br.;* Pil. assafœtidæ, *U. S.;* Pil. assafœtidæ comp. (galbani comp., *U. S.*); Spiritus ammon. fœtid., *Br.;* Suppos. assafœtidæ, *U. S.;* Tinct. assafœtidæ, *U. S.*, *Br.*

Physiological Action. *On Animals and Man.*—Experiments on animals prove the ready absorption and diffusion of the odorous principle of this substance, for when injected into the peritoneal cavity it is presently detected in the blood and the breath. Asafœtida in substance, or its essential oil, acts as a general and local stimulant, but during health the former operation is scarcely perceptible. This stimulation seems due entirely to the essential oil, and so is the peculiar garlicky or alliaceous odor exhaled by the breath and discharges of wind from the stomach and rectum. But in appropriate disorders, those especially connected with a depressed and therefore excitable condition of the nervous system, and in cases of gastro-intestinal flatulence associated with atony of the bowels, it displays incontestable and highly salutary powers. Its use as a condiment in Persia for the very same purposes for which garlic is employed in European cookery, proves it to be a stimulant of the bowels and a promoter of digestion.

Medical Uses.—Asafœtida is generally regarded as a nervine, and as remarkable for its usefulness in *hysteria*. In two ways it may influence this disease, by allaying the nervous disorder of the paroxysm when it is announced by premonitory symptoms, or by moderating its violence when fully formed; and, on the other hand, by tending to correct some of those derangements which predispose to the attacks. In the former way, however, its influence is most distinct. For this purpose it is best exhibited in enema. It is also of use in preventing or in mitigating the tympanites which is so common in hysteria. In the allied disorder, *hypochondriasis*, the medicine is often of service in removing the digestive ailments with which the mental disorder is apt to be associated. In *chronic bronchitis* attended with spasmodic dyspnœa, it is probable that asafœtida both diminishes the secretion in the lungs and controls the spasmodic element. The latter action is sometimes evident in *whooping-cough*, and possibly both may concur. When *constipation* and *tympanites* are met with, as they often are in persons of a feeble and nervous habit, this medicine is one of the very best that can be employed, either as a temporary remedy for the latter symptom, or as a more permanent cure for the former when combined with appropriate purgatives, of which aloes is the best. The compound pills of galbanum, which contain also myrrh and asafœtida, are exceedingly useful under these circumstances. But in tympanites a large enema of asafœtida mixture often gives prompt and complete relief. This condition, when it occurs in typhoid fever, may be greatly reduced by such an enema, which also acts favorably upon the typhoid element of the disease. The exhausted condition of the nervous system and the partial paralysis which often follows *nervous apoplexy*, may be removed more or less by the same means, as well as by administering the drug by the mouth. Asafœtida should not be neglected in *chorea* occurring in feeble, nervous girls about the age of puberty, particularly when the nervous disorder is accompanied with tardy or irregular menstruation.

Administration.—In substance the dose of asafœtida is from three to fifteen grains. It should be given in pill or in the officinal mixture. For prompt effect, the latter form or the tincture is to be preferred.

ATROPIA, *U. S.*, *Br.*—ATROPIA.

Atropinum, P. G.—*Atropine*, Fr.; *Atropin*, G.
Formula $C_{17}H_{23}NO_3$. Molecular weight 289.

Preparation.—Take of Belladonna Root in fine powder forty-eight troyounces; Purified Chloroform four troyounces and a half; Diluted Sulphuric Acid, Solution of Potassa, Alcohol, Water, each a sufficient quantity. Mix the powder with a pint of alcohol, and, having introduced the mixture into a cylindrical percolator, pour alcohol gradually upon it until sixteen pints have passed. From the liquid thus obtained distil off twelve pints of alcohol. To the residue add sufficient diluted sulphuric acid to give it an acid reaction, and, having evaporated the liquid to half a pint, add an equal bulk of water, and filter through paper. To the filtered liquid add, first a troyounce and a half of the chloroform, and then solution of potassa in slight excess, and shake the whole together, at intervals, for half an hour. When the heavier liquid has subsided separate it, and, having added a troyounce and a half of the chloroform to the lighter liquid, again shake them together, and separate the heavier from the lighter liquid as before. Add to this lighter liquid the remainder of the chloroform, and, after agitation, separate the heavier liquid for the third time. Mix the heavier liquids in a capsule, and set the mixture aside until, by spontaneous evaporation, the atropia is left dry. *U. S.*

Take of Belladonna Root recently dried and in coarse powder two pounds; Rectified Spirit ten pints; Slaked Lime one ounce; Diluted Sulphuric Acid, Carbonate of Potash, each a sufficiency; Chloroform three fluidounces; Purified Animal Charcoal a sufficiency; Distilled Water ten fluidounces. Macerate the root in four pints of the spirit for twenty-four hours, with frequent stirring. Transfer to a displacement apparatus, and exhaust the root with the remainder of the spirit by slow percolation. Add the lime to the tincture placed in a bottle, and shake them occasionally several times. Filter, add the diluted sulphuric acid in very feeble excess to the filtrate and filter again. Distil off three-fourths of the spirit, add to the residue the distilled water, evaporate at a gentle heat, but as rapidly as possible, until the liquor is reduced to one-third of its volume and no longer smells of alcohol; then let it cool. Add very cautiously, with constant stirring, a solution of the carbonate of potash, so as nearly to neutralize the acid, care, however, being taken that an excess is not used. Set to rest for six hours, then filter, and add carbonate of potash in such quantity that the liquid shall acquire a decided alkaline reaction. Place it in a bottle with the chloroform, mix well by frequently repeated brisk agitations, and pour the mixed liquids into a funnel furnished with a glass stopcock. When the chloroform has subsided, draw it off by the stopcock, and distil it by a water-bath from a retort connected with a condenser. Dissolve the residue in warm rectified spirit; digest the solution with a little animal charcoal; filter, evaporate, and cool until colorless crystals are obtained. *Br.*

The British process is that proposed by Mein, except that the alkaloid, instead of being simply precipitated from the watery solution of its sulphate, is removed by agitation with chloroform, in accordance with the suggestion of Rabourdin (1850). The lime, on being agitated with the tincture of the root, removes considerable resin and fat; the little lime which enters into solution being afterwards precipitated by sulphuric acid as sulphate of calcium, while the atropia remains in the liquid as sulphate, which is readily soluble in alcohol and water. On neutralizing the free acid with carbonate of potassium, another quantity of resin is separated, and on rendering the liquid alkaline the atropia is set free, and is taken up by the chloroform on being agitated with it. Treatment with alcohol and animal charcoal is resorted to for the purpose of removing the last traces of coloring matter, and obtaining the alkaloid crystallized.

A process similar to the preceding was proposed by Prof. Wm. Procter, Jr., in 1860, who, after treating the tincture with lime and sulphuric acid, and evaporating the alcohol, as described above, removed most of the remaining oil and resin by diluting the residue with water, filtering, and agitating with chloroform, in which the sulphate of atropia is insoluble; after the addition of caustic potassa, chloroform was used for extracting the alkaloid, of which 0.39 per cent. was obtained in a crystalline condition and of a fawn color, which was removed by treating the alcoholic solution with animal charcoal.

The U. S. process arrives at the same result by converting the alkaloid contained in the tincture of belladonna root into a sulphate. After most of the alcohol has been distilled off, the residuary liquid is poured into water, which retains the sulphate of atropia in solution, while nearly all the resin and oil are separated and removed by filtration. By means of potassa and chloroform, the alkaloid is obtained, on evaporating the latter, in yellowish crystals, which, although sufficiently pure for medicinal purposes, may contain variable amounts of impurities; these, however, are removed without much trouble and loss, by the treatment described above.

In all the above-mentioned processes it is of importance that the treatment with the alkalies and alkaline carbonate should take place at a low temperature and not be unnecessarily prolonged, since carbonate of potassium alters the atropia when acting upon its aqueous solution at an elevated temperature; caustic potassa effects a similar decomposition already in the cold during a contact for 24 hours.

Properties and Tests.—Pure atropia is in colorless acicular crystals, that of the U. S. Pharmacopœia yellowish-white. It is without odor, and has a disagreeably bitter and acrid taste. It fuses at 90° C. (194° F.), volatilizes at 140° C. (284° F.), partly unchanged, and at a higher heat is completely decomposed, leaving no residue. It dissolves in about 300 parts (450 parts, *Brandes*) of cold water, in 25 parts (36 parts, *Brandes*) of ether, in 3 parts of chloroform, 38 parts of olive oil, also in glycerin and in little alcohol. It has a strong alkaline reaction and neutralizes acids, forming crystallizable salts, which are soluble in water and alcohol, but insoluble in ether and chloroform. Its solutions are precipitated by chloride of gold, iodine, iodo-hydrargyrate of potassium and tannin, but not by platinic chloride, except when very concentrated. Concentrated nitric acid dissolves atropia with a yellow color, the solution, when heated, turning orange-red and then becoming colorless. Concentrated sulphuric acid yields with atropia a colorless solution, becoming red and black when heated, emitting, according to Gulielmo (1863), an odor resembling orange flowers. When heated with baryta water, soda, or strong hydrochloric acid, atropia is decomposed, yielding tropic acid $C_9H_{10}O_3$, atropic and isatropic acids $C_9H_8O_2$, and tropia, which is a crystallizable strongly alkaline compound having the formula $C_8H_{15}NO$. According to Hübschmann (1858) commercial atropia frequently contains an uncrystallizable alkaloid *belladonnia*, which is sparingly soluble in water, and has a faintly bitter, burning, acrid taste. It may be removed from atropia by adding to the watery solution of the salt a small quantity of carbonate of potassium when it is precipitated, before any atropia is liberated. In 1850, von Planta stated atropia to be chemically identical with daturia, the alkaloid of stramonium; and since that time it is said the latter alkaloid has not unfrequently been manufactured and sold as atropia, notwithstanding the researches of von Schroff and others have proved it to exert a more powerful physiological action than the latter. A. Poehl (1877) has pointed out the following differences between the two alkaloids: Atropia is optically inactive; but daturia turns polarized light to the left, its specific rotating power being —14.12°. Atropia salts are precipitated by platinic chloride, but daturia salts are not affected by the same reagent. Atropia salts are not precipitated by picric acid, which, however, precipitates daturia salts.

Off. Prep.—Atropiæ sulphas, *U.S.*, *Br.;* Liquor atropiæ, Unguent. atropiæ, *Br.*

ATROPIÆ SULPHAS, *U. S.*, *Br.*—SULPHATE OF ATROPIA.

Atropinum sulfuricum, P. G.—*Sulfate d'atropine*, Fr.; *Schwefelsaures Atropin*, G.

Formula $2C_{17}H_{23}NO_3.H_2SO_4$. Molecular weight 676.

Preparation.—Take of Atropia sixty grains; Stronger Ether four fluidounces and a half; Sulphuric Acid six grains; Stronger Alcohol a fluidrachm. Dissolve the atropia in the ether; then mix the acid and alcohol, and add the mixture, drop by drop, to the ethereal solution until the atropia is saturated. Allow the liquid to stand until the precipitate formed is deposited. Then decant the ether, and allow the residue to evaporate spontaneously until the salt is left dry. *U. S.*

Take of Atropia one hundred and twenty grains; Distilled Water four fluidrachms; Diluted Sulphuric Acid a sufficiency. Mix the atropia with the water and add the acid gradually, stirring them together until the alkaloid is dissolved and the solution is neutral. Evaporate it to dryness at a temperature not exceeding 37.7° C. (100° F.). *Br.*

Both processes yield the salt in a pure state, if care is taken to have the solutions perfectly neutral, and to avoid the application of heat. The U. S. process is modelled after that of Ch. Maitre, proposed in 1856; by it most of the salt is precipitated from the ether after it has been formed by the addition of the acid, the small portion remaining in solution being recovered by spontaneous evaporation.

Properties.—Sulphate of atropia forms a white somewhat crystalline powder, which is insoluble in ether and chloroform, but freely soluble in water and alcohol, the solutions being neutral to test-paper, and yielding a white precipitate with chloride of barium. If dissolved in 250 parts of water, the solution is not rendered turbid by carbonate of potassium unless belladonna be present. The salt leaves no ash if burned with free access of air.

Off. Prep.—Liquor atropiæ sulphatis. *Br.*

Physiological Action. *On Animals.*—Herbivorous animals and birds are but little affected by doses of atropia which are fatal to carnivora; pigeons will often recover after the hypodermic injection of two grains of the alkaloid, and their pupils are not dilated by any dose of it. Even upon dogs the toxical action of atropia is relatively slight. The injection of two or three grains into the cellular tissue of these animals may produce a staggering gait and agitation; and the same quantity thrown into the crural vein, although it may cause rigidity and apparent death, will not necessarily destroy the animal's life. In a few hours it may appear entirely well. The action upon the several physiological systems varies with the dose of atropia. In non-poisonous doses it causes great acceleration of the heart's action with diminished vascular tension, while a general quieting effect on the cerebro-spinal system is observed. Poisonous doses seem to render morbidly acute the general and the special senses, although the perceptions do not appear to be normal, and there is no tendency to narcotism. Death appears to be due to exhaustion of the forces which move the heart and the respiratory organs, and is preceded by general muscular paralysis. On examination, the heart, lungs, and brain are found surcharged with blood. A vast amount of labor in experiment and ingenuity in reasoning have been employed to illustrate and explain the mode of action of atropia in producing these phenomena. Even if the results were uniform their rationale would be uncertain, for the most contradictory explanations of identical phenomena are proposed by different experimenters, and necessarily so, since the physiological laws upon which the phenomena depend are as far as possible from being determined. But the results of apparently identical experiments are also the reverse of constant and uniform; and hence the only purpose for which they can interest physicians is unattained.

On Man.—The hypodermic injection of one-twentieth of a grain of atropia causes the pulse in twenty minutes to rise from 72 to 110, the mouth to grow dry, and the pupils to begin to dilate, the sight grows indistinct, and usually there are grotesque hallucinations, and sometimes actual delirium; there is giddiness with an inclination to sleep, and the dryness of the mouth and throat may last for twenty-four hours, with more or less nervousness, and instability in walking. In a case in which an excessive quantity of the alkaloid was applied to a blistered surface, there was, besides the above-mentioned symptoms, dyspnœa with dysphagia, injection of the conjunctiva, and choreic movements of the limbs; the pulse grew thready, and the patient died within two hours. In other cases a striking degree of cutaneous anæsthesia has been observed, and to this effect may be attributed in part the inability to direct the movements of the limbs to definite purposes, such as grasping small objects, etc. The effect of atropia applied to the eye in causing dilatation of the pupil has been diversely explained, one view being that the medicine paralyzes the oculo-motor and excites the sympathetic and trigeminus nerves. These opposite actions of the same agent, at the same moment, it is true, are not very intelligible. It is apparently proved by ordinary clinical experience, as well as by physiological experiment, that the action of atropia upon the pupil is essentially a local one; but whether it is the result of combined actions upon the muscles of the iris, or of a single one which is stronger than the normal opposing force, or whether it it not due in part to the power of the agent to contract the bloodvessels which supply the iris, are questions which are not, perhaps, conclusively settled. Ampler details upon the action of atropia will be found under the head of *Belladonna.*

Medical Uses.—For the relief of *pain*, atropia is, next to opium, of the highest value, and especially for two of its severest forms, the pain of *neuralgia* and the pain of *spasm.* It should be employed in both hypodermically. As with other anti-neuralgic remedies, sciatica is the most unyielding, and intercostal neuralgia the most amenable, to this medicine. Neuralgia of the trigeminus holds in this respect a middle position. Spasm itself, as it occurs in *tetanus* and in *poisoning by strychnia*, has been successfully combated by the hypodermic use of atropia. In such cases the dose must be large, being not less than one-twentieth of a grain repeated at intervals of not more than an hour, until its characteristic effects are developed. Various other forms of spasm are more or less subject to the power of this medicine. They will be found more fully described in connection with belladonna; but it may be stated that almost every form of spasmodic affection may be controlled by that medicine or by atropia. It may be mentioned here, however, that sulphate of atropia administered hypodermically in the dose of from one-hundredth to one-fiftieth of a grain has prevented the full development of the *epileptic* paroxysm and lessened the frequency of its occurrence. The following spasmodic disorders may also be particularly referred to: spasm of the *anus*, the *urethra*, the *bladder*, the *ureter*, the *uterus*, the *vagina*, the *rectum*, the *large and small intestine*, the *biliary ducts*, the *bronchia*, the *larynx*, the *œsophagus*, etc. In all of these affections the hypodermic injection of atropia may be substituted for the use of any preparation of belladonna internal or local. In the very opposite condition which occurs in poisoning by *Calabar bean*, it has been proved that atropia is a true antidote in nearly the whole range of its action. But atropia counteracts or prevents the lethal action of physostigma, even by quantities which are far below the minimum fatal dose of the former. Sulphate of atropia should be injected subcutaneously in doses of from one-fiftieth to one-thirtieth of a grain, and repeated until the pupils become dilated, the pulse-rate increased, and the secretion of bronchial mucus is checked. The effects of *heat exhaustion* (one of the forms of sunstroke) have been treated with alleged success by the hypodermic injection of atropia; strengthening the heart, stimulating the brain, restoring consciousness, and preserving life.

In various diseases of the eye the use of atropia is peculiarly appropriate; it is now universally employed for dilating the *pupil* so as to permit the inspection of the parts behind the iris, to facilitate the operation for *cataract*, and to prevent prolapse of the *iris* in cases of wounds and perforating ulcers of the cornea. In inflammations, also, of the cornea and of the iris it diminishes the congestion of the eye, and thereby lessens the pain and the photophobia, as well as favors the healing of ulcers in the former tissue; and when *prolapse* of the iris takes place through a corneal ulcer, or when adhesion occurs between the two, the action of atropia, by contracting the iris towards its periphery, tends to prevent permanent deformity of the organ and impairment of the sight. *Myopia*, or short-sightedness, being sometimes produced by excessive use of the eyes, through spasm of accommodation, may sometimes be prevented from reaching its full development by resting the organs, and maintaining for several weeks a paralysis of accommodation by means of atropia. It is probably through the power involved in these operations that atropia has been found efficient in cases of *profuse sweating* and also of *sialorrhœa* and *galactorrhœa*. The antagonism of atropia and morphia will be more conveniently discussed in the article on *Belladonna*. The antagonism of atropia and *prussic acid* has been both maintained and denied; but even if it were real in a physiological sense it would practically be of little importance, since the action of a lethal dose of prussic acid cannot be overtaken by the slower movements of atropia. The antagonism of atropia and *strychnia* has been shown in poisoning by the latter alkaloid; the hypodermic injection of atropia being followed by a decline in the number and severity of the spasms until they ceased to threaten life.

Administration.—A solution of atropia used for any of the above purposes, including hypodermic injection, should not exceed the strength of one part in one hundred of water. It may be applied by means of a fine camel's-hair brush while the lower punctum lacrymale is compressed to prevent the passage of the solution into the nasal passages and its consequent absorption. Several cases of atropia poisoning have arisen in this manner. Thin gelatine disks, containing about the quantity mentioned of the salt, are sometimes inserted between the lower lid and the eyeball, in order to prevent the accident just alluded to. An ointment of atropia may be used containing one grain of the alkaloid to a drachm of lard.

AURANTII AMARI CORTEX, *U.S.*—Bitter Orange Peel.

Aurantii cortex, Br.; *Cortex fructus aurantii*, P. G.; *Cortex aurantiorum, Cortex pomorum aurantii.—Écorce (zestes) d'oranges amères, Écorce de bigarade*, Fr.; *Pomeranzenschale*, G.

The rind of the fruit described below.

AURANTII FRUCTUS, *Br. Add.*—Bitter Orange.

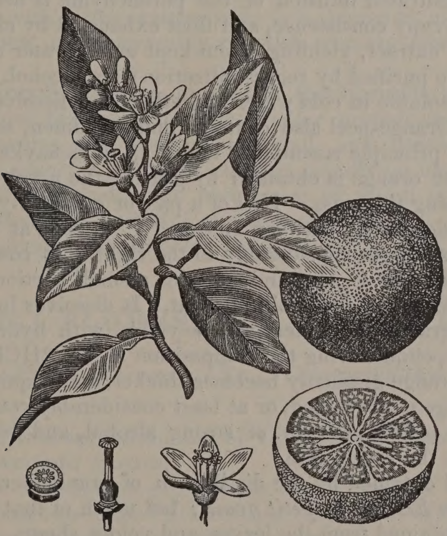
Poma aurantiorum, Aurantia.—Seville orange, E.; *Orange amère, Bigarade*, Fr.; *Pomeranzen*, G.

The ripe fruit of Citrus vulgaris, *Risso;* s. C. aurantium, var. amara, *Lin.;* s. C. Bigaradia, *Duhamel.*

Nat. Ord.—Aurantiaceæ.

Origin.—The Bigarade orange is a small tree, which is indigenous to the northern portion of India, but is largely cultivated near the Mediterranean, and in some of the West India Islands, and in that part of the United States which borders on the Gulf of Mexico. It closely resembles the sweet orange, excepting the fruit, leaves, and flowers; the latter being more fragrant.

Fig. 14.



Citrus vulgaris, *Risso.*

Description. 1. The Fruit.—The unripe fruit falling from the tree is collected and extensively used on the continent of Europe, where it is known as orange-berries (*E.*), *orangettes* or *petits grains* (*Fr.*), *Unreife Pomeranzen* (*G.*), and is officinal as Fructus (Baccæ) aurantii immaturi *vel* Aurantia immatura. They are globular or ovate-globose, one-eighth to three-quarters of an inch in diameter, with a circular depressed scar at the base, surrounded by eight or twelve smaller depressions, and with a slightly projecting remnant of the style at the apex. They are greenish to brownish-black in color, densely rugose, and consist of eight to ten or twelve cells, having a central placenta, and two rows of seeds in each cell. Their odor is agreeably aromatic, their taste aromatic and bitter, the aromatic properties being due to a volatile oil, which is contained in large oil-cells situated in the pericarp near the epidermis.

The ripe fruit is of the size and shape of a sweet orange, but is rougher externally, and of an orange-red color, the spongy parenchyma underneath being white, and the juice having an acid and bitter taste. It has been made officinal in the British Pharmacopœia for the purpose of preparing the Tinctura aurantii recentis.

2. THE PEEL.—Orange-peel is dried in slices, and usually forms flat or curved elliptical pieces, about three inches long, and one-eighth of an inch or more in thickness. The reddish-brown surface is of an uneven, somewhat granular appearance, covering the numerous large oil-cells and the spongy white parenchyma. The Curaçao orange-peel is obtained from a variety of the bitter orange cultivated in the Island of Curaçao. It is scarcely half the thickness of the ordinary orange-peel, and externally of a dark-greenish color. The commercial article sold under this name frequently consists merely of thin slices or spiral bands cut from the fully-developed but still unripe fruit grown elsewhere. Orange-peel is gratefully aromatic in odor, and has an aromatic and bitter taste. The white parenchyma is colored yellow by alkalies, and black by ferric salts.

3. THE LEAVES are smooth, ovate, or ovate oblong, entire, pellucid-punctate, aromatic, and have a jointed petiole, with a broadly obovate or obcordate wing.

Constituents.—The white parenchyma of orange and lemon-peel contains a crystalline principle, which was named *hesperidin* by Lebreton, its discoverer (1828); the concentrated infusion of the parenchyma is neutralized with lime, evaporated to a syrupy consistence, and then exhausted by alcohol, which leaves a granular, bitter extract, yielding, when kept under water or distilled vinegar, crystals, which are purified by recrystallization from alcohol. It has a bitterish taste, is almost insoluble in cold water and ether, and dissolves in ammonia with a yellow color. Orange-peel also contains gum, albumen, some fixed oil, resin, volatile oil, and a principle resembling tannin in its behavior to iron salts.

The oil of bitter orange is obtained by grating the nearly ripe fruit superficially and expressing the mass. It is of a pale or greenish-yellow color, limpid, varies in its specific gravity between 1.83 and 1.88, boils at 180° C. (356° F.), and rotates polarized light considerably to the right. It consists mainly of the hydrocarbon *hesperidene* $C_{10}H_{16}$, and contains a small portion of an oxygenated body $C_{10}H_{16}O$, having a higher boiling point. It dissolves in from 7 to 10 parts of alcohol, spec. grav. 0.85. Hesperidene yields, with hydrochloric acid gas, a crystallizable compound having the composition $C_{10}H_{16}.2HCl$. Exposed to the air, oil of bitter orange gradually becomes thicker, and acquires a terebinthinate odor. This change is prevented, or at least considerably retarded, by adding to the oil from three to five per cent. of strong alcohol, and decanting or filtering, if necessary, from the precipitate.

The volatile oil obtained by the distillation of orange-berries with water was formerly known as *Essence de petit grain;* but much of that which is now found in commerce is obtained from the leaves and young shoots. In chemical composition it resembles the oil of orange, but differs from it in odor, which varies even to some extent in the different cultivated varieties of the bitter orange.

Off. Prep. of the Fruit.—Tinct. Aurantii recentis, *Br.* *Of the peel:* Infus. Aurantii, Infus. Aurantii comp., *Br.* Infus. Gentianæ comp., *U. S.*, *Br.* Mistura Gentianæ; Spirit. Armoraciæ comp., *Br.* Tinct. Aurantii, Tinct. Cinchonæ comp., Tinct. Gentianæ comp., *U. S.*, *Br.*

Physiological Action and Uses.—Orange peel is a mild stimulant of digestion in consequence of its containing an essential oil, which, in the fresh bitter orange, is endowed with very active irritant properties, and acts upon the nervous system, in small doses, stimulating it, but in large doses, or by continued use, depressing and deranging all the nervous functions. Dried orange peel and its preparations are employed along with pure bitters to render these medicines stimulant and more acceptable to the stomach, as well as to improve their taste. They are also associated with purgatives which tend to *gripe*, or when the bowels are *flatulent*. Orange peel is prescribed as an addition to many infusions and decoctions. It should not be added to the latter until ebullition has terminated.

AURANTII DULCIS CORTEX, *U. S.*—SWEET ORANGE PEEL.

Cortex aurantiorum dulcium.—Ecorce (*Zestes*) *d'oranges douces*, Fr.; *Apfelsinenschalen*, G.

The rind of the fruit of Citrus aurantium, *Risso*, s. Cit. dulcis, *Lk.* Woodville, Med. Bot. 188; Risso, Hist. Orang. 3, 39; Bentley and Trimen, Med. Plants, 51.

Nat. Ord.—Aurantiaceæ.

Origin.—This variety of the orange tree, known as the sweet or Portugal orange, is extensively cultivated in warm countries; it differs from the preceding in the leaves having the petioles more narrowly winged, and in the fruit having an agreeable sweetish acidulous taste; many varieties have been produced by cultivation.

Description.—Sweet orange peel agrees in structure and in most of its physical properties with bitter orange peel; it is, however, always of a lighter and more yellow color, of an agreeably sweetish aromatic odor, and of a slightly bitterish taste.

Its composition is the same as that of the bigarade orange, except the bitter principle, which is present in much smaller proportion. The volatile oil is obtained by grating and pressing the rind, and consists mainly of the hydrocarbon *hesperidene*, $C_{10}H_{16}$. It changes rapidly on exposure to the air, acquiring a turpentine-like odor, the occurrence of which is prevented or retarded by the addition to the oil of 5 per cent. of alcohol.

Off. Prep.—Confectio aurantii cort., Syrup. aurantii cort., *U. S.*

AURANTII FLORES, *U. S.*—ORANGE FLOWERS.

Flores naphæ.—Fleurs d'oranger, Fr.; *Orangenblüthen, Pomeranzenblüthen*, G.

The flowers of Citrus aurantium and of C. vulgaris, *Risso*.

Origin.—See Aurantii fructus.

Description.—The flowers grow singly in the axils of the upper leaves, and consist of a small cup-shaped five-toothed calyx, and of five oblong, obtuse, fleshy and glandular punctate petals, which are white, or in the dried state pale brownish-white, and about $\frac{1}{2}$ inch long. The numerous (about 20) stamens are united at their base into 3 or more bundles. The globular ovary rises from a small fleshy disk, and bears a cylindrical style with a globular stigma. Orange flowers have a highly fragrant odor, the bitter variety being more aromatic than the sweet; their taste is aromatic and bitterish.

Lemon flowers are externally of a reddish color, and have a different odor.

Constituents.—Boullay found (1828) in orange flowers, besides the volatile oil, gum, bitter extractive, acetic acid and salts. The volatile oil known in commerce as *oil of neroli* is obtained in the preparation of orange-flower water, upon the surface of which it separates in small proportion. According to Flückiger and Hanbury, it is of a brownish hue, a bitterish aromatic taste, neutral to test-paper, of the density of 0.889, exhibits a bright violet fluorescence when mixed with alcohol, and assumes an intense permanent crimson hue on being shaken with a concentrated solution of bisulphite of sodium. It is a hydrocarbon, $C_{10}H_{16}$, containing a small quantity of inodorous crystallizable camphor. The commercial oil of neroli is very frequently adulterated with oil of bergamot and orange leaves.

Pharmaceutical Uses.—Orange flowers are employed in the fresh state for making Aqua aurantii florum.

Medical Action and Uses.—Orange flowers are chiefly used to prepare a distilled water which is an agreeable vehicle for some medicines, and is believed to stimulate the nervous system slightly, allaying its superficial disorders in very susceptible persons.

AURUM.—GOLD.

Or, Fr.; *Gold*, G.

Symbol Au. Atomicity univalent and trivalent. Atomic weight 196.7.

Origin and Properties.—This well-known metal is chiefly found in the metallic state, always associated with other metals, and frequently in various native sulphurets. It is the most ductile of all metals, softer than silver, fuses at nearly 1200° C. (2200° F.), has the density 19.3, and is of a reddish-yellow color and metallic lustre, but when powdered of a brown color, acquiring lustre by pressure. It is not altered by exposure to air and water, and does not dissolve in acids, but is soluble in liquids containing or generating chlorine. The following preparations of gold have been used :—

AURUM FOLIATUM, *gold-leaf*, is used for coating pills; is transparent with blue or green color; it should not be attacked by nitric acid, nor become tarnished by ammonia.

AURI PULVIS, *powdered gold*, may be prepared by triturating gold-leaf with crystals of milk sugar, potassium sulphate, or other hard soluble substance, until the metallic lustre has completely disappeared, when the compound is washed out with water. A solution of chloride of gold yields the metal in a finely divided condition when added to solution of ferrous sulphate, oxalic acid, or other oxidizable compound.

AURI CHLORIDUM, *chloride of gold*, or *auric chloride*, $AuCl_3$, is obtained by dissolving pure gold in nitro-muriatic acid, evaporating to dryness, dissolving in water, filtering from some aurous chloride, AuCl, and again evaporating. It has a dark-red or red-brown color, is decomposed above 150° C. (302° F.), dissolves readily in water, and is also soluble in alcohol, ether, and volatile oils, which solutions are gradually reduced.

AURI ET SODII CHLORIDUM, *Auro-natrium chloratum*, P. G., *chloride of gold and sodium.*—The French Codex orders the crystallized double salt, $NaCl.AuCl_3.2H_2O$, to be prepared by dissolving the auric chloride prepared from 110 parts of gold in sufficient distilled water, adding 3 parts of chloride of sodium, and evaporating to crystallization. It forms orange-colored rhombic prisms, which are soluble in water.

It is more frequently prepared with an excess of sodium chloride, according to the German Pharmacopœia, by dissolving 65 parts of gold in 260 parts of nitro-muriatic acid, evaporating until it is capable of solidifying on cooling, adding 100 parts of powdered chloride of sodium, and reducing the whole to a uniform powder, which is of an orange-yellow color, and from which alcohol dissolves half its weight of auric chloride.

AURI ET AMMONII CHLORIDUM, *ammonio-chloride of gold.*—Equal parts of auric chloride and chloride of ammonium are dissolved in water, acidulated with hydrochloric acid, and the solution evaporated to dryness (Dorvault). It resembles the preceding.

Auri cyanidum, *cyanide of gold*, is best prepared, according to Figuier (1847), by dissolving pure auric chloride in water, and adding a solution of an equivalent weight of pure potassium cyanide, when a lemon-yellow precipitate will be obtained; a larger quantity of the latter solution would change the color to brownish or orange-yellow. It is inodorous and tasteless, and contains 75 per cent. of gold.

Auri iodidum, *iodide of gold*, AuI_3, is obtained by precipitating a solution of auric chloride with potassium iodide, avoiding an excess of the latter, washing with water, and drying carefully. It is a dark green powder, which is soluble in solution of potassium iodide, and on exposure loses iodine, being first converted into yellow *aurous iodide*, AuI, and finally into metallic gold.

Auri oxidum, *auric acid*, *hydrate* (*oxide*) *of gold*, AuH_3O_3.—Pelletier directs the boiling of a solution of auric chloride with an excess of magnesia or oxide of zinc, collecting the precipitate upon a filter, and washing it first with dilute nitric acid (which must be free from chlorine) and afterwards with water. Fremy (1850) adds to auric chloride sufficient solution of potassa until the precipitate is redissolved, the solution is boiled for fifteen minutes, or until its dark-brown color has changed to light yellow, when it is acidulated with sulphuric acid, and the precipitate washed and dried; it retains a trace of potassium. Hydrate of gold is a blackish-brown powder, which is readily soluble in hydrochloric and hydrobromic acids, and when heated to 245° C. (473° F.) or boiled with alcohol, yields metallic gold.

Physiological Action.—Its action has, to some extent, an analogy with that of mercury; its salts producing local effects varying between irritation and causticity, and internally developing a state of erethism which resembles strongly mercurial fever. Within this limit it is represented as stimulating the functions generally, and in man especially the genital activity, while in women it is said to augment the menstrual flux. Some of the most dĕtailed and minute descriptions of its effects are due to the poetical observations of Italian physicians (Gozzi).

Medical Uses.—It appears that gold compounds, when persistently employed, may, through the febrile erethism above referred to, tend to eliminate the *syphilitic* poison from the system, and arouse the sluggish vital forces as they exist in *scrofula*. Indeed, it is said that this action sometimes goes so far as to produce a destructive activity in the morbid process. It is unnecessary to enter into any detail respecting a medicine which has deservedly fallen into disuse; it may suffice to state that powdered gold or its oxide is applied by friction upon the sides of the tongue in the dose of from one-fifth of a grain to three or four grains daily. The oxide is given internally in pill, and in the dose of one-tenth of a grain, after meals, and gradually augmented. Chloride of gold and sodium is a caustic, but in a diluted condition may be applied to the interior of the mouth, as above mentioned. The salivation which follows this manœuvre is due to a local and not to a constitutional action of the metal.

AVENÆ FARINA, *U. S.*—Oatmeal.

Farine d'avoine, Fr.; *Hafermehl*, G.

The meal prepared from the seed of Avena sativa, *Lin.*

Nat. Ord.—Graminaceæ.

Origin.—The native country of oat has not been ascertained. It is cultivated in most civilized countries, and many varieties have been produced, all having a loose panicle and two-flowered spikelets. The fruit is closely invested by the paleæ, lanceolate, pointed and grooved on one side. Oats deprived of the paleæ or husk are called *groats.* By grinding the grains oatmeal is obtained.

Description.—Oatmeal is a grayish-white not uniform powder, in which fragments of the tissue are observed by the naked eye; it has a slight odor and a somewhat bitterish taste. Viewed under the microscope, the starch consists of medium-sized polyhedral or mullar-shaped granules, with a rather distinct hilum, but without observable laminæ. Frequently two or three are united, or even a larger number, forming a nearly spherical mass with a checkered surface, and readily separating by pressure into the separate granules.

Constituents.—Oats consist on an average of 25 per cent. of husks and 75 per cent. of grain; the former contain 1 to 1½ per cent. of fixed oil, ½ to ¾ per cent. of sugar and gum, nearly 2 per cent. of protein compounds, and 6½ to 7 per cent. of ash, the remainder being cellulose. The grain contains 64½ to 66 per cent. of starch, 5 to 7 of fat, 18 to 21 per cent. of protein compounds, 1 to 3 per cent. of salts, the remainder being sugar, gum, and cellulose. The largest portion of the protein compounds is *avenin,* which may be obtained from oatmeal, by treating it in the cold with a weak solution of potassa, decanting from the sediment, and precipitating by acetic acid; the impure avenin is washed with diluted and strong alcohol and ether, redissolved in weak potassa solution, and precipitated by acetic acid (Kreusler, 1869). Avenin closely resembles legumin in its behavior to solvents; it contains 17 per cent. of nitrogen and ¾ to 1 per cent. of oxygen.

Medical Action and Uses.—Oatmeal is an excellent article of food, but is apt to undergo fermentation in the stomach, producing flatulence and sour eructations. It is more nutritious than the purely starchy articles, such as arrowroot and sago; and being somewhat laxative, in consequence partly of its usually containing a proportion of bran, it forms an appropriate article of diet in cases of habitual *constipation* from inertia of the intestines. This insoluble bran is, however, prone to accumulate, and sometimes to form concretions. Oatmeal gruel is prepared by boiling from one to two ounces of oatmeal with three pints of water, until reduced to two pints, straining the decoction, allowing it to stand until cool, and then rejecting the supernatant liquid. Its flavor may be improved by the addition of raisins towards the end of the boiling, and also by means of sugar and nutmeg.

AZEDARACH, *U. S.*—AZEDARACH.

Pride of India, Pride of China, E.; *Ecorce d'azédarach, Ecorce de margousier,* Fr.; *Zedrachrinde,* G.

The bark of the root of Melia azedarach, *Lin.* *Nat. Ord.*—Meliaceæ.

Origin.—Azedarach is a handsome tree which is indigenous to China and India, and cultivated as an ornamental tree in the United States, from Virginia southward, and in Southern Europe. It attains a height of 30 to 40 feet, has large deciduous and glabrous bipinnate leaves, the leaflets being lance-ovate, acuminate and serrate, and bears panicles of lilac-colored fragrant flowers and yellowish globular drupes of the size of a cherry, which, by fermentation, yield considerable alcohol. In the East Indies the bark of the *nim tree* or *margosa,* Melia azadirachta, *Lin.,* which has simply pinnate leaves, is used as a tonic and febrifuge. Bentley & Trimen, Med. Plants, 62.

Description.—The bark is met with in irregular curved pieces and quills, one or a few inches long and a quarter of an inch or more in diameter. The first layer of corky tissue is thin, of a blackish-brown color, somewhat glossy, and forms irregular longitudinal ridges or patches upon the bright red-brown cork underneath. In older barks, the corky layer is rust-brown and two or three times thicker than the remaining portion of the white inner bark, which contains few scattered, pale-yellow bast fibres, and is tangentially striate. The inner surface is uneven and longitudinally striate. The bark breaks with a short and smooth, and in the inner portion more or less fibrous, fracture. The cork has very little taste, but the inner bark is at first sweetish, afterwards bitter and nauseous. It should be collected from the smaller roots, or deprived of the thick corky layer.

Constituents.—Nothing is known concerning the medicinal principles of this bark, except what is indicated by its sensible properties. Its constituents may be analogous to those of the *margosa* or *nim bark*, from *Azadirachta indica*, Tuss. (Melia azadirachta, *Lin.*), in which Broughton (1873) found a bitter, dark-brown, resin-like principle, $C_{36}H_{50}O_{11}$, which is slightly soluble in water, but dissolves in alcohol, benzol, carbon bisulphide, and ether. Another amorphous principle, more soluble in water, and a crystalline fatty substance were likewise obtained. Cornish (1856) had separated a bitter crystalline principle, *margosin*, besides volatile oil, resin, and other widely diffused constituents.

Physiological Action and Medical Uses.—Even from the times of the Arabian physicians the poisonous properties of azedarach have been known, and then, as now, it was stated to have produced faintness, giddiness, dimness of sight, mental confusion and vomiting; later observers have added to these symptoms stertorous breathing, stupor, dilatation of the pupils, cold sweat, and purging. All of these effects resemble those produced by spigelia. The active properties appear to reside in the bark of the root. The berries are often eaten without injury by children and also by birds. Cows and horses are not injured by the leaves. Indeed, the latter are said to be given to horses infested with "bots," and the berries have been found an attractive and nutritious food for horses. In India and the southern portions of the United States, azedarach bark is said to be the most popular *vermifuge* for lumbricoid ascarides. It is usually administered in a decoction made by boiling two ounces of the bark (fresh, if possible), in a pint of water until reduced one-half. For a child, the dose is a tablespoonful every two or three hours, until it affects the stomach and bowels. It should be followed by a cathartic.

BALSAMUM PERUVIANUM, *U. S.*, *Br.*—BALSAM OF PERU.

Balsamum Peruvianum nigrum, *Balsamum indicum.*—*Baume du Pérou*, *Baume des Indes*, Fr.; *Peru balsam*, G.

A balsam obtained from Myroxylon (Myrospermum, *Royle*, Toluifera, *Baill.*), Pereiræ, *Klotzsch.* Bentley & Trimen, Med. Plants, 83.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The U. S. Pharmacopœia recognizes Myrospermum peruiferum as the tree yielding this drug; but since the latter is at present exclusively produced on the balsam coast of San Salvador, Central America, Myr. Pereiræ appears to be the only species from which the commercial article is now obtained. Carson regards the two species as identical; but, according to Royle, Klotzsch, and others, they are specifically distinct. (See *Am. Journ. Pharm.*, 1860, pp. 296 and 411.) The plant in question is a tree attaining a height of about 50 feet, has imparipinnate leaves with the leaflets oval-lanceolate, somewhat attenuate above, and slightly emarginate, and the flowers in subaxillary racemes.

Collection.—At the beginning of the dry season, early in November or December, the bark, for some distance up the trunk, is beaten with the back of an axe or other blunt instrument until it has separated from the wood, without breaking. This is done on four sides, leaving four intermediate strips untouched, so as not to destroy the vitality of the tree. Five or six days later the loosened bark is charred by means of torches, and in the course of another week the charred pieces fall off, when the bare wood is covered by rags, which absorb the exuding balsam, and which, when saturated, are gently boiled in water until most of the heavy balsam sinks to the bottom, the remainder being obtained by wringing the partly exhausted rags in a bag made of stout rope. The wounds of the tree are covered with fresh rags as long as any balsam exudes during the dry season. The strips left untouched in one season are similarly treated the following year, and the tree will thus yield an annual supply of balsam for thirty years, but it is allowed to rest for some time after five or six years, in order not to exhaust its productiveness. The balsam obtained from the rags by boiling and pressing is, on the following day, separated from the water and put into suitable vessels.

Commerce.—Balsam of Peru comes to us in earthen jugs and metallic drums, and is principally exported from the port of Acajutla on the Pacific coast, and from Balize on the Atlantic side. Formerly it reached Europe by way of Peru, and was supposed to be a product of that country. The importation into the United States amounted, in 1876, to 1271 lbs., and in 1877 to 4097 lbs.

Description.—The balsam is a thick liquid of the consistence and appearance of molasses, of a dark brown-black color when examined in bulk; in thin layers, red-brown, and perfectly transparent. It has an agreeable, fragrant, slightly smoky odor, and a warm bitterish taste, followed by a burning sensation in the fauces. Its specific gravity is 1.15 to 1.16. It is soluble in strong alcohol, chloroform, and glacial acetic acid, but dissolves slightly in the other simple solvents.

By subjecting the fruit to pressure, *white Peru balsam* is obtained. It forms a thick yellowish-white liquid, having an odor resembling that of tonka, and containing a crystallizable resin named *myroxocarpin.*

The tree exudes a gum-resin, which, according to Attfield (1864), contains 77.4 per cent. of resin, but no aromatic principle or cinnamic acid.

Constituents.—The balsam has recently (1869 and 1870) been examined by K. Kraut and by J. Kachler, from whose analyses it appears to contain some benzylic alcohol, benzylic benzoate and cinnamate, cinnamic and benzoic acids, and resin (32 per cent., Kachler). Kraut obtained in the distillate also stilben. Delafontaine's statement (1868), that styracin (cinnamylic cinnamate) is also present, was not corroborated by Kraut.

Benzylic cinnamate or *cinnamein* has the composition $C_9H_7(C_7H_7)O_2$, and is, when pure, a colorless oily liquid, of a faint agreeable odor and an aromatic sharp taste. Its specific gravity is about 1.095, and its boiling point somewhat above 300° C. (572° F.). By caustic alkalies it is decomposed into benzylic alcohol and cinnamic acid.

Benzalcohol or *benzylic alcohol*, $C_{14}H_8O_2$, is a colorless, faintly aromatic oil, heavier than water and boiling at 204° C. (399.2° F.), which, by oxidizing agents, is converted first into oil of bitter almonds, and, finally, into benzoic acid. It is considered to be the *peruvin* of Fremy in a pure state; as obtained by that author it was lighter than water.

Benzylic benzoate, $C_7H_5(C_7H_7)O_2$, is a colorless oil, which crystallizes at a low temperature, and boils at about 340° C. (674° F.).

Stilben, $C_{14}H_{12}$, forms colorless and inodorous pearly scales or prisms, which are fusible and boil above 290° C. (554° F.).

Adulterations.—Balsam of Peru is frequently adulterated with alcohol, fixed oils, copaiba, and Canada turpentine. Most fixed oils being soluble in about eight times their volume of balsam, the specific gravity of the latter is not materially affected. The presence of the adulteration is detected by triturating the balsam with its own or twice its weight of strong sulphuric acid, and when the mixture has cooled, washing it with water. Pure balsam leaves a hard or crummy mass, which is not adhesive on being kneaded between the fingers, unless copaiba or a fixed oil was present. For modifications in manipulation, see *Am. Journ. Pharm.*, 1870, p. 404, and 1876, p. 166.

Alcohol is best detected, according to Gavalowski (1875), by adding some of the suspected balsam to a solution of potassium bichromate, followed by concentrated sulphuric acid, when the characteristic odor of aldehyd, suggesting that of rotten apples, will be perceived. Or some of the balsam may be distilled with water, and the distillate treated while warm with a little iodine, followed by caustic soda or potassa until decolorized. On cooling, crystals of iodoform will separate (Lieben's alcohol test, 1869).

For the detection of turpentines, Hager recommends the evaporation of 100 parts of the suspected balsam until, on cooling, a brittle mass remains, which is treated with alcohol specific gravity .910. On evaporating the alcohol, pure balsam will leave not over 6 per cent. of residue, any excess indicating the presence of a turpentine.

Physiological Action and Medical Uses.—Balsam of Peru is a general stimulant with a special tendency to the mucous membranes. In large doses it irritates the gastro-intestinal mucous membranes, and may cause vomiting and diarrhœa; but in medicinal doses it occasions some heat of skin, increased frequency of pulse, and an augmented action of the kidneys. Locally, it hastens repair of tissue. As an internal medicine it is most useful in limiting bronchial secretion, and hence as a remedy in *chronic bronchitis*, occurring alone or as a complication of pulmonary consumption. It should not be used if much fever exists. By inhalation it may be prescribed for these purposes, and for the alleviation of *chronic laryngitis*. In chronic *dysentery* its action is of the same sort, and is often extremely salutary; and the same may be said of its use in the *diarrhœa* which is apt to persist in some cases of prolonged typhoid fever. As a dressing for various *ulcers*, especially those of the indolent sort, it promotes the cure by stimulation and by its protective agency. It is well suited for treating *sore nipples*, applied pure or in an ointment; for moderating the discharge of pus in *chronic catarrh* of the nostrils, ears, vagina, etc.; and as an application to *chilblains*. In some cases of obstinate local *eczema* its healing virtues are conspicuous. According to circumstances it may be applied pure, or diluted with glycerin, almond or olive oil, lard, etc. The addition of catechu improves its healing qualities in some instances. Internally it may be given in the dose of half a fluidrachm in an emulsion of almonds, gum arabic, or yelk of egg, with sugar, or dissolved in glycerin.

BALSAMUM TOLUTANUM, *U. S.*, *Br.*—BALSAM OF TOLU.

Baume de Tolu, *Baume de Carthagène*, Fr.; *Tolubalsam*, G.

A balsam obtained from Myroxylon toluifera, *H. B. K.*, s. Myrox. punctatum, *Klotzsch*, s. Myrospermum toluiferum, *A. Rich.*, s. Toluifera balsamum, *Lin.* Woodville, t. 215. Bentley & Trimen, Med. Plants, 84.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This evergreen tree attains a height of 70 to 80 feet, rising usually to about 40 feet from the ground without branching. Young trees always have a larger foliage than old ones, in which it is small and quite thin, if they have been much bled. The tree is found in the high rolling country of Venezuela and New Granada. Prof. Baillon regards the tree yielding Peru balsam as identical with this, and the difference of the two products as due to the manner in which they are extracted. (*Am. Journ. Pharm.*, 1874, p. 14.)

Collection.—Two sloping notches are cut through the bark, meeting at their lower ends in a sharp angle, below which the bark and wood are hollowed out a little to receive the calabash cup into which the balsam flows. Similar cuts are made as high up as a man can reach, until often as many as 20 cups are found on one tree. When the lower part of the trunk is too full of scars a rude scaffold is sometimes made around the tree, and new incisions made higher up. The balsam-gatherer collects the contents of the cups in flask-shaped bags made of raw-hide, a pair of them being slung over the back of a donkey. When filled, these bags are sent to the ports of exportation on the Magdalena River, where their contents are transferred into cylindrical tins. (John Weir, *Am. Journ. Pharm.*, 1864, p. 449.)

Commerce.—Tolu balsam is exported from the Venezuelan ports in tins holding 10 and occasionally 25 pounds. The amount imported into the United States varies considerably. In 1876 it was 9221 pounds, and in the following year 19,081 pounds.

Description.—Recently imported, Tolu balsam forms a semiliquid mass which gradually hardens, becoming quite brittle in the cold, but softening between the teeth, and fusing readily at a somewhat elevated temperature. In thin layers it is perfectly transparent, and of a yellowish or reddish-brown color. Viewed under the microscope, crystals of cinnamic acid are observed. It has an agreeable aromatic odor suggesting that of vanilla, which becomes more apparent on warming it, and a mild aromatic taste. It is readily soluble in alcohol, chloroform, potassa solution, and acetone; also in ether. Petroleum-benzin, benzol, and carbon bisulphide scarcely act upon it.

Constituents.—The main constituent of Tolu balsam is an amorphous resin, which, according to Kopp (1849), consists of a portion very soluble and another but slightly soluble in alcohol. Cinnamic acid is present to the exclusion of benzoic acid (Kopp, 1849, Carles, 1874), and a small quantity, about one per cent., of *tolene*, which is a colorless, thin, volatile oil, boiling at 160° C. (170° Deville), having a specific gravity of .858, an agreeable odor, and an acrid peppery taste. Its composition is $C_{10}H_{16}$. Busse (1876) found also some benzoic acid and benzylic ethers.

Adulterations.—Turpentines are sometimes added, and may be detected by their solubility in carbon bisulphide. Concentrated sulphuric acid imparts to pure Tolu balsam a cherry-red color; in the presence of turpentine the acid becomes black.

Pharmaceutical Uses and Preparations.—Balsam of Tolu is used as a vehicle in Pilula phosphori, *Br.* Syrupus tolutanus, *U. S.*, *Br.*, contains mainly the aromatic principle; and in Tinct. tolutana and Tinct. benzoini comp., *U. S.*, *Br.*, balsam of Tolu is completely dissolved in the alcoholic menstruum.

Physiological Action and Medical Uses.—Balsam of Tolu resembles balsam of Peru in its general properties, which are, however, much less distinct in the former. Its agreeable flavor renders it an eligible ingredient of mixtures, lozenges, vapors, etc., intended to modify subacute and chronic inflammations of the mucous membrane, especially the *bronchial*. It is much used by perfumers in the manufacture of burning pastilles. It may be administered in emulsion in doses of from ten to thirty grains. Its most usual form in medicine is the syrup.

BAPTISIA.—WILD INDIGO.

Indigo sauvage, Fr.; *Baptisie*, G.

The root of Baptisia (Sophora, *Lin.*, Podalyria, *Mich.*) tinctoria, *R. Br.*
Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—Wild indigo is a common, smooth, perennial herb, growing in dry, sandy ground in the United States and Canada. The branching stem is about

2 feet high; the leaves are trifoliate; the leaflets roundish-obovate and wedge-shaped at base; the stipules minute and caducous; the flowers yellow, in small, loose racemes. On drying, the herb becomes bluish-black.

Description.—The root consists of a short, knotty head, which is 2 to 3 inches broad, with irregular and broad stem-scars above, and below divided into several long cylindrical branches about half an inch in diameter, which are sparingly beset with branching fibres. The bark is externally of a dark brown color, with small warts somewhat arranged in transverse rows, or with a soft and friable corky layer; internally whitish, radially striate, thick, and covering a whitish, tough, and tasteless wood with indistinct medullary rays. Roots of one year's growth are smaller, of a light brown color externally, and have the ligneous meditullium about as thick as the bark. The root is nearly inodorous, and has a bitterish, acrid, and nauseous taste residing in the bark.

Constituents.—Wild indigo root contains resin, but no volatile or fixed oil (Smedley, 1862). An alkaloid, of which the hydrochlorate has a nauseous and acrid taste, was first obtained by J. A. Weaver (1871), and deserves further investigation.

Medical Action and Uses.—Nothing has recently been added to the knowledge possessed many years ago respecting this medicinal plant. Its young shoots, like those of phytolacca, have been eaten in the same manner as asparagus. When more mature the stalks and roots are violently emetic and cathartic, especially when fresh. A decoction of the bark has like effects. It would seem, however, to be possessed of stimulant powers, since it has been held in great repute as a remedy in *scarlatina*, *typhus*, and epidemic *dysentery*, and as a topical application in *aphthæ*, *mercurial sore mouth*, and various *ulcers*, especially those affected with gangrene. For the last-mentioned purpose it has been used in a poultice or an ointment. The leaves possess the same virtues as the root, but in a less degree. Wild indigo is given in decoction made with an ounce of the recent root to a pint of boiling water; the dose is about a tablespoonful every three or four hours; its tendency to occasion vomiting and purging may be diminished by lessening the dose or adding laudanum to the liquid.

BARII CARBONAS, *U. S.*—CARBONATE OF BARIUM.

Barium carbonicum, *Baryta carbonica*, *Carbonas baryticus*.—*Carbonate de baryte*, Fr.; *Kohlensaures Barium*, *Kohlensaurer Baryt*, G.

Formula $BaCO_3$. Molecular weight 197.

Origin and Preparation.—Carbonate of barium is found native, as *Witherite*, in large quantities, in the lead mines at Alston Moor and at Anglesark in Lancashire, England. It is also met with in Scotland and Sweden. It may be obtained artificially by precipitating a soluble barium salt with an alkaline carbonate, or by heating to redness and fusion a mixture of 10 parts of heavy spar (barium sulphate), 2 of carbon, and 5 of potash, and washing the fused mass with water, when barium carbonate is left behind. Its formation is explained by the following equation: $BaSO_4 + C_2 + 2HKO = BaCO_3 + K_2S + CO_2 + H_2O$.

Properties.—Witherite is found in pale yellowish or grayish fibrous masses or in rhombic crystals, varying in specific gravity between 4.3 and 4.56. The artificially prepared barium carbonate forms a soft, white, amorphous or crystalline, tasteless powder. Its specific gravity is 4.22 to 4.307. It requires over 15,000 parts of boiling water for solution, but dissolves more readily in solutions of chloride and some other salts of ammonium, and is also slightly soluble in some carbonates and even sulphates. When recently precipitated it decomposes the solutions of many salts, precipitating the metals either as hydrates or carbonates. Owing to its solubility in hydrochloric and other acids, it acts as a poison when taken internally. It has been admitted into the Pharmacopœia for preparing the chloride of barium.

Tests.—Barium carbonate should be completely soluble, with effervescence, in dilute muriatic acid (absence of barium sulphate). The solution is not colored or precipitated by ammonia or hydrosulphuric acid (absence of lead and other metals). When the solution is precipitated by an excess of sulphuric acid, the filtrate yields no precipitate with carbonate of sodium (absence of calcium and other earths).

BARII SULPHAS; heavy spar, *E.*; Spath pesant, *Fr.*; Schwerspath, *G.*, which has been noticed above, is a mineral from which other barium compounds are prepared by converting it first into soluble sulphide in the manner indicated below; on treating its solution with dilute sulphuric acid, sulphate of barium is again formed, and this is used under the name of *permanent white* or *blanc fix* for glazing cards, and by painters in place of white lead.

BARIUM CHLORIDUM, *U. S.*—CHLORIDE OF BARIUM.

Baryum chloratum, P. G.; *Baryta muriatica.*—*Chlorure de baryum*, Fr.; *Chlorbaryum*, *Chlorbarium*, G.

Formula $BaCl_2.2H_2O$. Molecular weight 244.

Preparation.—Take of Carbonate of Barium in small pieces, Muriatic Acid, each four troyounces; Water a pint. Mix the acid with the water, and gradually add the carbonate of barium. Towards the close of the effervescence apply a gentle heat, and, when chemical action has ceased, filter the liquid, and evaporate so that crystals may form when it cools. *U. S.*

In this process the muriatic acid reacts upon the carbonate of barium, producing barium chloride which remains in solution, and liberating carbonic acid gas which escapes, some water being also formed. The reaction is explained by the following equation: $BaCO_3 + 2HCl = BaCl_2 + CO_2 + H_2O$.

On the large scale this salt is often made from native sulphate of barium (heavy spar) by igniting its mixture with charcoal so as to form barium sulphide and carbonic acid, according to the equation $BaSO_4 + C_2 = BaS + 2CO_2$. The barium sulphide thus obtained is then dissolved in water and boiled with some excess of muriatic acid, whereby sulphuretted hydrogen is given off, barium chloride remaining in solution: $BaS + 2HCl$ yields $BaCl_2 + H_2S$. By evaporating the solution the salt is obtained in crystals.

Properties.—Barium chloride exists in colorless translucent rhomboidal tables or lamellæ. It is permanent in the air at the ordinary temperature, but loses one-half of its water above 55° C. (131° F.), and becomes anhydrous at 121° C. (250° F.). 100 parts of water retain at 105° C. (221° F.) 60 parts, at 40° C. (104° F.) about 41, at 20° C. (68° F.) 35.7, and at 10° C. (50° F.) 34.3 parts of the salt in solution. (*Mulder.*) The aqueous solutions are partly precipitated by muriatic and nitric acid, in which the salt is less soluble than in water. It is insoluble in absolute alcohol, but dissolves in spirit containing water, and imparts to the alcohol flame a yellow color. It possesses the persistently bitter and disagreeable astringent taste of the soluble barium salts. Its solution yields with nitrate of silver, and with potassium sulphate or dilute sulphuric acid, copious white precipitates, which are insoluble in nitric acid. Sulphates, phosphates, carbonates, and the salts of most organic acids yield with barium chloride, precipitates which are insoluble in water.

Tests.—Chloride of barium is entirely soluble in water (absence of barium carbonate and sulphate). The solution is not colored or precipited by ammonia or hydrosulphuric acid (absence of lead and other metals). When precipitated by an excess of sulphuric acid and filtered, the liquid yields no precipitate with sodium carbonate (absence of calcium and other earths). Alcohol shaken with the powdered salt, then poured off and ignited, does not burn with a red flame (absence of strontium chloride).

Off. Prep.—Liquor barii chloridi, *U. S.*

Other soluble salts of Barium: BARII BROMIDUM; Bromide of barium, *E.;* Bromure de baryum, *Fr.;* Brombarium, *G.* $BaBr_2.2H_2O$; molecular weight 333. It is obtained on dissolving barium carbonate in hydrobromic acid, and crystallizes in colorless rhombic plates, which dissolve in their own weight of cold water and are freely soluble in alcohol. The salt has a very disagreeable taste.

BARII IODIDUM; Iodide of barium, *E.;* Iodure de baryum, *Fr.;* Jodbarium, *G.* $BaI_2.2H_2O$; molecular weight 427. It is conveniently made by boiling a solution of iodide of iron with carbonate of barium, filtering and crystallizing. It forms large transparent rhombic prisms which are very freely soluble in water and alcohol, and when heated melt and become anhydrous.

Physiological Action.—The soluble salts of barium are all supposed to possess closely analogous powers; but the sulphate, owing to its insolubility, is probably inert. Long ago Gmelin used this language: "The salts of barium are powerful poisons, having a special power of destroying the irritability of the voluntary muscles; they act upon the stomach as irritant poisons, and also inflame the heart. The proper antidote for them is a soluble alkaline sulphate." Boehm's experiments, in which soluble barium salts were injected into the lymph-sacs of frogs, showed, as effects, mucous secretion from the skin, distension of the air-sacs, rigid extension of the limbs, convulsive movements under irritation, followed by relaxation and paralysis of the voluntary muscles first and then of those of respiration; the abdomen was, meanwhile, tumid, and through its walls vigorous intestinal peristalsis was visible; the lungs were distended, and active irritation of the animal extorted from it a loud and unnatural cry. In mammals injection of a strong solution of the salt into the veins immediately excites tonic and clonic convulsions, a discharge of urine and feces, and general paresis, or, if the dose has been excessive, death in convulsions may ensue. By the stomach the poison does not exhibit any effect for fifteen or twenty minutes, when alvine evacautions take place, the abdomen is distended and the peristaltic movements of the bowels are visible. In dogs profuse salivation occurs, with vomiting and prolonged straining. Gradually extreme muscular debility succeeds, the pupils dilate, but perception does not appear to be extinct until death, which is attended with slight spasms. The action of barium salts upon the heart is essentially the same on frogs and mammals; it occasions a contraction of the heart and arteries which is more or less prolonged according to the dose employed, and, as a consequence, augments the pressure of the arterial blood column. If, however, the dose employed is excessive, the heart is paralyzed and not made rigid. Boehm concluded from his experiments that barium salts "either stimulate powerfully the whole nervous sympathetic system, or have a special relation to unstriped muscular fibre."

We are not acquainted with any experiments upon man which illustrate the physiological action of these compounds, or which prove them to be tonic, diuretic, and diaphoretic, as they are said to be. It is certain that in an overdose chloride of barium may produce the symptoms common to the irritant poisons, abdominal pain, vomiting, purging, collapse with thready pulse, general muscular asthenia, coma, convulsions, and death. The most characteristic symptoms are labored respiration with bronchial effusion. After death the lesions in the stomach consist of vascular injection and extravasation, and even ulceration. The carbonate is said to have destroyed life in at least two cases. In one which ended in recovery, the patient complained of dimness of sight, double vision, headache, tinnitus, and cramps, with occasional vomiting and purging.

Medical Uses.—There is little in the summary above given of the action of the salts of barium to connect it with the therapeutic results which are said to have followed their administration in disease, unless, perhaps, it really have the power of "stimulating powerfully the whole nervous sympathetic system." Such an action might be admitted to explain the virtue attributed to it of curing *scrofula* of the glands. Hufeland claimed that in this affection its virtues "do not yield either to mercury or antimony," which might very well be the case, although it were more injurious than useful. A large number of writers might be cited who attribute to it peculiar virtues in scrofula. Among them, Phillips holds that as a local discutient it is not inferior to iodine, and that in cases where "the tallow-like complexion, the pale tongue, and the languid circulation, accompanied by irritability of the mucous surfaces, are present, its virtues are remarkably demonstrated." A later and a better authority, Lebert, declares that he has "never obtained the slightest advantage from its use" in glandular scrofula. And this experience, we apprehend, is more weighty than that of a multitude of less competent judges. In other forms of scrofula affecting the joints, eyes, etc., the evidence of its utility is, if possible, still less. The dose may be stated at from half a grain to one or two grains dissolved in a large quantity of water, and taken after meals.

BEBERIÆ SULPHAS, *Br.*—SULPHATE OF BEBERIA.

Sulfate de bébéerine, Fr.; *Schwefelsaures Bebirin*, G.

Prepared from nectandra or bebeeru bark.

Preparation.—Take of Bebeeru Bark in coarse powder one pound; Sulphuric Acid one-half fluidounce; Slaked Lime three-quarters of an ounce, or a sufficiency; Solution of Ammonia a sufficiency; Rectified Spirit sixteen fluidounces, or a sufficiency; Diluted Sulphuric Acid a sufficiency; Water one gallon; Distilled Water a sufficiency. Add the sulphuric acid to the water; pour upon the bebeeru bark enough of this mixture to moisten it thoroughly; let it macerate for twenty-four hours; place it in a percolator, and pass through it the remainder of the acidulated water. Concentrate the acid liquor to the bulk of one pint; cool, and add gradually the lime in the form of milk of lime, agitating well, and taking care that the fluid still retains a distinct acid reaction. Let it rest for two hours, filter through calico; wash the precipitate with a little cold distilled water, and to the filtrate add solution of ammonia until the fluid has a faint ammoniacal odor. Collect the precipitate on a cloth, wash it twice with ten ounces of cold water, squeeze it gently with the hand, and dry it by the heat of a water-bath. Pulverize the dry precipitate, put it into a flask with six ounces of the rectified spirit, boil, let it rest for a few minutes, and pour off the spirit. Treat the undissolved portion in a similar manner with fresh spirit, until it is exhausted. Unite the spirituous solutions, add to them four ounces of distilled water, and distil so as to recover the greater part of the spirit. To the residue of the distillation add, by degrees, and with constant stirring, diluted sulphuric acid till the fluid has a slight acid reaction. Evaporate the whole to complete dryness on the water-bath, pulverize the dry product, pour on it gradually one pint of cold distilled water, stirring diligently; filter through paper; evaporate the filtrate to the consistence of syrup, spread it in thin layers on flat porcelain or glass plates, and dry it at a heat not exceeding 140° F. Preserve the product in stopped bottles. *Br.*

The percolate obtained on treating bebeeru bark with acidulated water contains, besides sulphate of beberia, beberic acid, which is almost completely removed by the lime. The filtrate, which is still acid, is treated with ammonia, whereby impure beberia is precipitated, together with some lime compounds. From this mixture alcohol takes up the alkaloid still contaminated with coloring matter, which is not removed by the subsequent treatment with sulphuric acid. But, after evaporating to dryness, and redissolving in cold water, some foreign matters which are soluble in the acid solution remain on the filter.

Properties.—Thus prepared sulphate of beberia (or *bibiria*) forms dark-brown thin translucent scales, yielding a brownish-yellow powder, having a bitter taste, and being completely soluble in water and in alcohol. Pure sulphate of beberia is yellowish-white. The officinal salt contains also the sulphate of *sipirina*, a second and brown alkaloid met with in the bark. Beberia was considered by Walz (1860) to be identical with buxina, the alkaloid of the common box; the statement was corroborated by Flückiger (1869), who established also the identity of pelosina with the two alkaloids.

Tests.—The officinal salt yields a white precipitate with chloride of barium, and with caustic soda a yellowish-white precipitate, which is soluble in ether, and, on evaporating the solvent, again left as a yellow translucent residue, entirely soluble in dilute acids. The salt is completely decomposed by heat without leaving any fixed residue. These tests, in connection with the properties mentioned, are sufficient to prove the purity of the salt.

Physiological Action.—Administered hypodermically to frogs it produces tetanic rigidity without exaggerated reflex susceptibility, in which respect it resembles quinia, caffeine, and theine, and differs from strychnia. Internally it does not produce the headache, tinnitus, deafness, gastric irritation, etc., which quinia sometimes occasions, while it equals that alkaloid in its tonic influence upon the appetite and digestion.

Medical Uses.—Introduced as a substitute for quinia, it has not confirmed the estimate originally made of its efficacy; for although, like the greater number of vegetable bitters, it displays *antiperiodic* virtues, and like some of them, also, it will occasionally effect a cure of intermittent fever, yet, on the whole, its powers must be rated much lower than those of the cinchona salts. It has been found curative in some cases of periodical *headache*, and *neuralgia* of the same type, and as a useful tonic in cases of general debility from pulmonary phthisis and prolonged suppuration with *hectic fever*. In strumous *ophthalmia*, atonic *dyspepsia*, certain cases of *menorrhagia*, *leucorrhœa*, etc., it may be used as a substitute for quinia. The *dose* as a tonic is from one to three grains; as an antiperiodic from five to ten grains. It may be given, like sulphate of quinia, in watery solution with an excess of aromatic sulphuric acid.

BELÆ FRUCTUS, *Br.*—BAEL FRUIT.

Indian bael, Bengal quince, E.; *Bael, Coing du Bengale*, Fr.; *Baelfrucht, Bengalische Quitte*, G.

The dried, half ripe fruit of Ægle marmelos, *D. C.* (*Pharm. Journ.*, vol. x., page 166, plate), s. Cratæva marmelos, *Lin.*, s. C. religiosa, *Ainslie*. Bentley and Trimen, Med. Plants, 55.

Nat. Ord.—Aurantiaceæ.

Origin.—The bael tree is a medium-sized thorny tree, with ternate leaves and large white flowers, indigenous to the Himalaya Mountains, but much cultivated throughout India.

Description.—The fruit is from two to four inches in diameter, more or less globular in shape, and resembles an orange of large size in appearance and internal arrangement, it being divided into about twelve cells, containing in the ripe state a pleasant-flavored, highly mucilaginous juice, while the rind is quite aromatic.

As found in commerce the fruit is mostly broken, a portion of the dried pulp and seeds still adhering to the fragment of the rind. The latter is smooth, and of a brownish-gray color externally, about a line and a half thick, hard, and of a slightly astringent taste, destitute of aromatic properties. The exposed portion of the dried pulp is of a deep orange or red-brown color, whitish within, hard, of a mucilaginous, scarcely acidulous taste, and incloses some oblong, flat seeds, which are woolly, and very mucilaginous.

Constituents.—These have not been well ascertained. The rind contains mucilaginous and pectin compounds, but appears to be free from tannin, which, according to Collas (1856), is found in the ripe fruit to the amount of five per cent. The infusion of bael is scarcely affected by iron salts.

Substitution.—The fruit of Feronia elephantum, *Corr.*, another aurantiaceous tree of India, is used there like bael. It is known under the name of *elephant* or *wood-apple*, and differs from bael in being incompletely divided into five compartments.

Off. Prep.—Extractum belæ liquidum, *Br.*

Medical Action and Uses.—Bael appears to be a simple astringent. In India, where alone it is much used, it is thought highly of as a remedy for relaxed conditions of the bowels, depending upon chronic diarrhœa or dysentery, and is said not to occasion constipation. These are qualities which may be equally predicated of pure tannin. The *dose* of the fluid extract (*Br. Ph.*) is from one to two fluidrachms.

BELLADONNÆ FOLIA, *U.S.*, *Br.*—BELLADONNA LEAVES.

Folia (s. Herba) Belladonnæ.—Feuilles de belladonne, Fr.; *Tollkirschen-Blätter, Wolfskirschen-Blätter, Tollkraut*, G.

The leaves of Atropa belladonna, *Lin.*

BELLADONNÆ RADIX, *U. S.*, *Br.*—BELLADONNA ROOT.

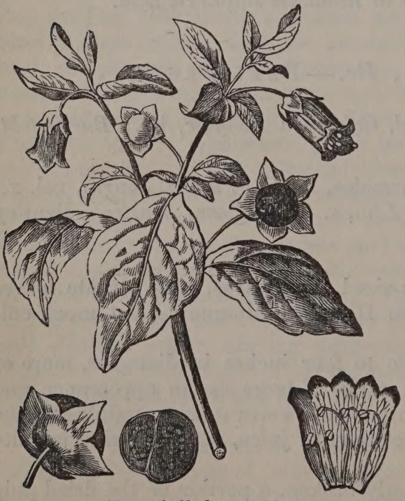
Racine de belladonnæ, Fr.; *Follkirschen-Wurzel, Wolfskirschen-Wurzel*, G.

The root of Atropa belladonna, *Lin.*, from plants more than two years old. Bentley and Trimen, Med. Plants, plate 193.

Nat. Ord.—Solanaceæ.

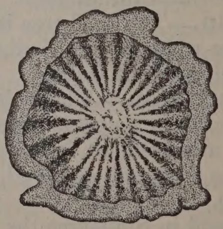
Origin.—Belladonna is a nearly glabrous, herbaceous, perennial plant, attaining a height of from four to six feet, and has dark-purple bell-shaped flowers and glossy purplish-black berries. It is found in the woods of Central and Southern Europe, and as far

Fig. 15.



Atropa belladonna, *Lin.*

Fig. 16.



Belladonna root, transverse section.

east as Asia Minor and Caucasia. It is cultivated in Europe and in this country.

Description. 1. Belladonna Root.—As collected from plants several years old, the roots are a foot or more long, half an inch to an inch thick, cylindrical above and gradually tapering, fleshy, and in the dry state with deep longitudinal wrinkles, and the bark covered with a brownish-gray cork, or, after its removal, of a light gray or grayish-white color externally, and somewhat lighter internally. A fine blackish cambium line separates the bark from the meditullium, in which the small yellow wood bundles, with large vessels, are arranged in radiating wedges, separated by rather broad medullary rays; near the centre, and in the young branches, the wood-bundles are loosely scattered around a central ligneous cord, while in old roots the woody tissue predominates considerably. When fresh the root has a disagreeable, heavy odor, which disappears on drying, leaving merely a faint earthy smell. The taste is not very marked, being at first sweetish, with a bitterish and somewhat acrid after-taste. The fracture of young roots is mealy, of old roots woody and tough. Young branches, peeled and dried, have some resemblance to marshmallow root (see Althæa). Old woody roots should be rejected for pharmaceutical use. The German Pharmacopœia directs the root to be kept not more than one year.

2. Belladonna Leaves.—The forking stem bears above numerous bright-green ovate to oblong leaves, with the margin entire, and arranged in unequal pairs, one being about one-half the size of the other. They attain a length of four to six inches, are tapering towards the apex, and narrowed at the base into the petiole, half to one inch in length. The leaves are entirely smooth, a slight downiness on the nerves beneath excepted. They become thin and papyraceous in drying, the upper surface readily assuming a brownish tint, the lower becoming grayish-green, and show, particularly on the lower surface, a granular appearance under the magnifying glass. Circular holes, resulting from the separation of suberous warts, are frequently observed. The heavy odor of the fresh leaves disappears on drying almost completely, but it is somewhat restored by moisture; the taste is slightly saline, bitterish, and acrid.

Admixtures.—Leaves of digitalis, hyoscyamus, verbascum, and other plants, occasionally met with in carelessly gathered belladonna, are easily distinguished by their characters, particularly the hairs. The leaves of Solanum nigrum are smaller, with the margin repand dentate. In some parts of Southern Europe the oblong obovate leaves of Scopolia atropoides, *Schultes* (s. Hyoscyamus scopolia, *Lin.*), are said to be collected with belladonna. They are stated to possess the same medicinal properties.

Constituents.—The most important principles contained in both belladonna root and herb are atropia and perhaps belladonnia (see page 253). Estimated by iodohydrargyrate of potassium, Lefort (1872) found young roots to contain 0.6, old roots 0.25, and dry leaves, both cultivated and wild grown, collected in the flowering period, 0.44 per cent. of atropia. The alkaloids are probably combined with malic acid. Besides the usual vegetable constituents, albumen, gum, etc., the root contains *atrosin*, a red coloring principle, found also in the berries, according to Hübschmann. The herb appears to contain asparagin, which sometimes crystallizes in the extract. (*Biltz*, 1839.)

Pharmaceutical Uses and Preparations.—Belladonna root is used in making atropia, *U. S.*, *Br.*, Emplast. belladonnæ, Extract. bellad. radic. fluid., *U. S.*, and Linim. belladonnæ, *Br.* The following preparations are made from the leaves: Extract. bellad. alcohol., *U. S.*, Ext. belladonnæ, and Tinct. belladonnæ, *U. S.*, *Br.*

Allied Plants.—Atropa mandragora, *Lin.;* s. Mandragora vernalis, *Bert.*, and M. autumnalis, *Bert.* *Mandrake*, E.; *Mandragore*, Fr.; *Alraunwurzel*, G. These acaulescent plants are indigenous to Southern Europe, where their roots are employed. They are two to three feet long, conical, sometimes forked, an inch or more thick; in the fresh state, fleshy, whitish, and of a heavy narcotic odor; in the dry state, wrinkled, externally brown, but internally whitish, showing a thick bark, and in the meditullium distant and narrow yellow wood-bundles. They have a sharp and bitter taste and a narcotic action. They are rarely met with in this country.

DUBOISIA MYOPOROIDES, *R. Br.*—This is a tree-like shrub of Australia, belonging to the group *Salpiglossidæ*, Nat. Ord. Solanaceæ. The leaves are alternate, short-stalked, smooth, lanceolate, entire, three to four inches long, and about an inch broad in the middle. A. W. Gerrard and A. Petit (1878) have isolated the alkaloid *duboisina* as a yellow viscous mass, which resembles atropia in its physiological action, but is colored red-brown by sulphuric acid, and, on warming the mixture, gives off an unpleasant odor, suggestive of butyric acid, while the odor evolved by atropia under the same circumstances is pleasant and aromatic.

Physiological Action. *On Animals.*—Birds and herbivorous animals eat the fruit of belladonna without injury, and the latter excrete its active principle with the urine. Yet in all of these animals, except birds, belladonna applied to the eye, or the urine of animals eating belladonna used in this manner, produces dilatation of the pupil. It has been suggested that the innocuousness of belladonna in the cases just referred to is due to the active principle being modified by the digestive action of the stomach; but the animals which cannot be poisoned by belladonna in the stomach are equally insusceptible to its action when it is introduced directly into the blood. Yet in them all the pupil becomes dilated by belladonna. Birds, as stated, are an exception. This is one of the many examples which show the danger of concluding from the lower animals to man in regard to the operation of medicines, unless the mode of action in the two cases is first proved to be identical. When belladonna, in the form of an extract, is given to dogs, or injected into their veins, they exhibit, along with dilated pupils, evidences of suffering, retching, or vomiting, general muscular debility, dulness of the senses, and increased frequency and force of the heart's action. Death appears to be produced by exhaustion, but only after very large doses. In no animal is there any degree of that delirious excitement which belladonna produces in man.

On Man.—The first and simplest effect of belladonna in small doses is to dilate the pupil, whether it be applied locally (in which case its action may be confined to one eye), or when taken internally. The continued use of such doses internally occasions also dryness of the throat, and a pink efflorescence on the skin closely resembling that of scarlatina; still larger doses excite a peculiar delirium, which will be presently described. All of the characteristic phenomena have been occasioned by the application of belladonna plasters and liniments to the skin, especially when the cuticle was broken, and by the milk of a female who had taken a large dose of the drug. The following is a summary of the effects of belladonna upon the several physiological elements of the economy. *On the nervous system.* A sense of tightness or pain is felt in the forehead and eyes; with giddiness, confusion of thought, and noises in the ears. The sight is confused, objects are hazy, or their character is mistaken. Often they appear to be much smaller than natural. Spectral illusions of a pleasing character are frequent, such as jewels, flashes of colored light, birds of brilliant plumage, and insects with enamelled wings. Sometimes there is total blindness of several days' duration, and even after all mental disorder has subsided. The mind is apt to be filled with extravagant ideas; there is often delirium, which is generally of a gay description and which prevents sleep, or disturbs it with fantastic dreams. Sometimes the patient is quite conscious of his illusions and delirium, but is without the power to control either of them. The delirium may be characterized by the incessant repetition for hours of some habitual act or phrase; sometimes, though rarely, it is violent, maniacal, and attended with injury to one's self or the attendants; but in general poisonous doses of the drug give rise to active, and, for the most part, joyous delirium. It is a powerful anæsthetic; in a case of poisoning by it ending in recovery, there was almost a total loss of sensibility of the skin lasting for several days. It has no direct soporific operation. *On the muscular system.* Belladonna in excessive dose renders the gait unsteady and staggering, producing numbness with trembling and jerking movements of the limbs; the patient unconsciously runs against objects in his way, or avoids encountering imaginary ones; he is unable to co-ordinate his movements or to pick up small objects. The pupil is dilated, the eye bright, the voice husky, or deglutition, owing to dryness of the throat, is impossible; the bladder is paralyzed and the urine retained, or both this secretion and the feces may be passed involuntarily. The upper eyelid is apt to be paralyzed, and may remain so for months. *On the circulation and secretions.* Under the action of full doses of belladonna the pulse is at first slower and fuller, contrary to what takes place in the lower animals after the subcutaneous injection of atropia, but afterwards becomes more frequent as well as more feeble, until in fatal cases it grows thready and intermittent. During the active period of the operation the whole capillary circulation would seem to be congested, for the external mucous membranes are dry, the face is red and turgid, there is a sense of fulness in the head with throbbing of the arteries, as if the blood were prevented from returning to the heart by a ligature around the neck. The general dryness of the skin and throat and larynx contrasts with the greatly augmented secretion of the kidneys during the active stage of belladonna poisoning. This diuresis has been attributed to the fact that the active principle of the drug is excreted with the urine, and almost exclusively in this manner. Irritation of the scrotum sometimes exists to a high degree.

Although it is impossible to present a clear and consistent rationale of the mode of action of belladonna in producing the phenomena that have been enumerated, it may be proper to state the most plausible views upon this subject. Like all other medicines which act directly through the nervous system, small and large doses of belladonna produce opposite effects, the former stimulating, the latter paralyzing it. The direct action of small doses upon the heart is to increase the vigor and the frequency of its contractions; but large doses render the pulse still more frequent and more and more feeble and thready. Under moderate stimulant doses the visible number of capillary vessels is increased, owing, it is alleged, to the greater force with which the blood is propelled; but the individual vessels undergo such a contraction at the same time that the amount of blood in the part is said to be diminished rather than increased. The continued use of such doses, or the immediate administration of larger ones, produces general dilatation of the capillary vascular system. This vascular stasis accounts for the dryness of the mouth and the redness of the skin; but it is not quite easy to explain by its means the absence of dryness of the external integument, nor the increased secretion of the urine and the bile, nor the greater facility of defecation, which are effects of medicinal doses of the medicine. The alleged hypnotic power of medicinal doses of belladonna may be referred to the diminution of blood which it occasions in the cerebral vessels; and in like manner the insomnia, hallucinations, blindness, etc., which large doses induce, may be attributed to the hyperæmia which they cause in the brain. The anodyne and anæsthetic powers of belladonna appear to be inherent, and not the indirect result of changes in the blood-supply. On the other hand, the spinal symptoms, as shown after toxical doses, by the suspension of mental control over movements and their co-ordination, seem to result from impaired sensibility and motility.

Medical Uses.—Belladonna is probably powerless to remove any sort of malignant *tumor*, but it very certainly does retard the growth and lessen the pain, even of cancers, and promote the removal of some other tumors, especially the glandular which are susceptible of absorption. It may be presumed to do this by lessening the blood supply, and thereby restricting the nutrition of the morbid growth, and its pressure upon the sensitive nerves. The virtues of belladonna in certain forms of *neuralgia* illustrate the folly of rapidly generalizing. The relations of opium to pain of all descriptions are so nearly identical, that it was naturally to be inferred that the same was true of belladonna, and yet there is only one form of uncomplicated pain, neuralgia, in which this medicine is of much service as a direct anodyne, and one variety of that form chiefly. It is a powerful remedy for neuralgia, but almost exclusively for neuralgia of the face and head. It is next most useful in intercostal neuralgia, then in visceral neuralgia, and least of all in sciatica. It should be given internally to the production of slight constitutional effects, while local applications of belladonna in ointment or liniment are made upon the sound or blistered skin, or atropia is hypodermically employed. The application of a belladonna plaster, or, still better, of a plaster of belladonna and conium over the *heart* is of signal service in many cases of the pain which is usually felt near the apex, and is oftener associated with palpitation depending upon functional than upon organic disease.

The physiological action of belladonna, as revealed by experiments, is far from pointing clearly to one of the most useful applications of the drug in *relaxing spasm*, which has long been well known as a clinical fact. Sometimes, doubtless, it is difficult to disengage from this symptom the often associated element, pain, which by turn excites and is produced by spasm. This is evidently the case in spasm of the *sphincter ani*, and of the *urethra*, and probably in spasm of the *gall ducts*, the *ureters*, the *bladder*, the *intestines*, and the *uterus*. It is probably so in pain depending upon muscular spasm in *rheumatism*, and in that caused by the irritation of wounded and inflamed *nerves*. But the consideration of other cases of spasm without pain, shows that the direct anti-spasmodic power of the medicine is very great. It will not be pretended that spasm of the *os uteri* during labor is the effect of the pain which accompanies it, and yet belladonna overcomes the rigidity in question, probably in the same manner in which it may be overcome by venesection. It is alleged that the medicine relieves *jaundice*, supposed to depend upon the presence of unspissated bile in the ducts, but not necessarily occasioning pain; strangulated *hernia* is said to have been cured by local applications of belladonna, and also *phimosis*, and *paraphimosis;* and its relaxing influence on the bowels has frequently been resorted to successfully in cases of *obstinate constipation.* The purely anti-spasmodic operation of the medicine is still more clearly seen in *whooping-cough.* It should not be used until the inflammatory stage of the disease has declined, and then in doses not exceeding, at first, the eighth of a grain twice a day. The dose should be gradually increased until the pupils exhibit its effects. In other *nervous coughs* it is equally available, especially in such as depend upon laryngeal irritation. In *spasmodic asthma* it is one of the most reliable remedies, provided it be given in doses sufficient to produce its characteristic operation. For this purpose the hypodermic injection of atropia is to be preferred; and, when the paroxysm occurs regularly, its approach may be prevented by this remedy. The inhalation of an atomized preparation of belladonna may be used. The *nervous vomiting* of pregnancy may be moderated by the internal use of the drug, or by rubbing a solution of the extract upon the epigastrium. In *tetanus* the medicine has occasionally produced a cure; and also in cases of poisoning by *strychnia*, and in others of *epilepsy*, especially in children.

The supposed power of belladonna to limit the amount of blood in the spinal cord has been invoked with apparent advantage in the treatment of *epidemic meningitis.* As it was given along with ergot, to which the same operation is attributed, the share of the former medicine in the cure is difficult to determine. These two medicines were originally associated in the treatment of *paraplegia* due to myelitis; ergot being at first administered alone, after which belladonna was given internally, and applied in a plaster to the spine. Subsequently, iodide of potassium was prescribed, in addition to the other remedies. It is open to question what was the value of the elements time and rest in this method of treatment.

One of the most useful applications of belladonna is in the treatment of *incontinence of urine*, an affection presenting neither evident spasm nor pain, but in which, probably, the former state exists. By blunting the organic sensibility of the neck of the bladder, it allays the spasm of this part, and prevents a call of nature until a due amount of urine has accumulated. The power of belladonna in dilating the pupil is most valuable in permitting a thorough exploration of the interior of the *eye* by means of the ophthalmoscope, or otherwise, in preventing the unnatural adhesions which are so apt to occur in *iritis*, and also in preventing, or in remedying, prolapse of the *iris*. It is probable that the medicine lessens the congestive process in the eye by diminishing the calibre of the bloodvessels, and by lowering the sensibility of the retina to light. Both locally and internally, it is one of the most efficient remedies for *photophobia*. In all of those cases in which the eye is concerned, the action of belladonna may be obtained by smearing its extract, softened with water, around the orbit; but the use of atropia is both more cleanly and more efficient. The dryness of the skin produced by belladonna has been proved clinically to render it an efficient remedy for all forms of passive *perspiration*. The hectic sweats of phthisis, of profuse suppuration, of articular rheumatism, are all more or less under its control, and local and unilateral sweats have been arrested by its topical application. It is curious that in some cases the suspension of the cutaneous exhalation was followed by a compensatory diarrhœa. The requisite dose for checking perspiration is one that will produce a commencing dilatation of the pupil and a very slight dryness of the throat. A similar control over excessive *salivation* has been exhibited by this medicine when the symptom in question followed hemiplegia. The control of belladonna over the *mammary secretion* has long been known, and liniments containing it have been used for drying up the milk, or for diminishing it when excessive. The protective power of belladonna against the contagion of *scarlatina* has been both firmly maintained and vehemently denied. A careful examination of the evidence bearing upon the question has led us to the conclusion that so long as persons are under the influence of belladonna, as indicated by the state of the pupils, the throat, and the skin, the liability to contract scarlatina is very much diminished. Nor does there seem to be wanting a good reason why it should be so, since the mucous membrane of the throat and larynx is maintained by the drug in a condition unfavorable to absorbing the scarlatinous or any other morbid element that enters the body through these channels.

The *antagonism* of *belladonna* and *opium* has long been known and practically tested in cases of poisoning by the one or the other of those agents. Doubtless their antidotal action was suggested by their opposite actions upon the pupil. More recent observations have shown other points of opposition; thus, opium tends to produce coma, belladonna cerebral excitement, opium diminishes the internal and increases the cutaneous secretions, while belladonna increases the secretions of the gastro-intestinal tract and diminishes those of the skin; opium lessens the secretion of urine, but belladonna augments it; and, above all, opium exerts a depressing action upon the lungs and heart, while the functions of these organs are stimulated by belladonna. These opposite actions of the two medicines may surely be described by the single word antagonism, and neither experiments upon animals, however numerous, nor any amount of reasoning, however ingenious, can diminish its significance or its importance. Harley has shown, experimentally, that by removing the restraint due to partial collapse of the lungs, and by direct stimulation, also, belladonna relieves the distended heart; and clinical observation demonstrates that this special stimulant operation is the very one that is needed to preserve life in opium poisoning. Indeed, electricity, the cold dash, coffee, and other agents employed with success to combat the effects of this condition, can have no other mode of action. Every one who has witnessed the use of electricity or of flagellation in the successful treatment of opium narcotism, must have been convinced that these agents stimulate the lungs and heart, and so preserve life until the excess of the poison is eliminated or destroyed. It is evident that belladonna and its preparations can act in no other manner, and, indeed, clinical observation proves it; for, unless the condition of the patient is such as to allow him to be impressed by the physiological antidote, it can do no good; and, on the other hand, unless the dose of the antidote is such as to attain, without exceeding, the due degree of stimulation, it may do serious harm. It results from experience that repeated and small doses of belladonna, or of its alkaloid (from one-sixtieth to one-fortieth of a grain of the latter, hypodermically, is preferable), should be administered until the pulse and respiration acquire more force, and the pupil begins to be dilated, but care must be taken not to substitute the narcotic action of belladonna for that of opium. By observing these rules, a great many cases of opium poisoning have terminated favorably, which, without treatment, would probably have ended fatally.

Although poisoning by *physostigma* (Calabar bean) is uncommon, it should be known that belladonna (in the form of atropia) is the appropriate antidote for its effects. Its administration should be conducted upon the principles just set forth, and the guide for its dose and the frequency of its administration are to be found, also, in the dilating effect produced upon the contracted pupil.

Administration.—One grain is the primary dose of the powder of belladonna root or leaf. It should be gradually increased until the pupil begins to be affected. An infusion may be made with twenty grains of the leaves in half a pint of water, of which the dose is half a fluidounce every four or five hours. The tincture, fluid extract and extracts, and atropia are more frequently used than belladonna in substance. For external use the ointment and plaster, and various liniments containing the before-mentioned preparations, are employed.

BENZOIN.—Spice-Bush.

Wild allspice, Fever-bush, E.; *Laurier benzoin*, Fr.; *Benzoelorbeer*, G.

The bark and fruit of Benzoin odoriferum, *Nees.*, s. Lindera (Laurus, *Lin.*) benzoin, *Meissner.*

Nat. Ord.—Lauraceæ.

Origin.—The spice-bush is a shrub, about 10 to 15 feet high, common in damp woods of Canada and the United States. It has deciduous oblong-obovate, entire and smooth leaves, and produces in March and April lateral clusters of 4 or 5 yellow inconspicuous flowers.

Description.—1. The bark is in thin quills or curved pieces, yellowish or pale brown and smooth upon the inner surface, and blackish-brown, minutely dotted, with corky warts, somewhat glossy and nearly smooth upon the outer surface. It breaks with a short granular fracture, has an agreeable though not very strong odor, and an aromatic, somewhat pungent and astringent taste. Older bark has a brown-gray or dark-ash color, and more prominent corky warts.

2 The fruit is an obovate or oblong drupe, with a circular depressed scar of the pedicel, almost three-eighths inch long, red, after drying blackish and granular upon the surface, and contains a single large white seed, with plano-convex cotyledons, and having an oily taste. The fragile integuments of the fruit have a spicy taste, and, when bruised, an agreeable odor.

Constituents.—The bark was analyzed by J. Morris Jones (1873); it contains some tannin, fat, starch, sugar, tasteless resin, and volatile oil, which, on being treated with oxidizing agents, develops the odor of bitter almonds, and belongs to the cinnamyl series. The air-dried bark yields 3 per cent. of ash. P. M. Gleim (1875) obtained from the berries, by treatment with petroleum-benzin, 44 per cent. of a deep-red very aromatic oily liquid which is soluble in ether and chloroform, and partly soluble in alcohol, glycerin, and oil of turpentine. The fresh berries yielded by distillation 5 per cent. of a colorless volatile oil, having the specific gravity .87, and a fragrance somewhat like that of jessamine.

Medical Action and Uses.—The virtues of this plant, which depend upon its essential oil, are those of a vascular stimulant and diaphoretic. As such it has been used in the forming stage of acute *pulmonary inflammations* and *rheumatism*, and in chronic forms of the latter affection. It has also been employed as a *vermifuge*. During the Revolutionary War the berries are said to have been used as a substitute for allspice, and in the late civil war a similar use was made of them in the Southern States. The oil has served as an ingredient of embrocations for rheumatism, contusions, and other local painful affections, and internally to relieve *flatulent colic*. The bark and the berries are usually administered in decoction; the oil may be prescribed in alcoholic solution, or suspended in water by magnesia.

BENZOINUM, *U. S.*, *Br.*—BENZOIN.

Benzoe, P. G.; *Resina benzoe*, *Asa dulcis.*—*Gum benjamin*, E.; *Benzoin*, Fr.; *Benzoe*, G.

A balsamic resin obtained from Styrax benzoin, *D. C.* Philos. Trans., vol. lxxvii., plate 12.

Nat. Ord.—Styraceæ.

Origin.—The tree yielding benzoin is of medium height, has a hard dense wood, large branches forming a beautiful crown, a handsome dark-green, underneath white hairy foliage, and reddish or white flowers in axillary racemes. It is indigenous to Borneo, Java, and Sumatra, and probably also to Cochinchina and Siam, though it is not unlikely that the benzoin coming from the latter country may be produced by a different species.

Collection.—The tree is cultivated in Sumatra to a considerable extent, but benzoin is also obtained from wild trees. When about 6 or 7 years old, the trunks are about as many inches in diameter, and incisions are then made through the bark, when a white liquid resin commences to exude slowly; when sufficiently hard, this is scraped from the bark. During the first three years the resin contains a large number of white tears, and is then called by the Malays *head benzoin.* During the next 7 or 8 years the white tears decrease in number, and the product is termed *belly benzoin.* At the expiration of this time the exudation is considerably diminished, the tree cut down, and an inferior quality, called *foot benzoin*, scraped from the wood.

Siam benzoin is likewise collected from incisions.

Commerce.—At the ports of Sumatra benzoin is received in the form of cakes wrapped in matting, and after having been softened by heat is packed in chests and sent to Penang and Singapore, whence it finds its way into general commerce. In Siam, benzoin is carried on bullock's backs to the Menam River and then shipped to Bangkok, whence it is exported to other countries. In the year 1866–1867, 5827 lbs. of benzoin were imported into the United States. In the recent statistical reports, benzoin is enumerated with other resins and gum resins.

Description.—Sumatra benzoin is met with in commerce usually in the form of large rectangular blocks, which consist of milk-white opaque tears, varying in size and frequently quite small, always agglutinated by a brown-gray resin. In the interior it frequently presents a mere mottled or variegated, but no distinct amygdaloid appearance. It has an agreeable odor, distinct from and weaker than that of Siam benzoin. It is always mixed with fragments of bark, of which the inferior kinds almost exclusively consist.

Siam benzoin has mostly a similar appearance, the inferior varieties consisting mainly of a reddish-gray resin, which upon a fresh fracture is brown-red, mottled with lighter spots, but containing few or no tears. The better quality is distinctly amygdaloid in appearance, on account of the milk-white tears which are up to one-half inch and more in diameter. The resin is often porous, and crystals of benzoic acid are observed in the cavities. In the finest amygdaloid variety the tears largely preponderate over the brown translucent resin, which is nearly entirely absent in the *benzoin in tears*. This variety is met with in separate or loosely agglutinated, roundish or flattened pieces, not often exceeding one inch in diameter, which are of a reddish-yellow color externally, and internally white or striped. The odor of Siam benzoin is pleasantly balsamic, somewhat like that of vanilla.

Impurities are present to a larger or smaller extent in all varieties of cake benzoin.

Constituents.—Benzoin contains several resins, a trace of volatile oil, and from 12 to 20 per cent. of benzoic acid. Kolbe and Lautemann (1860) found in Siam benzoin also cinnamic acid, and the same acid was observed in Sumatra benzoin by Aschoff (1861). The quantity of cinnamic acid varies considerably, and it is often altogether absent. The cause of its presence has not been ascertained. The white tears often contain less benzoic acid than the resin. This portion consists of about four resins, which are alike or nearly so in their composition and behavior to alcohol, in which they are soluble, and to caustic potassa; by treating them with fused potassa, paraoxybenzoic acid, $C_7H_6O_3$, and protocatechuic acid are obtained, besides products of secondary decomposition.

The presence of cinnamic acid in benzoin is determined by an oxidizing agent which will develop the odor of bitter almonds. For this purpose the tincture of benzoin may be precipitated by hot water, filtered from the resin, and the filtrate treated with a solution of potassium permanganate, or chlorinated lime. Or the benzoin may be triturated with peroxide of lead, and the mixture boiled with water.

Off. Prep.—Acidum benzoicum, *U. S.*, *Br.*; Adeps benzoatus, *Br.* (Ung. benzoini, *U. S.*); Tinct. benzoini, *U. S.*; Tinct. benzoini comp., *U. S.*, *Br.*

Physiological Action and Medical Uses.—The internal action of benzoin has been considered in connection with benzoic acid, upon whose presence the virtues of the balsam chiefly depend; but the resin and volatile oil, which it also contains, communicate to it other qualities which assimilate it with the resins in general. Like these, it is a general and local stimulant, tending to elimination by the mucous membranes. This fact accounts for its established reputation in the treatment of chronic *bronchitis* and chronic *diarrhœa* and *dysentery*. In the first of these affections the compound tincture of benzoin, or Turlington's balsam, has long been famous, and of all its class of medicines none exceeds it in utility in this disease. Locally, the tincture is a most excellent stimulant. The *dose* is stated to be from ten to forty grains, but benzoin is never administered in substance.

BENZOLUM.—Benzol.

Benzene, E.; *Benzole*, *Benzène*, Fr.; *Benzol*, *Benzen*, G.
Formula C_6H_6. Molecular weight 78.

Preparation.—Benzol is obtained by the dry distillation of benzoic acid mixed with excess of lime, and by agitating the oily distillate with potassa solution, and rectifying. It is largely obtained from *coal-tar*, one of the secondary products of the coal-gas manufacture; on subjecting it to distillation, water and ammonia pass over, accompanied by a brown oily liquid (8 or 10 per cent. of the tar), known as *light oil*, because it floats on water. Subsequently *dead oil* is obtained, as an oily liquid heavier than water, and containing anilina, quinolina, naphthalin, carbolic acid, etc.; the residue in the retort constitutes pitch, and is used in place of asphaltum. The light oil contains mainly *benzol*, *toluol* (C_7H_8), *xylol* (C_8H_{10}), and *isocumol* (C_9H_{12}), and, after rectification to free it from some dead oil, is known in commerce as *coal naphtha*, which owes most of its disagreeable odor to volatile bases, which are removed by agitation with dilute sulphuric acid. The hydrocarbons are separated from one another by repeated fractional distillation, until liquids of a nearly constant boiling point are obtained. The fraction boiling near 80° C. (176° F.) consists chiefly of benzol, that with the boiling point 110° C. (230° F.) of toluol, that distilling near 140° C. (284° F.) of xylol, and the portion coming over near 170° C. (338° F.) of isocumol. The benzol may be further purified by exposing it to a low temperature, and expressing the portion remaining liquid.

Properties.—At the ordinary temperature, benzol is a thin colorless, very inflammable liquid, of considerable refractive power, and a strong odor of coal-gas. It congeals at the freezing point of water, melts again at 5.5° C. (42° F.), and boils between 80° and 85° C. (176° and 185° F.). It is nearly insoluble in water, readily soluble in alcohol, methylic alcohol, ether and acetone, dissolves some phosphorus, sulphur and iodine, and considerable quantities of fats, volatile oils, caoutchouc, gutta percha, and some resins. To distinguish it readily from *petroleum benzin*, Pusch (1875) recommends iodine, which dissolves in the latter with a raspberry-red, and in benzol with a violet-red color; the former color is stated to be so intense that a small admixture of benzin can be recognized. The name *benzin* was formerly used, and is still used to some extent for benzol, but is best discarded as a synonym for the latter.

Composition.—Benzol is the hydride of phenyl, HC_6H_5; the hydrate of the same radical, C_6H_5HO, is carbolic acid.

Pharmaceutical Uses.—Benzol is useful as a solvent for some alkaloids, and the substances mentioned above, but is chiefly employed in the manufacture of nitrobenzol and anilina, which see.

Physiological Action and Medical Uses.—According to Husemann, the vapors of benzol are destructive of insects, but pigs tolerate very large doses of it, *e. g.*, three or four drachms. In man the fumes produce a sort of intoxication, narcotism, and anæsthesia. As much as fifty drops have been given to trichina patients without injury, but the continued use of the oil produces the effects just mentioned. It has been employed in the treatment of *scabies;* but although it destroys the itch insects, it does not affect their eggs. It has been tried in *trichiniasis*, but ineffectually. Like creasote and carbolic acid, it restrains fermentation in certain forms of *dyspepsia*.

BERBERIS, *U. S.*—BARBERRY BARK.

Cortex radicis berberidis.—Ecorce de racine de berbéride (épine-vinette, vinettier), Fr.; *Berberitzen- (Saurach-, Sauerdorn-), Wurzelrinde*, G.

The bark of the root of Berberis vulgaris, *Lin.* Bentley & Trimen, Med. Plants, 16. *Nat. Ord.*—Berberidaceæ.

Origin.—The barberry is a shrub 6 to 8 feet high, with three-parted spines, fascicles of obovate-spatulate and bristly serrulate leaves, yellow flowers in pendulous racemes, and oblong one-celled scarlet berries of an acidulous taste. It is indigenous to Western Asia and the greater part of Europe, and has been naturalized in thickets and waste grounds in New England and other parts of North America. In Europe, the entire root is usually employed, but the U. S. Pharmacopœia recognizes only the bark of the root.

Description.—The thick and branching root has a tough wood of a pale lemon-yellow color, distinctly porous from the rather large vessels, which are arranged in concentric circles, and with plainly visible medullary rays. The rather thin bark is found in small irregular pieces, is externally of a yellowish-gray, and upon the nearly smooth inner surface, of an orange-yellow color; the corky layer is soft, and the deep yellow bast fibres are in tangential rows imbedded in a yellow parenchyma which is striate by medullary rays. The nearly inodorous bark has a strongly bitter taste, and imparts to the saliva a yellow color; its infusion does not yield a black precipitate with ferric salts.

Constituents.—According to the analysis of Polex (1836), barberry bark contains berberina, oxyacanthin, some starch, and tannin producing dark-green precipitates with iron salts, besides the usual constituents of vegetables.

Berberina, or berberia, was first discovered by Chevallier and Pelletan (1826) in the bark of Xanthoxylum clava Herculis, and named *xanthopicrit;* its identity with berberina was proved by Perrins (1862). A. Buchner obtained it (1835) crystallized from barberry root, believed it to possess acid properties, and named it berberin. It had been previously separated in an impure condition by Brandes (1825), and by Buchner (1830). G. Kemp (1841) noticed that it forms crystallizable compounds with various mineral and organic acids; but its alkaloidal nature was first proven by Fleitmann (1846). Since then it has been discovered in numerous plants of the orders Berberidaceæ, Ranunculaceæ, Menispermaceæ, etc. (See papers in *Am. Journ. Pharm.*, 1863, pp. 97, 301, and 456).

For the preparation of berberina, Procter (1864) gives a process which is based upon those of Buchner and Fleitmann. The root of hydrastis is exhausted with boiling water, the decoction evaporated, the soft extract exhausted by strong alcohol, some water is added, most of the alcohol distilled off, and then an excess of sulphuric acid added, when, on cooling, sulphate of berberina crystallizes, requiring recrystallization from hot water for purification. Its solution in hot water is then decomposed by freshly precipitated oxide of lead (caustic baryta, *Fleitmann*), and the filtrate allowed to crystallize. It forms fine yellow needles, which lose at 100° C. (212° F.) nearly 19.5 per cent. of water, fuse at 120° C. (248° F.), are insoluble in ether and petroleum benzin, dissolve slightly in cold water and benzol, and more freely in alcohol. Its composition is $C_{20}H_{17}NO_4$ (Perrins). By adding to its hot solution an excess of acid, crystals of neutral or acid salts are obtained, which are usually of a bright or golden-yellow color, have a bitter taste, and are very slightly soluble in acidulated water. Dissolved in hot alcohol, the salts of berberina yield, with solution of iodine in potassium iodide, dark green scales, of a metallic lustre, and appearing reddish-brown in transmitted light; if an excess of iodine be employed, the crystals are of a red-brown color in reflected light. This behavior is recommended by Perrins as a convenient test for this alkaloid. Muriate of berberina assumes with chlorine a blood-red color (Buchner). Fused with potassium hydrate, berberina is decomposed, yielding two acids, one of which is sublimable, and vapors having the odor of chinolin (Hlasiwetz and Gilm).

Oxyacanthin remains in the mother-liquor from which the berberina salt has been precipitated by an acid. To avoid confusion with principles in Cratægus oxyacantha, Berzelius proposed to call it *berbina*, and Wacker suggested the name of *vinetina*. It is a white alkaloid, soluble in ether, alcohol, and chloroform, nearly insoluble in water, and has a bitter taste and an alkaline reaction. Sulphuric acid colors it brown-red, the colors changing, on heating, to bright red and brown. Nitric acid imparts a yellow, and, when heated, a purple color.

Allied Species.—In India, the root bark of BERBERIS ARISTATA, *D.C.*, B. ASIATICA, *D.C.*, and B. LYCIUM, *Royle*, is employed as a tonic; it contains berberia in abundance.

In Oregon, the bitter bark of a tree is used as a tonic under the name of barberry bark or *chittam bark;* we have not yet ascertained its origin. It is about $\frac{1}{16}$ inch thick, externally purplish-brown, with transverse, oblong, whitish spots, and larger grayish-white patches. Internally, it is brownish-yellow, the inner surface smooth. Its taste is bitter.

BERBERIS (MAHONIA, *De C.*) AQUIFOLIUM, *Pursh.*, is found on the west coast of North America, principally in the Coast Range and Cascade Mountains, from Vancouver's Island south to California and Colorado. It is an under-shrub having a stem only a few inches high, annulated from the leaf-scars, with a whitish or light brownish-yellow thin bark, which is deeper yellow within, and covers a tough white wood, striate by fine medullary rays, and inclosing a white pith. The long horizontal rhizome is knotty and crooked, from the size of a quill to an inch in diameter, externally of a dingy yellowish-brown, otherwise resembling the stem. The bark has a bitter taste, and, according to the analysis of P. Neppach (1878), contains berberina.

Physiological Action.—This bark has long been employed in India as a tonic and febrifuge. Its virtues appear to depend upon berberina, which has also been found in several other medicines used as bitter tonics. It was administered hypodermically to rabbits by Falck and Guenste. But the effects produced were not uniform. In one experiment they observed depression, paralysis, convulsions, and resolution, followed by death. In a second, in addition to such symptoms, profuse salivation, hurried and shallow breathing, anæsthesia, etc.; but the animal recovered. In a third case no sensible results were produced. Nearly fifty grains given to a dog, in divided doses, caused no definite effects; but a strong solution of muriate of berberina thrown into the veins occasioned salivation, diarrhœa, convulsions, paralysis, and tremulousness, which last symptom continued for some time after the other phenomena had disappeared. In man, doses of fifteen or twenty grains occasioned some diarrhœa with or without colic. Small doses, on the other hand, appeared to increase the appetite and confine the bowels.

Medical Uses.—Berberina is supposed to act as a stomachic tonic and to increase the secretion of bile. It has been used in atonic *dyspepsia*, especially in that condition following cholera; in *diarrhœa* from the same cause, in infantile and tuberculous diarrhœa, etc. In a word, it seems to be adapted to such cases as are usually treated with columbo. It has also been used with alleged success in reducing the *spleen* enlarged by malarial poisoning. It may be given in doses of from two to five grains in pill or powder, or in alcoholic solution.

BETULA.—BIRCH.

Bouleau, Fr.; *Birke*, G.

The bark, leaves, and saccharine juice of different species of Betula.

Nat. Ord.—Betulaceæ.

Origin.—This genus comprises shrubs and trees, which are indigenous to the northern hemisphere, have alternate simple and straight-veined leaves, drooping staminate catkins and shorter cylindrical fertile catkins, producing broadly winged nutlets. The young twigs and leaves of most species are pungently aromatic; the bark is more or less completely separable into thin concentric layers, and when wounded in the spring exudes a juice having a sweet and somewhat acidulous taste.

Description and Constituents.—BETULA ALBA, *Lin.*, is a slender and graceful tree, indigenous to Northern Asia, Europe, and America, in the latter continent as far south as Pennsylvania. There are several varieties, varying in height from 15 to 75 feet. The bark of the branches is brownish and verrucose, of the trunk white, smooth, separating in thin sheets, and of an astringent, somewhat bitterish taste. The leaves are triangular-deltoid, acuminate, doubly serrate, light-green, shining, and of an astringent taste, when young glandular and pungent. The buds and young twigs yield by distillation one-third per cent of a colorless *volatile oil*, having a balsamic and pungent odor, and by the dry distillation of the bark a light brown-red *empyreumatic oil of birch* is obtained having a strong and persistent odor of Russia leather. The bark contains also a camphoraceous body, *betulin*, $C_{24}H_{36}O_2$, which forms light flocculent crystalline masses, fusible above 200° C. (392° F.), subliming when heated with care, and soluble in ether, volatile oils, and alcohol.

BETULA PAPYRACEA, *Ait.*, the *Canoe birch*, grows in Canada and the northern part of the United States, has ovate, heart-shaped, taper-pointed leaves, and a tough white bark splitting into thin papery layers, which are used by the Indians in making canoes.

BETULA LENTA, *Lin.; Sweet, black, or cherry birch.* It is indigenous to Canada and the northern part of the United States, has oblong heart-shaped and acuminate leaves, which are pubescent on the veins beneath, and a brownish-white bark, the outer layers of which are slightly laminate, and the inner layers close and reddish-brown. The bark and leaves yield a volatile oil, which Procter (1843) found to be identical with oil of gaultheria. It does not pre-exist in the plant, but is formed by the action of water and an unknown compound of the bark upon *gaultherin.* This principle is syrupy, colorless, soluble in alcohol and water, insoluble in ether, and when distilled with dilute sulphuric or muriatic acid, yields oil of gaultheria.

Medical Action and Uses.—White birch is a popular remedy in the north of Europe. The sap is held to be a purifier of the blood, and is in general use for the cure of scaly diseases of the *skin*, *rheumatic* and *gouty* disorders, chronic affections of the *bladder*, *scurvy*, and *intermittent fever.* The fresh leaves are used to form a bed in which rheumatic patients lie, and which excites profuse sweating. Reduced to a pulp, and mixed with gunpowder and cream, the bark is thought to be a sovereign remedy for the *itch.* A similar pulp mixed with oil is reputed to be efficient in discussing *scrofulous* enlargements of the glands. The oil of birch is likewise employed to cure chronic *cutaneous eruptions*, and is taken internally for the relief of *gonorrhœa.* The American species (sweet birch) also appears to possess stimulant qualities; the bark and leaves are sometimes used to prepare diaphoretic infusions.

BIDENS.—SPANISH NEEDLES.

The herb of Bidens bipinnata, *Lin.* *Nat. Ord.*—Compositæ, Senecionideæ.

Description.—This annual smooth weed is indigenous to the United States, and attains a height of about 3 feet. The stem is quadrangular; the leaves are opposite, broadly ovate in outline, bipinnately dissected, the divisions lanceolate, mostly wedge-shaped at the base; the flower-heads are small, on long peduncles, have a double involucre, 3 or 4 short, yellow, and dark-veined ray florets, and slender quadrangular 3- or 4-awned achenes. The plant has a disagreeable odor when rubbed, and an herbaceous, afterwards acrid taste. Its constituents have not been investigated.

Allied Species.—Bidens tripartita, *Lin.; Chanvre aquatique, *Fr.;* Wasserhanf, *G.;* indigenous to Europe, has three-lobed serrate leaves, yellow tubular florets, and two-awned achenes. It was employed like the preceding. The same common names are applied in Europe to Bidens cernua, *Lin.*, Bur-marigold, *E.*, which is also indigenous to Canada and the United States south to Virginia; it is known by its lanceolate, serrate, somewhat connate leaves, its nodding flower-heads with or without pale yellow rays, and its flat, retrorsely-barbed, two-awned achenes.

Medical Uses.—There appears to be nothing to be added to the statement long ago made respecting this plant, that its roots and seeds have a popular reputation as *emmenagogues*, and as remedies for acute *laryngeal* and *bronchial* affections; whence it may be inferred to be a stimulant, and, when suitably administered with hot water, a diaphoretic.

BISMUTHI OXIDUM, *Br. Add.*—OXIDE OF BISMUTH.

Bismuthum oxydatum, Oxydum bismuthicum.— Oxyde de bismuth, Fr.; *Wismuthoxyd,* G.

Formula Bi_2O_3. Molecular weight 468.

Preparation.—Take of Subnitrate of Bismuth one pound; Solution of Soda four pints. Mix and boil for five minutes; then, having allowed the mixture to cool and the oxide to subside, decant the supernatant liquid, wash the precipitate thoroughly with distilled water, and finally dry the oxide by the heat of a water-bath. *Br.*

In this process the subnitrate of bismuth is decomposed by the soda, nitrate of sodium and white hydrate of bismuth being formed, the former of which remains dissolved in the water. $2(BiNO_4.H_2O) + 2NaHO$ yields $Bi_2 6HO$ (or $Bi_2O_3.3H_2O$) $+ 2NaNO_3$. At the temperature of boiling water the hydrate of bismuth parts with its water, leaving the anhydrous oxide.

Properties.—Oxide of bismuth forms a dull-yellow, more or less crystalline powder, which dissolves in acids without effervescence, and when heated to incipient redness is not diminished in weight. At a higher temperature it fuses to a brown mass, which becomes yellow again on cooling. The oxides of lead and silver are likely to be present as impurities, and are detected by dissolving in nitric acid, and testing as described under Bismuthi subnitras.

BISMUTHI SUBCARBONAS, *U. S.*—SUBCARBONATE OF BISMUTH.

Bismuthi carbonas, Br.; *Bismuthum subcarbonicum*, *Subcarbonas bismuthicus*.—*Carbonate of bismuth*, E.; *Sous-carbonate de bismuth*, Fr.; *Basisches kohlensaures Wismuthoxyd*, G.

Formula $(BiO)_2CO_3$. Molecular weight 512; or $(BiO)_2CO_3.H_2O = 530$.

Preparation.—Take of Bismuth in pieces two troyounces; Nitric Acid eight troyounces and a half; Water of Ammonia five fluidounces; Carbonate of Sodium ten troyounces; Distilled Water a sufficient quantity. Mix four troyounces and a half of the nitric acid with four fluidounces of distilled water in a capacious glass vessel, and, having added the bismuth, set the whole aside for twenty-four hours. Dilute the resulting solution with ten fluidounces of distilled water, stir it thoroughly, and, after twenty-four hours, filter through paper. To the filtered liquid, previously diluted with four pints of distilled water, slowly add the water of ammonia, diluted with an equal measure of distilled water, constantly stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with two pints of distilled water, and drain it again. Then place the precipitate in a proper vessel, add the remainder of the nitric acid, and afterwards four fluidounces of distilled water, and set the solution aside. At the end of twenty-four hours filter through paper.

Dissolve the carbonate of sodium in twelve fluidounces of distilled water, with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of nitrate of bismuth, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with distilled water until the washings pass tasteless. Lastly, dry it on bibulous paper with a gentle heat, and rub it into powder. *U. S.*

Take of purified Bismuth in small pieces two ounces; Nitric Acid four fluidounces; Carbonate of Ammonia six ounces; Distilled Water a sufficiency. Mix the nitric acid with three ounces of distilled water, and add the bismuth in successive portions. When the effervescence has ceased, apply for ten minutes a heat approaching that of ebullition, and afterwards decant the solution from any insoluble matter that may be present. Evaporate the solution until it is reduced to two fluidounces, and add this in small quantities at a time to a cold filtered solution of the carbonate of ammonia in two pints of distilled water, constantly stirring the mixture as it is formed. Collect the precipitate on a calico filter, and wash it with distilled water until the washings pass tasteless. Remove now as much of the adhering water as can be separated from the precipitate by slight pressure with the hands, and finally dry the product at a temperature not exceeding 150° F. *Br.*

In the process of the British Pharmacopœia a solution of bismuthous nitrate is first formed and concentrated by evaporation, when it is added to a cold solution of an alkaline carbonate. The United States Pharmacopœia assumes the presence, in the metallic bismuth, of some arsenic, which is also oxidized by the nitric acid, so that arseniate of bismuth is found in the solution; on diluting it somewhat with water most of the arseniate is gradually and slowly deposited as a white precipitate. The clear solution is now added to an excess of ammonia, which combines with the nitric and the remaining arsenic acid, so that the precipitated and well washed hydrate of bismuth is nearly free from arsenic. By dissolving the hydrate again in nitric acid, and adding this to an alkaline carbonate, the bismuthous carbonate is obtained. In following this process, it is important that the dilution with water should be carried far enough until a turbidity is observed, which does not disappear completely on stirring;

this solution should be set aside for a sufficient length of time as indicated; the acid solutions should be added slowly and with continual stirring to the alkaline solutions, in order to insure the complete decomposition of the acid salt; and the washing should not be continued for too long a time, in order to avoid gradual decomposition of the subcarbonate into hydrate. If the final precipitation be effected at a boiling temperature, an anhydrous subcarbonate would be precipitated.

The final reaction is explained by the equation $2(Bi3NO_3) + 3Na_2CO_3 = (BiO)_2CO_3 + 6NaNO_3 + 2CO_2$, showing that carbonic acid gas is given off.

Properties and Tests.—Bismuthous subcarbonate is a white or yellowish-white powder, inodorous and tasteless; insoluble in water, but soluble with effervescence in nitric acid diluted with half its volume of water; and when this solution has been saturated with the powder, it will yield a white precipitate on being added to water. Neither dilute sulphuric acid nor solution of silver nitrate occasions a precipitate in the nitric acid solution (absence of lead and chloride). On adding the powder to sulphuric acid, tinged blue with solution of indigo, the color of the latter is not discharged (absence of nitric acid). Subjected to Marsh's test, it yields no arsenic, or merely a trace. Arsenic is more conveniently detected by boiling subcarbonate of bismuth with zinc and an excess of potassa solution in a test-tube, the mouth of which is covered with a piece of white filtering paper moistened with solution of silver nitrate, which will change to gray or black if arsenic is present. When the powder is heated to redness, it gives off water and carbonic acid, and loses 9½ per cent. of its weight (*U. S.*); anhydrous carbonate would lose 8.6, and the monohydrated 11.7 per cent. of weight; a partial decomposition of the salt has therefore taken place, mainly occasioned by the loss of water in drying.

Medical Action and Uses.—Introduced as a substitute for subnitrate of bismuth, this preparation was claimed to possess the advantages of greater solubility in the gastric juices, and therefore to be less likely than the subnitrate to confine the bowels and color the stools. But these effects should not be considered advantages, for they would unfit the salt completely for being used in the class of cases in which the subnitrate has been found advantageous only because it is nearly insoluble. *Dose*, from ten to sixty grains, suspended in water.

BISMUTHI SUBNITRAS, *U. S.*, *Br.*—SUBNITRATE OF BISMUTH.

Bismuthum subnitricum, P. G.; *Bismuthum hydrico-nitricum*, *Magisterium bismuthi*, *Subazotas (s. subnitras) bismuthicus.*—*Sous-azotate de bismuth*, Fr.; *Basiches salpetersaures Wismuthoxyd*, G.

Formula $BiONO_3.H_2O$. Molecular weight 306.

Preparation.—Take of Bismuth in pieces two troyounces; Nitric Acid, Carbonate of Sodium, each ten troyounces; Water of Ammonia six fluidounces; Distilled Water a sufficient quantity. Mix four troyounces and a half of the nitric acid with four fluidounces of distilled water in a capacious glass vessel, and, having added the bismuth, set the whole aside for twenty-four hours. Dilute the resulting solution with ten fluidounces of distilled water, stir it thoroughly, and at the end of twenty-four hours filter through paper.

Dissolve the carbonate of sodium in twelve fluidounces of distilled water with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of nitrate of bismuth, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with distilled water until the washings pass tasteless, and drain again as completely as possible. Then place the moist precipitate in a capacious vessel, gradually add the remainder of the nitric acid, and afterwards four fluidounces of distilled water, and set the solution aside. At the end of twenty-four hours filter through paper, and to the filtered liquid, previously diluted with four pints of distilled water, slowly add the water of ammonia, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with two pints of distilled water, and dry it again. Lastly, dry it upon bibulous paper with a gentle heat, and rub it into powder. *U. S.*

Take of Purified Bismuth in small pieces two ounces; Nitric Acid four fluidounces; Distilled Water a sufficiency. Mix the nitric acid with three ounces of distilled water, and add the bismuth in successive portions. When effervescence has ceased, apply for ten minutes a heat approaching that of ebullition, and decant the solution from any insoluble matter that may be present. Evaporate the solution until it is reduced to two fluidounces, and pour it into half a gallon of distilled water. When the precipitate which forms has subsided, decant the supernatant liquid, add half a gallon of distilled water to the precipitate, stir them well together, and after two hours decant off the liquid, collect and drain the precipitate in a calico filter, press it with the hands, and dry it at a temperature not exceeding 150° F. *Br.*

The first process takes cognizance of the arsenic which is usually present in commercial bismuth. By dissolving the metal in nitric acid, the latter is partly decomposed, nitrous acid vapors being evolved and water generated, while the bismuth dissolves, forming bismuthous nitrate, thus: $Bi_2+8HNO_3=2Bi3NO_3+2NO+4H_2O$. Other metals likely to be present are dissolved with the formation of nitrates, except arsenic, which is oxidized to arsenic acid. On diluting the solution, which is strongly acid, with sufficient water until a turbidity begins to form without disappearing again on stirring, the arseniate of bismuth in solution becomes sparingly soluble, and is mostly deposited in the course of 24 hours, and may then be removed by filtration. On adding the filtrate slowly to an excess of an alkaline carbonate, the bismuth is precipitated as subcarbonate, together with the other metals, except arsenic, nearly the whole of which will remain in solution as arseniate of sodium, and may be removed by washing with water. The precipitated subcarbonate is again converted into nitrate, and this solution again set aside for 24 hours, to remove any arseniate of bismuth which may separate. The filtered liquid of bismuthous nitrate is now mixed with water, when subnitrate of bismuth will be precipitated, a portion of the bismuth remaining in solution in the liberated nitric acid; the decomposition is shown by the equation, $6(Bi3NO_3)+10H_2O=5(BiONO_3.H_2O)+Bi3NO_3+10HNO_3$. In order to recover the bismuth remaining dissolved in the acid liquid, the latter is nearly neutralized with ammonia, when an additional quantity of bismuthous subnitrate will be precipitated, thus: $Bi3NO_3+2NH_4HO=BiONO_3+2NH_4NO_3$, nitrate of ammonium being formed at the same time. Under no consideration must the solution be allowed to become neutral, lest the other metals (iron, copper, etc.) which may be present would likewise be precipitated; the ammonia should be added in a thin stream and with constant stirring, to avoid even the partial formation of the hydrate of any of the metals, which, particularly towards the close of the process, would again be converted into nitrate with difficulty. It is probably on this account that the British Pharmacopœia simply precipitates the solution of the pure bismuthous nitrate with water, preferring rather to lose some bismuth than to contaminate the preparation with another compound. In all cases, however, the acid mother-liquor may be treated with an alkaline carbonate to recover the bismuth remaining in solution, and the deposits of bismuthous arseniate may be freed from the latter metal by boiling with excess of alkali, after which the undissolved portion may again be worked up by the officinal process for subnitrate.

Properties.—Subnitrate of bismuth is a heavy, white powder, in minute crystalline scales and of a somewhat satiny appearance. It has a faintly acid odor and taste, and, when moistened on litmus paper, a decidedly acid reaction. It is entirely soluble, without effervescence, in nitric acid, and the solution yields no precipitate with dilute sulphuric acid or with solution of silver nitrate (absence of lead and chlorides). When mixed with sulphuric acid diluted with an equal bulk of water, it dissolves, and the solution acquires a black color on the addition of ferrous sulphate (presence of nitrates). It should be entirely free from arsenic, or contain only traces of that metal, so that a small portion of it when treated by Fleitmann's test as described above (see page 22), produces merely a gray stain upon the filtering paper moistened with solution of silver nitrate. When heated to redness, it loses about 20 per cent. of its weight, bismuthous oxide, Bi_2O_3, remaining behind; its formula would require a loss of 23.5 per cent.

The difference between the calculated and the actual loss sustained upon heating to redness, may be due to drying the officinal compound at too high a temperature, it losing one-half its water at 110° C. (230° F.). But usually it is owing to changes in its composition, occurring during its preparation under the following circumstances: if the salt is left for too long a time in contact with the acid mother-liquor, an oxynitrate of the formula $4BiONO_3.BiH_3O_3.3H_2O$ is gradually formed; by precipitating the solution with water of about 50° C. (122° F.), an oxynitrate is obtained having the composition $5BiONO_3.BiH_3O_3.3H_2O$; and by washing the officinal or the above compounds for some time with water, they are decomposed into still more basic salts of the formulas $3BiONO_3.BiH_3O_3.3H_2O$ and $3BiONO_3.2BiH_3O_3.H_2O$. The loss by ignition of these non-officinal oxynitrates ranges between 16 and 20 per cent.

When the solution of bismuth in nitric acid is somewhat evaporated and then allowed to cool, large prismatic crystals of *bismuthous nitrate*, $Bi3NO_3.5H_2O$, are obtained which are free from arsenic. By redissolving these crystals in nitric acid, and adding the requisite quantity of water to the solution, a precipitate of the officinal subnitrate is obtained which is free from arsenic. The crystallized nitrate fuses at a moderate heat and at about 80° C. (176° F.) parts with a portion of its water and nitric acid. Mr. Balmanno Squire (1876) found the bismuthous nitrate to be soluble in glycerin, and this solution, when recently made, is miscible with water without being precipitated. Mr. J. Williams observed that heat must be avoided in preparing the solution and after diluting it with water, and that potassa and soda cause in it a white precipitate, which is dissolved by an excess of the alkali, the alkaline solution being miscible with water, but not with alcohol. Mr. W. W. Moorhead (1877) proposed a *glycerite of nitrate of bismuth* using two troyounces of the crystals to sufficient glycerin to make eight fluidounces. The salt may thus be prescribed in a perfect solution, which may be diluted by the patient when using it.

Off. Prep.—Bismuthi oxidum, Trochisci bismuthi, *Br.*

Physiological Action.—There is no doubt that, practically subnitrate of bismuth is insoluble in the gastro-intestinal juices. Long ago, it is true, Orfila detected its presence in the liver, the spleen, and the urine, and his statements have been confirmed and extended by recent observations. Nevertheless, the quantity absorbed is quite inconsiderable, and there is nothing to show what the action is, if any, of that portion. Pure subnitrate of bismuth appears to act upon the stomach and bowels simply by coating their mucous membrane with a virtually insoluble and at the same time perfectly unirritating substance, which protects it against the action of the contents of these viscera, and at the same time probably restrains their secretions. There is no doubt that it may be taken in unlimited doses without occasioning any signs of irritation whatever. When, as sometimes has happened, in experiments on animals and in clinical experience, the medicine has produced all the effects of a corrosive poison, an examination of the specimen used has shown it to be adulterated with arsenic, or rather that the arsenic which is naturally associated with bismuth has not been completely separated from it in the manufacture; or else that the preparation used was the nitrate and not the subnitrate of bismuth. Pure subnitrate of bismuth occasions no morbid symptoms, but confines the bowels, and blackens and deodorizes the feces. After death, in persons who have been using it freely, the gastric mucous membrane presents no peculiarities, but that of the small intestine is in parts bluish, and the colon and rectum are stained black by the combination of the bismuth with the sulphurous secretions of the part.

Medical Uses.—Subnitrate of bismuth was originally employed to relieve certain chronic and painful affections of the stomach, which appear to have been *gastralgia* and *simple ulcer* of that organ. It is probable that the latter was the disease most commonly treated successfully, and that it was sometimes associated with neuralgia of the stomach. It is certain that pure gastralgia is not peculiarly benefited by bismuth, and that simple ulcer is signally improved by it. If the pain is greatest upon taking food there is probably ulcer; if the paroxysms occur when the stomach is empty, they are probably neuralgic. Ulcerated *cancer* of the stomach is favorably influenced by subnitrate of bismuth, which, as in simple ulcer, forms a covering to the raw and irritable surface, and thereby lessens pain and vomiting. In almost every form of *diarrhœa* due to irritation or ulceration of the intestinal coats, this medicine is of the utmost service, in all those cases, indeed, for which chalk has for a long time been employed. The premonitory diarrhœa of *cholera* is generally under its control, when it is given in doses of not less than thirty or forty grains; and the same is true of the evacuations of *cholera infantum*. There is no better agent for controlling the diarrhœa of *typhoid fever*, when this is excessive at any period of the disease, and especially during its decline; and the same is true of *tuberculous diarrhœa*, provided that the doses of the medicine are large, and of all forms, indeed, of chronic diarrhœa and *chronic dysentery*.

As a topical application subnitrate of bismuth is useful wherever a neutral protective and absorbent powder is indicated. Nothing is superior to it as an application for superficial abrasions and ulcerations; as in *intertrigo*, slight *burns*, confluent *variola*, *eczema*, *zona*, *fissures of the anus*, *chapped nipples*, *lips*, and *hands*, and *leucorrhœa*. In the last-named disease powdered bismuth on a roll of charpie should be introduced into the vagina through a speculum, and withdrawn after six or eight hours. Subnitrate of bismuth is an efficient remedy for acute *coryza* when repeatedly and thoroughly snuffed into the nostrils. Its efficacy may be increased by associating with it morphia and powdered gum arabic, *e. g.*, muriate of morphia, gr. j; powdered gum arabic, ʒj; subnitrate of bismuth, ʒiij. In chronic coryza the following powder has been strongly recommended as a snuff: subnitrate of bismuth four parts, liquorice powder eight parts, iodide of sulphur thirty parts. In most of these affections the cure will be hastened by associating with the bismuth oxide of zinc in the proportion of about one-fourth. In some cases of scrofulous *ozæna* cures have been effected by forcibly snuffing the finely powdered subnitrate into the nostrils, and daily cleansing the passages by means of the douche. Sometimes the subnitrate is topically applied suspended in water, which appears to be irrational; and sometimes in glycerin, which is less so, since the glycerin, if pure, tends to rob the tissues of their moisture.

The *dose* of subnitrate of bismuth varies from three or four grains, in infantile cases, to a teaspoonful in adults; but the average dose for adults may be stated at ten grains. It is best given with water alone, and when the stomach is empty. Milk, soup, and similar liquids as vehicles tend to envelop the medicine, and to that extent neutralize its action.

BISMUTHI TANNAS.—TANNATE OF BISMUTH.

Bismuthum tannicum, Tannas bismuthicus.—Tannate de bismuth, F.; *Gerbsaures Wismuthoxyd, Wismuthtannat*, G.

Preparation.—Forty-four parts of crystallized bismuthous nitrate are dissolved in the least possible quantity of nitric acid, previously diluted with half its weight of water; the solution is poured into an excess of solution of soda, the precipitate well washed with water, until the washings cease to have an alkaline reaction, and the moist precipitate triturated with 20 parts of tannin, diluted with water, strained through muslin, and dried with the aid of a moderate heat.

This is Cap's process proposed in 1860; in the first part of it, bismuthous hydrate is formed from the nitrate, by decomposing it with sodium hydrate; the precipitate is then directly combined with tannic acid, with which it should be left in contact for an hour or two before being washed and dried.

Properties.—It forms a light yellow powder, which is insoluble in water and alcohol, and is entirely tasteless. When thoroughly dried its composition represents 53 per cent. of bismuthous oxide and 47 of tannin.

Medical Action and Uses.—This preparation is astringent, and was at one time used internally in *diarrhœa*, and topically in *gonorrhœa, leucorrhœa, ophthalmia*, etc. It is now very seldom employed.

BISMUTHI VALERIANAS.—VALERIANATE OF BISMUTH.

Bismuthum valerianicum, Valerianas bismuthicus.—Valérianate de bismuth, Fr.; *Baldriansaures Wismuthoxyd, Wismuthvalerianat*, G.

Preparation.—A solution of bismuthous nitrate in the smallest quantity of nitric acid, previously diluted with half its weight of water, is precipitated by a rather concentrated solution of valerianate of sodium; the precipitate is washed with water, to which some valerianic acid has been added, until the washings, on evaporation, leave no residue, and afterwards dried. Or 50 parts of subnitrate of bismuth are digested for four hours with 150 parts of ammonia diluted with the same weight of water; the sediment, consisting of hydrate of bismuth, is well washed with water, drained, transferred to a mortar, and well triturated with 15 parts of concentrated valerianic acid, 30 parts of alcohol being gradually added during the trituration. It is afterwards collected upon a filter, and dried at the ordinary temperature.

Properties.—Prepared by either process it is a white amorphous powder, having a decided odor of valerianic acid, insoluble in water and alcohol, soluble in nitric and in sulphuric acid; the latter solution does not acquire a black color on the addition of ferrous sulphate (absence of nitrate). Other impurities may be detected by the same tests as in the subnitrate of bismuth.

Medical Uses.—There is no sufficient reason for believing that this compound is of the least therapeutical value.

BISMUTHUM, *U. S., Br.*—BISMUTH.

Bismuth, Fr.; *Wismuth*, G.

BISMUTHUM PURIFICATUM, *Br.*—PURIFIED BISMUTH.

Bismuth purifié, Fr.; *Gereinigtes Wismuth*, G.
Symbol Bi. Atomicity trivalent and quinquivalent. Atomic weight 210.

Origin.—The supply of bismuth is chiefly derived from the mines in Saxony, where it exists in the metallic state, associated with cobalt, nickel, and silver ores. It is likewise found oxidized as bismuth ochre, and in combination with sulphur and with tellurium. Deposits of bismuth ores have recently been discovered in France, Australia, Mexico, and Texas.

Preparation.—The metal is extracted by a simple process of smelting, advantage being taken of its low melting point, and run into hot iron receiving pots, where it congeals. The sulphide of bismuth requires to be roasted; it is thus converted into oxide, which is reduced to the metallic state by being heated with charcoal. The crude metal thus obtained contains variable quantities of arsenic, copper, iron, and other metals.

Purification.—Take of Bismuth ten ounces; Nitrate of Potash in powder two ounces. Put the bismuth and one ounce of the nitrate of potash into a crucible, and heat them to a temperature at which both the metal and the salt are fused. Continue the heat, constantly stirring the contents of the crucible for fifteen minutes, or until the salt has solidified into a slag over the metal. Then remove the salt, add the remainder of the nitrate of potash to the bismuth in the crucible, and repeat the process as before. Finally, pour the bismuth, while fused, into a suitable mould, and allow it to cool. *Br.*

A method proposed by Mr. Méhu (1873) aims at the formation of an alloy with potassium, by heating to redness a mixture of powdered crude bismuth, potassium carbonate, charcoal and soap under a layer of well-washed charcoal; the metallic button obtained at the end of an hour is then fused in a capsule, for the purpose of oxidizing the potassium to potassa, which is accomplished when a yellow-brown layer of bismuthous oxide begins to form. It is claimed that arsenic and sulphur are completely removed by this process.

Properties.—Bismuth is a brilliant grayish-white metal with a distinct roseate tinge, and a crystalline lamellate texture. When fused bismuth is cooled until a crust has formed, and the liquid portion is then poured out, the crucible will be found lined with rhombohedral crystals resembling cubes. Its specific gravity is 9.83, which is diminished by high pressure. It fuses at 264° C. (507° F.), and when congealing expands considerably, like water under similar circumstances. It is not altered at the ordinary temperature by exposure to the air, but at a red heat burns with a bluish flame to brown oxide, becoming yellow on cooling, and when exposed, in closed vessels, to a still higher temperature, it volatilizes. It has the peculiar property of lowering the fusing point of metals; an alloy of two parts of bismuth and one part each of lead and tin fuses at 93.75° C. (200.75° F.). It is but slightly attacked by boiling muriatic or dilute sulphuric acid; but nitric acid dissolves it readily, the solution on concentration yielding crystals of bismuthous nitrate (see Bismuthi subnitras); the mother liquor or the original solution in nitric acid, suitably diluted with water and separated from the white precipitate of subnitrate, should not yield a white precipitate with sulphuric acid (lead), or a blue one with potassium ferrocyanide (iron), or with the same reagent a reddish-brown one (copper). The presence of arsenic is ascertained by adding sulphuric acid to the solution, evaporating it to complete dryness, and applying Marsh's or Fleitmann's test (see pages 21 and 22). Silver, which is occasionally present, will be indicated by the white precipitate which takes place in the nitric acid solution on the addition of muriatic acid. The fetid breath following the administration of bismuth preparations has been attributed by C. Ekin (1876) to the presence of some tellurium.

Off. Prep.—Bismuthi subcarbonas, Bismuthi subnitras. *U. S.*, *Br.*

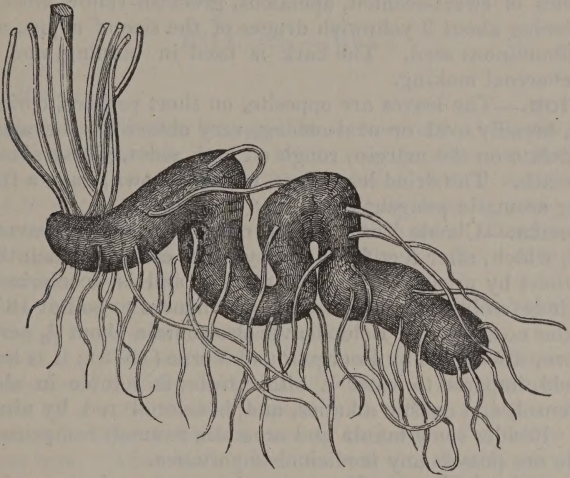
BISTORTA.—BISTORT.

Snakeweed, E.; *Bistorte, Couleuvrine*, Fr.; *Wiesenknöterich, Natterwurz*, G.

The rhizome of Polygonum bistorta, *Lin.* Woodville, t. 232; Bentley and Trimen, Med. Plants, 212.

Nat. Ord.—Polygonaceæ.

Fig. 17.



Rhizome of Polygonum bistorta, *Lin.*

Origin.—Snakeweed is an herbaceous perennial which grows in swampy meadows throughout Asia, north from the Himalayas, the greater portion of Europe, in Canada, and the mountainous regions of the Western United States, from Colorado northward. Its simple stems bear alternate ovate leaves, with long and striate sheaths, and a terminal cylindrical dense racemose spike of rose-colored flowers. The young shoots and leaves are used for greens in the north of England and in subarctic countries, and the roasted rhizome is eaten in Siberia and Iceland.

Description.—The rhizome, which is collected in spring or autumn, is bent twice upon itself, is flattish on one side, rounded upon the other, transversely furrowed or annulated from the leaf-scars, and marked with the scars of the rootlets. As found in commerce, its total length is about 2 inches, it is about $\frac{1}{2}$ inch broad, about $\frac{1}{4}$ inch thick, and of a firm texture, though fleshy and somewhat spongy when fresh. Externally it is blackish-brown, internally reddish or brownish-red, and shows upon the transverse section a moderately thick bark, a large central pith, and a circle of very small whitish wood-bundles. It is inodorous, and has a strongly astringent taste.

Constituents.—Bistort contains much starch and tannin. Bowman (1869) found the latter to amount to 21 per cent. The rhizome is also said to contain gallic acid.

Medical Action and Uses.—In Europe this medicine is used for all the purposes of a simple and mild astringent, both internally and externally; *i. e.*, in *diarrhœa*, passive *hemorrhages*, *leucorrhœa*, relaxation of the *throat*, *anus*, *vagina*, etc. It may be prescribed in powder, decoction, or extract.

BOLDUS.—Boldo.

Boldo, Fr., G.

The leaves of Peumus boldus, *Molina*, s. Ruizia (Peumus, *Pers.;* Boldoa, *C. Gay*) fragrans, *R. & Pav.* Bentley and Trimen, Med. Plants, 217.

Nat. Ord.—Monimiaceæ.

Origin.—Boldo or boldu leaves are derived from a tall evergreen diœcious shrub, which is a native of Chili, and is there frequently cultivated in gardens. It has lax cymes of sweet-scented, apetalous, greenish-yellow flowers, the pistilate ones producing about 3 yellowish drupes of the size of a pea, and containing a single albuminous seed. The bark is used in tanning, and the wood is esteemed for charcoal making.

Description.—The leaves are opposite, on short petioles, coriaceous, about 2 inches long, broadly oval or oval-oblong, very obtuse at the apex, entire or somewhat undulate on the margin, rough on both sides, glossy above, and pale and hairy beneath. The dried leaves are reddish-brown, have a fragrant odor, and refreshing aromatic pungent taste.

Constituents.—Claude Verne (1875) obtained from the leaves 2 per cent. of volatile oil, which, after rectification, is yellow, colored hyacinth-red by sulphuric acid, violet by nitric acid, red by potassa, and is decolorized by hydrochloric acid; it is freely soluble in alcohol, commences to boil at 185° C. (365° F.), and contains no aldehyd. Boldo leaves also contain about $\frac{1}{10}$ per. cent. of the alkaloid *boldina*, discovered by Bourgoin and Verne (1873); it is best extracted with acetic acid, imparts to water a bitter taste, is soluble in alcohol, ether, chloroform, benzol, and caustic alkalies, and is colored red by nitric and sulphuric acids. Besides some tannin and aromatic resinous compounds, the other constituents do not possess any medicinal importance.

Pharmaceutical Uses.—Verne has proposed a *tincture of boldo*, made with 20 parts of the leaves and 100 parts of 60 per cent. alcohol; *wine of boldo*, made with 3 parts of the leaves and 100 of Madeira wine; an *aqueous* and an *alcoholic extract of boldo*, the latter prepared by evaporating the tincture.

Allied Plants.—Atherospermia moschata, *Labil.*, an Australian tree, has in all parts an odor resembling somewhat that of nutmeg; the bark which is used as an antiscorbutic and tonic, contains tannin, and the bitter alkaloid *atherospermia* (Zeyer, 1861). The allied South American genera, *Citrosma* and *Laurellia*, are highly aromatic.

Physiological Action.—Like all plants which are rich in essential oil, boldo is, in moderate doses, an active stimulant of the nervous and circulatory system, and in excessive doses an acro-narcotic poison. In the experiments which have been made with it, some of the effects produced are referable to the alcoholic vehicle. Thus, when it is said that fifteen grains of the extract dissolved in fourteen cubic centimetres of alcohol were injected into a dog, and the dose renewed at the end of an hour, when the animal could not stand on his legs and was sleepy, and his temperature had fallen a degree or two, it is evident that of these effects the greater part were due to the alcohol. The judgment is not essentially different when thirty grains of alcoholic extract of boldo were injected dissolved in eight cubic centimetres of alcohol. It is confirmed when we find that, among the symptoms following the administration of the volatile oil to a large dog, not one refers to the nervous system, but chiefly to the urine which acquired a strong smell, to the stomach which was disturbed by vomiting, and to the bowels which were affected with diarrhœa. In man even the tincture is represented not to have produced cerebral or spinal phenomena, but only a glow in the mouth, fauces, and stomach, and some quickening of the pulse; and the oil in the dose of thirty or forty centigrames, in capsules, caused some burning at the epigastrium, nausea, and eructations, which, as well as the smell of the urine, lasted for not less than twelve hours. In still larger doses, only a higher degree occurred of the same phenomena, with the addition of diarrhœa. It is, therefore, an error to say, as has been done, that it is a diffusible stimulant resembling oil of turpentine in its action.

Medical Uses.—It has been recommended, in alcoholic or vinous solution, in *anæmia*, *dyspepsia*, and *general debility;* and the oil has been proposed for the relief of *catarrh*, especially of the urino-genital organs. It does not appear to have commended itself to general use.

BOLUS.—BOLE.

Bol, Fr.; *Bolus*, G.

Description.—This term is applied to certain native silicates of aluminium, which are soft and unctuous to the touch, readily adhere to the moist tongue, and are easily scraped with the knife; they break with a conchoidal fracture, are insoluble in water, with which they gradually form a pasty mass, and for medicinal use are powdered and elutriated with water. They contain alumina and silica in the approximate proportion of 3 to 5. According to color, they have been distinguished as

BOLUS ALBA, known also as *terra alba;* it is of a white color, and contains small quantities of magnesia and traces of iron.

BOLUS ARMENA, or *Armenian bole*, was formerly brought from Armenia, but is at present obtained in different parts of Europe. Its brown-red color is due to the presence of a considerable proportion of oxide of iron. *Terra lemnia*, formerly employed, differed from it merely in being of a yellowish color, and containing less iron. After having been formed into flattish circular pieces and impressed with a seal, these boles constituted the *terræ sigillatæ*, which were formerly in high repute.

Medical Action and Uses.—Bole was very generally used in Greek and Roman medicine, and in Europe until a quite recent date, in numberless cases requiring astringent and absorbent medicines. Of internal affections for which it was employed may be mentioned *menorrhagia*, *hæmoptysis*, *chronic bronchitis*, *diarrhœa*, and *dysentery*. Topically it was applied in *leucorrhœa*, *prolapsus ani*, *sore nipples*, *aphthæ*, *intertrigo*, *burns*, *ulcers*, *erysipelas*, etc. The small proportion of iron contained in it may have increased its efficacy.

BORAGO.—BORAGE.

Bourrache, Fr.; *Borasch*, *Boretsch*, G.

Borago officinalis, *Lin.* *Nat. Ord.*—Boraginaceæ.

Description.—Borage is an erect hispid annual indigenous to the Levant, but naturalized in Southern and Middle Europe, and frequently cultivated in gardens. It has a white fleshy root and an erect branching stem 1 or 2 feet high. The leaves are oval or obovate, alternate—the lower ones petiolate, entire or wavy on the margin—the upper side and the veins beneath with stiff hairs. The flowers are in terminal racemes with ovate bracts, a five-parted calyx, and a sky-blue or reddish corolla, which is rotate, closed in the throat by 5 emarginate appendages, and has 5 stamens. The fruit consists of 4 brownish-black ovate roughish nutlets, which are excavated at the base. The fresh plant has a slight cucumber-like odor and a saline taste. The herb is used as a salad and occasionally employed in medicine; the root and flowers have likewise been used.

Constituents.—Borage has been analyzed by Lampadius and Braconnot, who found considerable mucilage, a little resin, and potassium and calcium combined with organic and mineral acids. Braconnot obtained from the inspissated juice 30 per cent. of salts; Waltl (1829) from the dry herb 2 to 3 per cent. of potassium nitrate.

Allied Plants. CYNOGLOSSUM OFFICINALE, *Lin.* Hound's tongue, *E.;* Langue de chien, *Fr.;* Hundszunge, *G.*—A biennial European plant, naturalized in North America. The stem is 2 feet high; the leaves are hairy, elliptic, and petiolate—the upper ones lanceolate, sessile, and somewhat clasping; the flowers are brownish-red, and have a short, white tube; the ovate nutlets are covered with short, hooked prickles. The fresh plant has a disagreeable odor; the taste is mucilaginous and slightly bitter.

PULMONARIA OFFICINALIS, *Lin.* Lungwort, *E.;* Pulmonaire, *Fr.;* Lungenkraut, *G.*—A perennial European plant with a simple hairy stem and rough-hairy entire leaves, often marked with white spots, and with reddish or purple nodding flowers. The radical leaves are ovate-cordate, pointed, and petiolate; the stem leaves are spatulate or ovate—the upper ones sessile. The herb is inodorous, and has a mucilaginous, somewhat astringent taste.

Medical Action and Uses.—The virtues of borage are chiefly those of an emollient and protective, which it owes to the mucilage it contains, while its saline elements render it somewhat diuretic when its infusion is freely used. In France especially it is much employed in acute *febrile* affections and in *pulmonary catarrhs.* The infusion is made with from one to three drachms in a pint of water. A decoction made from the whole plant, and a fomentation prepared with the flowers, are used in local inflammations.

BRAYERA, *U. S.*—Kooso.

Cusso, Br.; *Flores kosso,* P. G.—*Kousso, Kusso,* E.; *Cousso, Kousso,* Fr.; *Kosso, Kusso, Cusso,* G.

The flowers and unripe fruit (flowers and tops, *Br.*) of Brayera anthelmintica, *Kunth,* s. Banksia abyssinica, *Bruce,* s. Hagenia abyssinica, *Willd.* Bentley and Trimen, Med. Plants, 102.

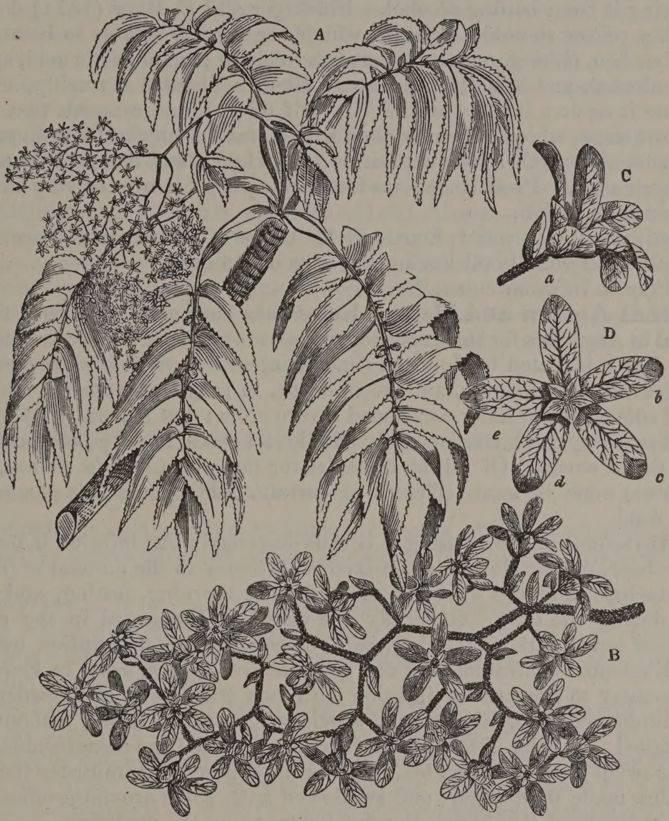
Nat. Ord.—Rosaceæ, Roseæ.

Origin.—This is a handsome tree, attaining a height of 40 to 60 feet; it produces an abundance of large oddly pinnate leaves, at the base with a sheath, formed by the large adnate stipules; the inflorescence is abundant, axillary, unisexual, and paniculate. The tree, which flowers in October and November, is indigenous to the table-land and mountainous districts of Abyssinia, and is generally planted near towns and villages.

Description.—The panicles are about 12 inches long, much branched; axis and branches zigzag, hairy, and glandular, each branch supported by a ciliate sheathing bract; flowers very numerous, small, each with two membranous veined bracts at the base of the shortly stalked, top-shaped, and hairy calyx, which has 10 membranous and veined segments arranged in two alternating whorls. The sepals of the outer whorl of the male flowers are greenish-yellow, small, and nearly linear; but in the female flowers they are larger than the inner row of sepals, and, when fully developed, are obovate and of a reddish color. The five linear petals are inconspicuous and much shorter than the inner sepals, with which they alternate. Stamens between 15 and 30, very small and shrivelled in the female flowers, equalling the petals in the male flowers, inserted in the contracted throat of the calyx. Carpels two, distinct, inclosed in the calyx-tube; style projecting from the tube; fruit a small membranous achene.

The female inflorescence being most frequently collected, the commercial article should have a pale brownish-red hue, and is often distinguished as *red kousso.* It is collected before the fruit has ripened, and either the entire inflorescence is dried loosely, or before quite dry a number of panicles are formed into cylindrical rolls varying in length and thickness; the loose panicles are usually much broken. The male inflorescence has in the dry state a light greenish-brown color, and is sometimes known as *kousso-esels.* The odor of both varieties is not strong, but pleasant and tea-like; the taste is gradually developed, bitterish, acrid, and disagreeable.

Fig. 18.



Brayera anthelmintica, *Kth.*—*A.* Flowering branch. *B.* Branch of panicle. *C* and *D.* A single flower. *a, b, c, d, e,* sepals.

The drug reaches commerce mostly by way of Aden and Bombay, or partly through Egypt to Southern Europe.

Constituents.—According to Wittstein (1840), kousso contains as principal constituents 6.25 per cent. of a bitter acrid resin and 24.4 per cent. of tannin, consisting of two kinds; he also obtained 15.71 per cent. of ashes and some tasteless resin, besides the common constituents, chlorophyll, wax, sugar, and gum. The acrid resin appears to be the medicinally active principle, and has been variously called *brayerin, kwosein, koussin,* and *kosin.* As prepared by Dr. C. Bedall (1872), by Pavesi's process, it was found to be an efficient tænifuge. Kousso is repeatedly treated with alcohol to which slaked lime has been added; the residue is boiled with water, the different liquids mixed, filtered and distilled, and the remaining liquid treated with acetic acid, which separates about 3 per cent. of koussin as a white flocculent precipitate, becoming denser and resin-like, and on drying yellowish, or at a higher temperature brown; in larger quantities it has a peculiar odor of Russian leather, a persistent bitter and acrid taste, and is of a distinct crystalline appearance when viewed under the microscope. Dr. E. Merck has subsequently further purified it, probably by crystallizing it from boiling alcohol. Flückiger and E. Bury (1874) describe it as forming yellow rhombic crystals, which are readily soluble in benzol, bisulphide of carbon, chloroform, and ether, less freely in glacial acetic acid, sparingly in cold alcohol, and insoluble in water; alkalies dissolve it readily, and acids precipitate it again; it fuses at 142° C. (287.6° F.), and congeals to a transparent yellow mass, which, when touched with a trace of alcohol, is converted into stellate tufts of crystals; its composition is $C_{31}H_{38}O_{10}$, and it is probably an ether of isobutyric acid. Prof. Buchheim found this *pure kosin* to be very inferior in its anthelmintic action.

By distillation with water, kousso yields traces of valerianic and acetic acids, and a little solid volatile oil having the odor of the drug.

Off. Prep.—Infusum cusso, *Br.*

Medical Action and Uses.—Kousso has been employed from time immemorial in Abyssinia for the expulsion of tapeworms, which there prevail extensively. But it is stated by Johnson that the operation of it is so severe that it often produces miscarriages, and even death, in pregnant women. In Europe it is said sometimes to have occasioned severe colic; but generally its operation is not distressing, and consists only of slight nausea followed by feculent and then by liquid stools. Of all the remedies for tapeworm (*tænia solium*, *t. bothriocephalus*) none is more efficient or certain. The parasite is generally discharged dead.

The Abyssinian mode of using it is thus described: An infusion is made with water or beer, or the flowers are mixed with honey to the amount of from four to six drachms, and the whole is taken in the morning, fasting, and no food is eaten during the day. Generally the worm is discharged in the course of twenty-four hours without purging, pain, or colic. This description by Aubert and by Engleman contradicts the one given above. It is usual in Europe and in this country to prepare an infusion with two drachms of the powdered drug in four fluidounces of boiling water, which, when cold, is drunk without having been strained. As the taste and smell of this infusion are disagreeable, resembling somewhat those of senna tea, it has been proposed to administer the powder in granules made with sugar, and swallowed with some aromatic infusion. In all cases the patient should fast the day before using the medicine.

BROMAL.—Bromal Hydrate.

Hydrate de bromal, Fr.; *Bromalhydrat*, G.
Formula $C_2HBr_3O.H_2O$. Molecular weight 299.

Preparation.—Bromal was discovered by Löwig (1832), and is obtained by leaving one part of ether or absolute alcohol and three parts of bromine in contact for several days, and distilling off about three-fourths, the distillate consisting of hydrobromic acid and various brominated compounds; the residue, dissolved in water, yields crystals of bromal hydrate, which require purification with sulphuric acid, rectification over lime, and recombination with water. Schäffer (1871) obtained better results, and with less bromine, by passing the latter in the gaseous state into alcohol, distilling, and collecting the portion coming over between 165° and 180° C. (329° and 356° F.), consisting chiefly of bromal and *bromoform*, which are separated by fractional distillation, the latter boiling at 152° C. (305.6° F.).

Properties.—Bromal is a colorless oily liquid, boiling at about 172° C. (342° F.), and remaining liquid at —20° C. (—4° F.); it has a peculiar penetrating odor, and a pungent burning taste; its vapors are irritating to the eyes. On exposure to a moist atmosphere it is converted into a white crystalline mass of *bromal hydrate*, which is obtained in larger transparent crystals from its solution in water; the hydrate has the odor and taste of bromal, fuses at 53.5° C. (128.3° F.), and when distilled is decomposed into water and bromal. The *alcoholate* fuses at 44° C. (111.2° F.), is slightly soluble in water, and decomposed by heat. Solution of potassa or soda decomposes bromal and its hydrate, forming formiate and bromoform, the latter having a sweet taste and an agreeable aromatic odor.

Tests for Purity.—A mixture of bromal hydrate and strong sulphuric acid separates oily bromal, but is not colored brown. The solution of bromal hydrate in distilled water is clear, and yields no precipitate with nitrate of silver.

Physiological Action and Medical Uses.—Bromal hydrate is a powerful and almost caustic irritant; applied to the skin in an ointment it occasions redness and swelling, with subcutaneous infiltration, and therefore should not be used hypodermically. Unless greatly diluted it cannot be taken internally, and even then it soon gives rise to burning in the throat, vomiting, and diarrhœa. It has been tried in *epilepsy* ineffectually; and there is no reason why it should be used at all as a medicine.

BROMINII CHLORIDUM.—CHLORIDE OF BROMINE.

Chlorure de brôme, Fr.; *Chlorbrom*, G.

Preparation.—According to Balard, chlorine gas is conducted into bromine, and the vapors given off are condensed by the aid of a refrigerating mixture.

Properties.—It is a reddish-yellow, thin, and very volatile liquid, which is soluble in water, and yields a hydrate fusible at 7° C. (44.6° F.). On treating the solution with potassa, chloride and bromate of potassium are formed; its composition is probably $BrCl_5$.

Physiological Action and Surgical Uses.—This powerful caustic has been chiefly known as the principal ingredient of Landolfi's paste, which, about 1854, attracted considerable attention, in Germany especially, for the treatment of *cancer* and other recurrent growths. The man and his method were subjected to a critical examination, with the result of condemning the former as a charlatan and the latter as more mischievous than useful.

BROMINIUM. *U. S.*—BROMINE.

Bromum, Br., P. G.—*Brôme*, Fr.; *Brom*, G.

Symbol Br. Atomicity univalent. Atomic weight 80.

A liquid non-metallic element, obtained from sea water and from some saline springs.

Origin and Preparation.—Bromine does not exist in the free state, but is found widely distributed in nature, the bromides usually accompanying chlorides. It is more particularly found in sea water, in the waters of Kreuznach, Kissingen, and other mineral springs, but is now obtained in considerable quantities from the mother-liquors of many salt works in the United States and at Stassfurth, Germany. These mother-liquors, which have been freed by crystallization as much as possible from other salts, chlorides and sulphates, contain the bromine, usually in combination with magnesium or calcium. These compounds are decomposed either by heating their solution with black oxide of manganese and hydrochloric acid, or by warming it to between 45° and 50° C. (113° and 122° F.), while chlorine gas is being passed into it; the bromides are at once decomposed: $MgBr_2+Cl_2$ forms $MgCl_2+Br_2$; the bromine volatilizes, and is condensed under a small quantity of water, which is contained in a deep Woulf's bottle kept cool by water, while that portion of bromine which escapes condensation is conducted into a solution of caustic potassa contained in an open bottle; this solution, when it has nearly lost its alkaline reaction, is subsequently utilized for the preparation of potassium bromide. The mother-liquors, as obtained in Western Pennsylvania and West Virginia, yield about one-half per cent. of bromine, or the brine about one pound of bromine to thirteen bushels of salt. The production of the Ohio and Kanawha valleys amounts to about 130,000 pounds of bromine annually, in addition to which from 800 to 1000 pounds are manufactured in Pennsylvania (S. S. Garrigues, 1873). According to Wellcome (1877) about 1000 pounds are daily manufactured in the United States.

Properties.—It is a dark brown-red, very volatile liquid, which exhales deep-orange colored vapors. Its odor, which is suggestive of chlorine and iodine, is strong and disagreeable, hence its name (from βρῶμος, a stench). It boils at 63° C. (145.4° F.) (Pierre); Balard and others give the boiling point as low as 47° C. (117° F.). At 15° C. (59° F.) its specific gravity is 2.97, and at the freezing point of water 3.187. It congeals at about —20° C. (—4° F.), at the same time increasing its volume about 6 per cent. It destroys cork, wood, etc., bleaches coloring principles, and alters or destroys most odorous organic compounds. It dissolves in 33 parts of water, and in less of alcohol and ether; the solutions are bleached rapidly in the sunlight, hydrobromic acid being formed. Bromide of potassium increases the solubility of bromine in water.

Impurities.—Iodine at present does not often form an impurity of bromine; its presence may be detected by adding the bromine to solution of soda until a permanent yellow color is produced, when the addition of a cold solution of starch will cause the blue color of iodide of starch to appear. Bromide of carbon is often present in crude bromine and may be removed by careful rectification, its boiling point being considerably higher than that of bromine.

Pharmaceutical Uses.—In the manufacture of most of the medicinal bromine compounds, free bromine is or may be employed; it is directed for Ammonii bromidum and Potassii bromidum, *U. S.*, *Br.*

Physiological Action.—When dogs are confined in an atmosphere of bromine vapor, they suffer a profuse secretion from the eyes, nostrils, and fauces, with cough, hoarseness, and dyspnœa. It is a corrosive irritant to the stomach, producing vomiting, pain, diarrhœa, and death by exhaustion. On dissection the mucous membrane of the stomach and bowels is found softened. Applied to the shaven hide bromine acts as a caustic, and produces gangrenous sores. As it is extremely volatile care must be taken not to allow its vapors to reach the eyes, nostrils, or mouth.

Medical Uses.—Formerly bromine was employed in the class of cases in which the use of iodine has become general, viz., glandular and other forms of *scrofula*, chronic diseases of the *skin*, constitutional *syphilis*, chronic enlargement of the internal *lymphatic* and *mesenteric glands*, the *liver*, *spleen*, *ovaries*, *uterus*, etc., but in all of these uses it has been superseded by iodine. During the Civil War of the United States it was extensively and successfully used in the treatment of *hospital gangrene*, according to the method of Dr. Goldsmith. This method consisted essentially of cleansing the wound as far as possible of gangrenous tissue, and then applying pure bromine by means of a cotton or lint swab attached so a long wooden handle. Lint moistened with a weak solution of bromine in water was then applied, covered with oiled silk or other impermeable tissue, and secured with a bandage. After a few hours a poultice was substituted, under which the eschar separated, leaving a healthy wound. The operation was severe, and the patient while undergoing it was etherized. *Cancer* of different forms and of various external organs has been treated by tissue injections of a strong solution of bromine in alcohol, one part to three; but owing either to its inefficiency, or its painfulness, the method does not appear to have been generally adopted. A weaker solution (one part in eight) has been used with some advantage as a local application to the skin, for the purpose of allaying *pain*.

BRYONIA.—BRYONY.

Bryone, Couleuvrée, F.; *Zaunrübe, Gichtrühe*, G.

The root of Bryonia alba, *Lin.*, and Br. dioica, *Lin.*
Nat. Ord.—Cucurbitaceæ.

Origin.—Both plants are climbing perennials and indigenous to Europe, Br. alba being more frequent in the northern, and Br. dioica in the southern section of that continent. They have rough, cordate, five-lobed and toothed alternate leaves, and cymes of four to six small greenish-yellow flowers. Br. alba has black, Br. dioica red, globular berries, which are one-quarter inch in diameter; hence the names *black* and *red bryony*.

Description.—The roots are 18 inches to 2 feet long, and 2 to 4 inches thick, nearly simple, in the fresh state fleshy and somewhat lactescent. Both are externally pale grayish-brown, transversely wrinkled, the root of Br. alba with numerous transversely elongated suberous warts or ridges. Internally they are white, have a thin bark, a brown cambium line, narrow wood-bundles, and broad medullary rays. They are usually dried in transverse slices, which have an irregular radiating appearance from the projecting wood-rays. Dried bryony root is inodorous and has a disagreeable bitter taste.

Constituents.—The bitter principle *bryonin* appears to have been first obtained pure by Walz (1859), though Schwerdtfeger had previously separated pearly crystals of a bitter and acrid taste, which, however, contained nitrogen. The aqueous solution of the alcoholic extract is precipitated by subacetate of lead, the filtrate treated with sulphuretted hydrogen, neutralized with soda and precipitated by tannin; this precipitate is dissolved in alcohol, the solution treated with lime, the filtrate decolorized with animal charcoal, evaporated and washed with ether. It forms a white powder having the composition $C_{48}H_{80}O_{19}$, of an intensely bitter taste, insoluble in ether, and soluble in water and alcohol. When boiled with dilute sulphuric acid, bryonin is split into glucose and amorphous *bryoretin* and *hydrobryoretin*.

Allied Plants.—BRYONIA AMERICANA, *Lam.*, and BR. AFRICANA, *Thunb.*, are employed in their native countries like European bryony. The former species is indigenous to the West Indies, the latter to Southern Africa.

BR. EPIGÆA, *Rottl.*, of India has a mucilaginous and slightly bitter root, which is used by the natives as an alterative in syphilis and as a remedy in snake bites.

Tayuya root of Brazil, which has been recently recommended as a remedy for syphilis and scrofula, is said to come from a species of Bryonia.

Physiological Action.—The powder introduced into a wound in a dog's leg caused the animal's death in twenty-four hours, with symptoms of great depression, the wound suppurating. Conveyed into the stomach of a similar animal, and the œsophagus being tied, death occurred after about the same interval, and the mucous membrane of the stomach and rectum was found inflamed. The fresh plant applied to the skin produces vesication. Taken accidentally by man it has occasioned profuse watery stools, violent colic, and vomiting, collapse and death.

Medical Uses.—In the Hippocratic writings bryony root prepared with wine was recommended in tetanus, prolapsus of the rectum, and uterine ulcers. Dioscorides in addition speaks of the young sprouts as purgative and diuretic, and of the root applied in poultices, etc., for the cure of various cutaneous eruptions, abscesses, etc. One species, the black, was especially recommended in affections of the spleen and kidneys, and as a remedy for epilepsy. Later ancient writers speak of it as an emmenagogue and abortifacient, and as a remedy for the bites of venomous animals and insects. In modern medicine it has been principally employed as a hydragogue cathartic in *dropsy*, in the same manner as jalap. In certain cases of *epilepsy* depending upon intestinal worms it has effected a cure. It has also been used in chronic intermittent fever with enlargement of the *spleen*, and in chronic *bronchitis* with serous effusion in the air-tubes. Externally, it has been applied as a rubefacient or vesicant in cases of *hydrarthrosis*, chronic articular and muscular *rheumatism*, and *glandular* engorgements. Slices of the fresh root have been applied behind the ears of children as a substitute for suppressed eruptions during dentition; and the juice has been used topically in *scabies*.

The *dose* of the powder is from ten to sixty grains. An infusion made with two drachms of the root in eight fluidounces of water may be prescribed in doses of two fluidounces.

BUCHU, *U. S.*—BUCHU LEAVES.

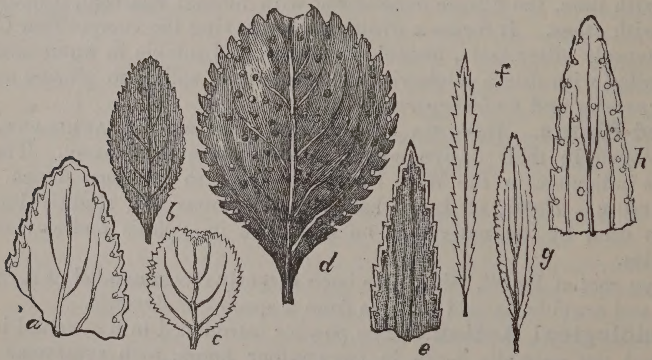
Buchu folia, Br.; *Folia bucco, Folia diosmæ, s. barosmæ.—Feuilles de bucco* (*booko, buchu*), Fr.; *Buckublätter, Buccoblätter*, G.

The leaves of, 1, Barosma betulina, *Bartling*. 2. Barosma crenulata, *Hooker*. 3. Barosma serratifolia, *Willd.*, s. Diosma serratifolia, *Curt.* Bentley and Trimen, Med. Plants, plates 45, 46, 47.

Nat. Ord.—Rutaceæ.

Origin.—The three plants are shrubs attaining a height of several feet; the short stalked or nearly sessile leaves are opposite or subalternate; the flowers, which are handsome, have the calyx deeply five-lobed; the five petals white or pinkish, longer than the calyx, and glandular punctate on the back; and the five hypogynous stamens alternating with the petals. The fruit consists of five carpels, which are united by their inner margin, are dehiscent above, by their

Fig. 19.



Buchu Leaves.—*a*, *b*. Barosma crenata, *Kze.* *c*, *d*. Bar. betulina, *Bartl.* *g*, *h*. Bar. serratifolia, *Willd.* *e*, *f*. Empleurum serrulatum, *Ait.* *b*, *c*, *f*, *g*, natural size.

ventral suture, and contain each one smooth, glossy, and black seed. The shrubs are indigenous to the southern portion of Africa, more particularly to various parts of Cape Colony.

Much uncertainty has prevailed in relation to the diagnosis of the two first-named species, due to the great variation of the leaves. At the present time the following synonyms appear to be generally admitted:—

1. Barosma betulina, *Bartl.;* Diosma betulina, *Thunb.;* D. crenata, *D. C., Lindl. and others.* 2. B. crenulata, *Hook.;* B. crenata, *Kunze;* B. eckloniana, *Berg;* D. crenata, *Lin.;* D. crenulata, *Lin.;* D. odorata, *D. C.;* D. latifolia, *Lodd.*

Description.—The leaves of the first species constitute most of the so-called *short buchu* of the market; they are ½ to ¾ of an inch long, obovate or rhomboid-obovate, cuneate below, usually obtuse, and with the apex recurved; margin sharply serrate, each serrature containing a gland; base almost entire; texture cartilaginous.

The second species likewise contributes to the short buchu, the larger leaves being occasionally held as an *intermediate* variety between the short and the long. The leaves vary between ¾ and 1¼ inches in length, and between oval and ovate or obovate in shape, obtuse above, margin serrulate or crenate, each crenature with a gland.

The leaves of the third species differ materially in shape from the preceding; they constitute the *long buchu* of our commerce, are rather thinner than the two preceding kinds, 1 to 1½ inches long, linear-lanceolate in outline, tapering towards both ends, obtuse, margin serrulate, with a gland in each serrature, midrib prominent, with four lateral veins running nearly parallel to the margin.

Buchu leaves are smooth, have a dull-green color, are paler on the lower surface, and have numerous large oil cells, which render the leaves pellucid punctate when held up to the light; they have a strong peculiar odor and a bitterish and aromatic taste. Prof. Flückiger (1873) has observed a layer of colorless cells between the epidermis of the upper side and the green tissue, which cells yield a large quantity of mucilage to water.

Constituents.—The leaves of the first species yield from 1.21 (Bedford, 1863) to 1.63 (Flückiger and Hanbury, 1874) per cent.; those of the third species only 0.66 per cent. of volatile oil (Bedford). The two oils agree with each other in sensible properties, and probably also in composition. In odor they resemble peppermint; exposed to a low temperature they separate *barosma camphor*, a stearopten which, after recrystallization from alcohol, is in needles having a peppermint odor, fusing at 85° C. (185° F.), and subliming at a higher temperature. It is probably this camphor which was described by Landerer (1844) as *diosmin*, and observed in a tincture of buchu three years old. The diosmin of Brandes was an extract-like body of a bitterish taste. The leaves possibly contain a body similar to rutin (Flückiger). Besides the constituents mentioned, resinous, gummy, albuminous, and coloring matters and saline compounds have been observed. *B. crenulata* yields 4.7 per cent. of ash.

Impurities and Substitutions.—The short buchu is sometimes mixed with the flowers and the non-aromatic capsules, which must be separated. The long buchu is usually cleaner, but is occasionally mixed with or replaced by the leaves of *Epleurum serrulatum*, Ait., Nat. Ord. Rutaceæ, indigenous to Southern Africa; they are one to three inches long, have a narrow linear shape, a serrulate margin, and an acute glandless apex; their odor is different from buchu. From other leaves, buchu is readily distinguished by the characters given above.

Off. Prep.—Extr. buchu fluid., *U.S.;* Infusum buchu, Tinct. buchu, *U.S.*, *Br.*

Physiological Action and Medical Uses.—Buchu excites a sense of warmth in the stomach, which diffuses itself over the whole body. It augments the appetite, promotes digestion, favors the secretion of urine, and gives it a peculiar aromatic smell. Large doses excite vomiting and purging. The Hottentots, from whom a knowledge of this medicine was derived, employed an ointment made from it as a vulnerary, and a vinous tincture as a remedy for various disorders of the stomach and the urinary organs. It is chiefly in the last-named affections that it is used, viz., *chronic pyelitis*, *cystitis*, and *urethritis*. It is most commonly, perhaps, resorted to as a remedy for *catarrh of the bladder* caused by extension of urethral irritation; but catarrh of the whole urinary tract is favorably influenced by it, as well as vesical tenesmus and atony of the bladder when they are attendant symptoms. Like other bitter plants containing a volatile oil, it may sometimes be useful in *feeble digestion* with flatulence. It may be administered in substance (gr. xx–gr.xxx), or in the officinal infusion or fluid extract. An infusion made with buchu and the analogous plant, uva ursi, is generally preferable to one containing either alone: ℞. Buchu, uva ursi, āā ʒj–ʒiv; hot water Oj. Digest for half an hour in a covered vessel, and strain. *Dose*, from half a fluidounce to two fluidounces, three times a day.

BURSA PASTORIS.—SHEPHERD'S PURSE.

Bourse a pasteur, *Molette*, Fr.; *Hirtentäschlein*, G.

The herb of Capsella (Thlaspi, *Lin.*) Bursa pastoris, *Moench*.

Nat. Ord.—Cruciferæ, Siliculosæ.

Description.—This annual is a native of Europe, but is extensively naturalized in most civilized countries. It has clustered, more or less deeply serrate or pinnatifid root leaves, a stem about a foot or more high, with arrow-shaped sessile leaves and numerous small white flowers in terminal corymbs, which become much elongated. The fruit is a triangular obcordate pouch, which is laterally flattened, has a narrow partition, and contains numerous minute brown seeds. It flowers from early in spring to autumn, and has, particularly in summer, an acrid and bitter taste.

Constituents.—Daubrawa (1854) found in the herb, besides the ordinary constituents of herbs, 6 per cent. of soft resin, some sulphuretted volatile oil, and 9 per cent. of ash. The volatile oil obtained from the seeds was proven by F. Pless (1846) to be identical with oil of mustard. Mulder (1858) obtained from the seeds 28.8 per cent. of fixed oil, and 26.5 per cent. of protein compounds.

Allied Plants.—Pless obtained oil of mustard also from Raphanus raphanistrum, *Lin.* (wild radish or jointed charlock), Sisymbrium officinale, *Scop.* (hedge mustard), and Iberis amara, *Lin.* (bitter candytuft). A mixture of the volatile oils of mustard and garlic was obtained from Thlaspi arvense, *Lin.* (pennycress or mithridate mustard), and Alliaria officinalis, *Andr.*, s. Sisymbrium (Erysimum, *Lin.*) alliaria, *Scop.* (hedge garlic). Different species of *Lepidium* (peppergrass or pepperwort) were found to contain myrosin, but not myronic acid, and to yield a sulphuretted volatile oil which dissolves in sulphuric acid with a red color, and is reprecipitated by water; the species examined were Lep. ruderale, *Lin.*, Lep. sativum, *Lin.*, and Lep. campestre, *Lin.* It is not unlikely that a similar volatile oil might be found in Lep. virginicum, *Lin.*, and L. intermedium, *Gray*, the wild pepperworts indigenous to North America. Another sulphuretted volatile oil was obtained from the root and seed of Raphanus sativus, *Lin.* (radish), the seeds of Brassica napus, *Lin.* (rapeseed), and of several other European cruciferæ. Most of the plants named have been medicinally employed in a manner similar to that of shepherd's purse.

Medical Action and Uses.—This plant, which is acrid and aromatic, was anciently employed, and its seeds also, as stimulants to promote *menstruation*, and more recently in *diarrhœa*, *dysentery*, and intermittent fever. Its use is entirely obsolete.

CADMII IODIDUM, *Br.*—IODIDE OF CADMIUM.

Cadmium iodatum, Iodidum cadmicum.—Iodure de cadmium, Fr.; *Jodcadmium, Kadmiumjodür*, G.

Formula CdI_2. Molecular weight 366.

Preparation.—This salt is generally prepared by digesting an excess of metallic cadmium with iodine and water, until a colorless solution is obtained, which is filtered and evaporated. It may also be obtained by dissolving 20 parts of potassium iodide and 15 parts of cadmium sulphate in water, evaporating the solution to dryness, exhausting the residue with warm absolute alcohol, and filtering and crystallizing. (A. Vogel, 1863.)

By the first process a direct combination of the metal and iodine is effected, while in the second process a mutual decomposition of the two salts takes place with the formation of cadmium iodide and potassium sulphate. The latter, being insoluble in alcohol, remains upon the filter; $CdSO_4 + 2KI$ yields $CdI_2 + K_2SO_4$.

Properties and Tests.—Iodide of cadmium exists in white, flat, micaceous crystals, of a pearly lustre, soluble in alcohol, and, at the ordinary temperature, in a little more than its own weight of water. Heated to about 310° C. (600° F.) it forms an amber-colored liquid, and at a dull red heat is decomposed, vapors of iodine being given off. The aqueous solution, which reddens litmus, yields, with sulphuretted hydrogen, a yellow precipitate of CdS, which is insoluble in sulphydrate of ammonium (difference from arsenic), and the filtrate from this precipitate is not affected by ammonia, sulphydrate or carbonate of ammonium (absence of the metals of the zinc group, and of the earths and alkaline earths), and after applying these tests, leaves no residue when evaporated to dryness and ignited (absence of alkalies). The presence of heavy metals would be indicated by the brown or blackish discoloration in the yellow color of the precipitated sulphide. Ammonia would be detected by the odor given off on the addition of an excess of potassa solution. Most other cadmium salts differ considerably from the iodide in appearance. Their possible presence, however, may be inferred by applying the following test of the British Pharmacopœia: "Ten grains dissolved in water and nitrate of silver added in excess give a precipitate which, when washed with water and afterwards with half an ounce of solution of ammonia, and dried, weighs 12.5 grains." Any deviation from this weight indicates the presence of foreign salts.

Off. Prep.—Unguentum cadmii iodidi, *Br.*

Medical Action and Uses.—According to Garrod, it has the same action, and may be used in the same cases, as yellow iodide of lead, particularly in *scrofulous* enlargement of the *glands* and chronic skin diseases. It does not stain the skin. An ointment may be used containing 60 grains of the salt to an ounce of lard.

CADMII SULPHAS, *U.S.*—SULPHATE OF CADMIUM.

Cadmium sulfuricum, P. G.; *Sulfas cadmicus.—Sulfate de cadmium*, Fr.; *Schwefelsaures Cadmiumoxyd, Kadmiumsulfat*, G.

Formula $3CdSO_4.8H_2O$. Molecular weight 768.

Preparation.—Take of Cadmium in small pieces a troyounce; Nitric Acid two troyounces; Carbonate of Sodium three troyounces; Sulphuric Acid four hundred and twenty grains; Distilled Water a sufficient quantity. To the cadmium and two fluidounces of distilled water, contained in a glass vessel, add by degrees the nitric acid, and, when the action slackens, apply a gentle heat until the metal is dissolved. Filter the solution, and, having dissolved the carbonate of sodium in six fluidounces of distilled water, mix the solutions thoroughly. Wash the precipitate obtained until the water passes tasteless, and dissolve it in the sulphuric acid diluted with four fluidounces of distilled water. Then evaporate the solution to one-third, and set it aside to crystallize. Lastly dry the crystals on bibulous paper. *U. S.*

In following this process, nitrate of cadmium is first formed and then converted into cadmium carbonate by decomposition with sodium carbonate, the resulting precipitate, after thorough washing, being formed into cadmium sulphate by dissolving it in sulphuric acid. No reason can be assigned for this roundabout process, since the same result may be attained, with a considerable saving of time and of nitric acid, by dissolving the metal, with the aid of about 300 grains of nitric acid, directly in the sulphuric acid, previously diluted with 3 ounces of water. Cadmium dissolves slowly in diluted sulphuric acid with the liberation of hydrogen; but in the presence of nitric acid it is readily dissolved with the evolution of nitric oxide, according to the equation, $3Cd_2+6H_2SO_4+4HNO_3=6CdSO_4+8H_2O+4NO$. Sufficient heat will be generated to cause the reaction to proceed briskly. When it slackens, heat is applied, and the whole evaporated to dryness to expel excess of acid; the residue is dissolved in three times its weight of water, the solution filtered, evaporated to one-half, and set aside to crystallize. The crystals are collected upon a filter and dried at a moderate heat. The mother-liquor may be made to yield more crystals by further evaporation. From the last portions the cadmium may be obtained by precipitation with zinc.

Properties and Tests.—Sulphate of cadmium crystallizes in colorless rhombic prisms, which effloresce somewhat in the air. It dissolves in less than one and a half times its weight of water, and is insoluble in alcohol; at 100° C. (212° F.) it loses 11.8 per cent. (5 molecules) of water, and the remainder when heated nearly to redness. Its purity may be ascertained in the same manner as that of cadmium iodide, except that its solution in water should be precipitated by barium nitrate, but not by silver nitrate.

Medical Action and Uses.—Sulphate of cadmium is astringent and irritant, like sulphate of zinc, but is much more powerful. A grain taken internally has occasioned profuse salivation, vomiting, and tenesmus. It has been chiefly used in *conjunctivitis*, ulcers and opacities of the *cornea*, *otorrhœa*, and *gleet*, in lotions containing about one grain of the salt to two ounces of water.

CADMIUM, *U. S.*—Cadmium.

Cadmium, Fr., G.; *Kadmium*, G.

Symbol Cd. Atomicity bivalent. Atomic weight 112.

Origin and Preparation.—This metal is found near Bishopstown, Scotland, in the form of sulphide, as the mineral Greenockite; but it is more frequently present in small quantities in some kinds of calamine, blende, and other zinc ores. Cadmium being more volatile than zinc, it is contained in the first portions obtained on the distillation of the latter metal, and its presence is indicated by the appearance of a brown flame, the so-called brown blaze, before the greenish-white flame of burning zinc is noticed. To obtain cadmium, the zinc, or the zinc oxide containing it, is dissolved in dilute sulphuric or muriatic acid, and the cadmium precipitated by metallic zinc. Or the acid solution is treated with sulphuretted hydrogen to precipitate the cadmium as yellow sulphide, which is used as a pigment under the name of *cadmia;* the sulphide is dissolved in strong hydrochloric acid, the solution precipitated by an excess of ammonium carbonate, to remove copper and traces of zinc, and the washed and dried precipitate mixed with lampblack and distilled.

Properties.—Cadmium is a malleable and ductile metal, having the color of tin, and, like the latter, it emits a crackling sound when bent. It becomes brittle at 82° C. (180° F.), fuses near 315° C. (592° F.) (B. Wood, 1862), and volatilizes, according to Becquerel (1863), at 720° C. (1319° F.). In the presence of acids, cadmium slowly decomposes water, hydrogen being given off, but nitric acid dissolves the metal readily. The salts of cadmium are mostly white, those soluble in water have an acid reaction and a disagreeable metallic taste. Their solutions, treated with sulphuretted hydrogen or ammonium sulphydrate, afford orange-yellow precipitates of CdS, which is insoluble in an excess of the precipitant and in dilute acids and alkalies. Caustic alkalies produce white precipitates of CdH_2O_2, which is soluble in ammonia, but not in potassa or soda. The soluble carbonates, phosphates, and oxalates, and ferrocyanide of potassium produce white precipitates.

Tests.—The impurities likely to be present in metallic cadmium are mainly zinc and copper, the former of which is recognized by precipitating the solution in nitric acid with sulphuretted hydrogen, when the filtrate from the bright orange-yellow precipitate will yield a white precipitate on the addition of ammonia and ammonium sulphydrate. When the solution in nitric acid is precipitated by slight excess of ammonium carbonate, the filtrate will have a blue color if copper be present.

Off. Prep.—Cadmii iodidum, *Br.;* Cadmii sulphas, *U. S.*

CAFFEA, *U. S.*—COFFEE.

Semen coffeæ.—*Café*, Fr.; *Kaffee*, G.

The fruit of Coffea arabica, *Lin.* *Nat. Ord.*—Rubiaceæ, Caffeineæ.

Origin.—Coffee is indigenous to tropical Africa, more particularly to Abyssinia, whence its growth has spread most likely across the continent to Liberia, where it grows wild, and where it is also now extensively cultivated. It is supposed to be indigenous likewise to Southern Arabia, but this is denied by some authors. At present it is very extensively cultivated in most tropical and subtropical countries. Some botanists consider the Liberian coffee plant to be a distinct species.

In its wild state the coffee tree attains a height of from 20 to 30 feet, and has somewhat the aspect of a cherry tree; but its bark is whitish and furrowed, and its numerous branches are opposite. In cultivation it is trimmed down to the height of about 6 feet. The smooth evergreen leaves are ovate oblong, rather acuminate, 4 to 6 inches long, 1½ to 2 inches wide, dark-green and glossy above, paler beneath, and somewhat glandular near the midrib. Flowers in clusters of 3 to 5 or 7, with a small 5-lobed calyx, a white tubular 5-lobed corolla, 5 stamens and 1 pistil with a bifid style. The fruit is an oval, deep-purple, two-seeded drupe, the parchment-like endocarp inclosing two plano-convex seeds, which are placed together by their flat sides, and constitute the raw coffee of commerce.

Description.—The seeds are oval, longitudinally grooved upon the flat side, usually almost completely deprived of the membranous finely wrinkled testa, fragments of which remain in the groove and sometimes upon the back. The seed consists of a horny albumen of the shape of the seed, and, according to the variety, of a yellowish, brownish, bluish, or greenish tint. The albumen is folded, or rather rolled up, whereby the groove is produced. The embryo is situated under the convex side near one end, is slightly curved, and occupies about one-fourth the length of the seed. Raw coffee has a very faint odor and a sweetish, slightly astringent, and bitterish taste. The commercial varieties vary considerably in flavor, in size, and in the shade of color.

Constituents.—According to Payen's analysis (1849) coffee contains 13 per cent. of fat, 15.5 of glucose, dextrin, and an undetermined vegetable acid, 10 of vegetable casein, 5 of chlorogenate of caffeina and potassium, 3 of nitrogenized principle, 0.8 of caffeina, 0.001 of solid volatile oil, 0.002 of liquid aromatic principle soluble in water, 6.7 of ashes, and 12 of moisture, the remainder being cellulose. The fat consists of palmitin and olein. The acids contained in coffee have been the subject of repeated investigations. These render it probable that, besides a little citric acid, the principal one is *caffeotannic acid*, which, according to Rochleder, is Payen's *chlorogenic acid*, and yields, with lead salts, yellow precipitates. Vlaanderen and Mulder (1858) separated this principle under the name of *caffeic acid*, and regard the other acids of coffee (*caffeanic*, *cærulic*, and *caffeelic*) as products of oxidation; and they believe the various colors of raw coffee to be due to mixtures of these derivatives. They consider chlorogenic as a mixture of their caffeic and cœrulic acids; Rochleder's *viridinic acid* (1848) may be a similar mixture. The *caffeic acid* of Hlasiwetz (1867) is obtained by continued boiling of caffeo-tannin with excess of potassa solution, and separation by sulphuric acid. When pure it has the composition $C_9H_8O_4$, is in straw-yellow crystals, forms mostly yellow-colored salts, and, like the amorphous gum-like caffeo-tannin, yields, with fusing potassa, protocatechuic acid, $C_7H_6O_4$. By dry distillation, pyrocatechin is obtained. Zwenger and Siebert (1861) obtained from Java coffee 0.3 per cent. of kinic acid, which is most likely the coffeic acid of Stenhouse, obtained (1854) from coffee leaves, and which readily yielded kinone when treated with manganic deutoxide and sulphuric acid.

Probably the most important constituent of coffee is *caffeina*, or *caffeia*, which is obtained by precipitating the decoction of coffee with acetate of lead, removing the excess of lead from the filtrate by sulphuretted hydrogen, neutralizing by ammonia, evaporating, and recrystallizing (Garot). It is in colorless, or white silky needles, or thin prisms, which are inodorous, of a faintly bitter taste, fusible and sublimable without decomposition. It is not freely soluble in cold water, more so in alcohol and chloroform, but less so in absolute alcohol and ether. Crystallized from water it contains 8.5 per cent. (1 molec.) of water, with which it parts above 100° C. (212° F.). The anhydrous crystals have the composition $C_8H_{10}N_4O_2$, and contain 28.8 per cent. of nitrogen. Chemically caffeina is *methyl-theobromina*, and may be formed by heating theobromin-silver with methyliodide in sealed tubes. Its salts have an acid reaction to test-paper, and are, most of them, decomposed by water or alcohol. Their concentrated solutions yield, with hydrargyro-potassium iodide, a precipitate which soon crystallizes in needles (Delffs). Caffeina, moistened with chlorine water and evaporated, leaves a purple residue, which, on being heated, becomes yellow, and turns red again by ammonia from the formation of *murexoin* (Schwarzenbach). When caffeina is heated with alcoholic potassa or with solution of barium hydrate, water is assimilated, carbonate of barium is precipitated, methylamina and a little ammonia are given off; and from the residue Strecker obtained (1861) a strong and uncrystallizable base *caffeidina*, $C_7H_{12}N_4O$, which is easily soluble in water and alcohol, but to a slight degree in ether. The decomposition takes place mainly according to the equation $C_8H_{10}N_4O_2 + H_2O = C_7H_{12}N_4O + CO_2$. O. Schultzen (1867) and F. Rosengarten (1871) proved that by prolonged boiling a further decomposition takes place, affecting chiefly the caffeidina, and resulting in the production of sarkosina, formic acid, methylamina, and ammonia, thus: $C_8H_{10}N_4O_2 + 6H_2O = C_3H_7NO_2 + CH_2O_2 + 2CH_3H_2N + NH_3 + 2CO_2$. Coffee yields between 0.8 and 1.0 per cent., Maté or Paraguay tea and Chinese tea between 1.1 and 1.25, and guarana about 5 per cent. of caffeina.

The roasting of coffee, which is best accomplished at a temperature of about

250° C. (482° F.), renders the seeds pulverizable, and at the same time gives them a more agreeable taste, and enables them to yield more of their constituents to water. The coffee thus acquires a chestnut-brown color, and loses about 18 per cent. of its weight. The generation of gaseous compounds ruptures the cells, and a peculiar and agreeable aroma is produced, probably through the decomposition of the fat and tannin. But Payen's, as well as Rochleder's, investigations failed to point out the principle to which these changes are due. Very probably they depend upon the decomposition of several of the organic compounds, and unquestionably upon the production of a pyrogenated volatile oil, to which the grateful aroma is due. Caffeina does not appear to partake of these changes, except that it is slowly volatilized at the temperature we have stated; hence the roasting of coffee ought to be effected in closed vessels.

Physiological Action. *On Animals.*—In the last century, coffee and tea used in experiments upon frogs were shown to produce in these animals paralysis of the hinder legs. More recently similar experiments with caffeina upon a great variety of animals—including dogs, rabbits, cats, birds, and fish—showed that this substance is fatal to them by producing, first of all, spasm, and then paralysis. One grain of it thrown into the veins of a small dog was sufficient to destroy its life; but in a large animal of the same species even thirty grains produced only salivation, muscular rigidity, exhaustion, hurried breathing, and defecation. In all the experiments with full doses, hyperæsthesia was apparently manifested, with exaggerated reflex irritability at first and afterwards still more decidedly—the heart and pulse at first beating more frequently, but gradually settling down to their normal rate or even lower. In most cases, and however the caffeina was introduced, increased defecation or diarrhœa occurred. The tetanoid rigidity of the muscles is followed by complete resolution, which, however, is not paralysis, since direct irritation of the limbs revives the rigid contraction. Indeed, it is eminently the property of caffeina to increase reflex excitability, until it is extinguished by the approach of death. As an examination of the spinal cord does not exhibit any uniform condition after death from this substance, and especially no marked degree of hyperæmia, it has been doubted if the muscular spasms are of spinal origin alone, or partly due to the state of the bloodvessels in the muscles themselves. It seems probable that both actions concur.

On Man.—Since coffee was introduced into Arabia, from Africa, in the fifteenth century, numerous opinions have been expressed of its salutary and of its mischievous effects. The consequences of an abuse of tea were declared to be similar long before chemistry had demonstrated the identity of theina with caffeina. Among their evil effects were enumerated the following: indigestion, acidity, heart-burn, watchfulness, tremors, debility, irritability of disposition, and dejection of spirits. By some persons both tea and coffee were accused of producing paralysis. Most of these effects are more likely to follow the habitual use of tea than of coffee, perhaps because, as a general rule, more of the former than of the latter is consumed; but the spinal symptoms, such as painful muscular tension and cramp, and persistent wakefulness, are more apt to be produced by tea. In experiments undertaken with a number of selected healthy persons, the operation of caffeine has been found to vary exceedingly; by the same dose some were scarcely at all affected, while others suffered from palpitation of the heart, a full, frequent, or irregular pulse, irritable bladder and difficulty of urination, trembling limbs, headache, roaring in the ears, flashes before the eyes, sleeplessness, phantasms, a sort of intoxication, and even delirium, when a very large dose was taken, and a subsequent unfitness for bodily or mental labor. These effects, which may be called poisonous, illustrate the danger of exceeding due moderation in the use of coffee, for they show that it may, if immoderately consumed, tend to develop a morbid condition of the nervous system which must render it peculiarly liable to disease, although in a much less degree than opium or alcohol. Indeed, the excessive use of coffee is much more injurious to the spinal than to the cerebral functions. In its primary operation it agrees with those stimulants in exciting to muscular and mental activity as well as to cheerfulness, and in its after-effects it does not tend to produce narcotism or stupor, but only that unsteadiness of the mind, and still more of the spinal functions, which denotes exhaustion. It agrees with them, with tobacco, with Chinese and Paraguay teas, and with various other stimulants used by different nations, in the main features of its action. It results from carefully conducted experiments that caffeine is diuretic in the sense of increasing the secretion of water by the kidneys, but that it diminishes all the solid constituents of the urine except the fixed salts; that the proportion of carbonic acid in the expired air declines under its use, and that its ultimate tendency is to diminish rather than increase the frequency, volume, and force of the pulse, after its primary and transient stimulant impression. Its effect, in other words, is to lessen the amount of blood that is supplied to all the organs, and thereby their functional activity. According to carefully conducted experiments, this effect appears to be due to a contraction of the whole capillary system, in consequence of which the venous side of the circulation becomes distended with blood. It is to this mode of action that is referred the engorgement of the portal circulation which the immoderate use of coffee tends to produce, and which is shown by the formation of hemorrhoids and chronic enlargement of the liver. Possibly it is to this cause, also, that may be attributed the dyspnœa and hurried breathing which some persons experience after an excessive use of coffee, and the coolness of the hands and feet which are more usual.

The moderation of tissue-waste which, it has been said, belongs to it in common with other articles having the same general action, and in use among different nations, is illustrated by various well-established facts. The inhabitants of Central Africa, the native country of coffee, in their predatory excursions are said to subsist entirely upon a mixture of coffee and butter, which is prepared in masses of the size of a billiard-ball, one of which will keep a man in strength and spirits during a day's fatigue. Jomand says: "120 grammes (4 oz.) of powdered coffee, and three litres (8 pints) of an infusion made with 200 grammes (6½ oz.) of different kinds of coffee, enabled me to live for five consecutive days, without lessening my ordinary occupations, and to use more, and more prolonged, muscular exercise than I was accustomed to, without any other physical injury than a slight degree of fatigue and a little loss of flesh." The Belgian coal miners live and work efficiently upon a ration of solid food much less than that of the French miners, and yet perform more labor than the latter. The only difference in the quality of their food consists in the Belgians receiving a ration of coffee, and to this is attributed their superior endurance. Such facts show that Böcker was in error when he alleged that coffee assists digestion only by hurrying forward the alimentary mass and preventing its assimilation; and also when he concluded that they only who live to eat, and not those who eat to live, should use coffee with their meals. This is a notable instance of scientific error.

It may seem, at first sight, irrational that a substance which restricts tissue-waste should be used for the very purpose of quickening certain functions, and especially those of the brain. The mental exhilaration, physical activity, and wakefulness, it causes, explain the fondness for it which has been shown by so many men of science, poets, scholars, and others devoted to thinking. It has, indeed, been called "the intellectual beverage." But all these occupations involve increased functional activity, and therefore increased waste of tissue in the brain and spinal marrow, the very action which coffee is said to restrain. To reconcile these apparent incongruities it has been maintained that coffee does not act primarily as a cerebral stimulant, but only secondarily by removing the vascular plenitude occasioned by prolonged study, by a full meal, and especially by alcohol, opium, or other agents which directly tend to load the brain with blood; that if taken on an empty stomach it does not quicken the functions of the brain, but, on the contrary, renders it dull and inapt for steady thought, creates general debility and nervousness, and frequently causes hemicrania. During digestion, however, the case is different, particularly if a full and stimulating meal has been taken; the mind grows dull and sluggish, a tendency to sleep arises, and everything indicates an increased amount of blood in the brain. In like manner prolonged mental labor produces cerebral plenitude and drowsiness. It is this condition, apparently, which coffee corrects by contracting the bloodvessels and relieving the brain of its oppressive load of blood. The habit of taking coffee at breakfast and after dinner is explained by the stimulant action (whether direct or indirect) which it exerts not only upon the nervous system generally, but especially upon the stomach and bowels; there can be no doubt that it quickens gastric digestion and relieves the sense of plenitude in the stomach, stimulates the secretion of bile, and augments the peristaltic action of the intestine, thereby promoting defecation. It is quite as certain that, used to excess, it paralyzes the digestive function in all its steps, and leads to further disorders, of which the chief are congestion of the liver, constipation, and hemorrhoids. Whether these effects are to be ascribed to a power in coffee to produce contraction of the capillary bloodvessels, may be uncertain, but their reality is beyond doubt. To such an operation has also been ascribed an anaphrodisiac action of coffee, which is alleged by Willis, Linnæus, and by numerous French writers, one of whom cites a Persian tale to the same effect. It would be singular if such were the case, when, as is well known, the consumption of coffee is greatest by the very nations most notorious for sexual excesses. It is not, however, without interest to remember that the use of coffee is universal and excessive in France, and that the smallness of the families of that country is quite exceptional.

Uses.—The mode in which coffee assists digestion has been described, and the popular use made of it to prevent or to relieve *indigestion;* but it is only in those forms of the affection which are associated with exhaustion or debility, and which result from previous excesses in eating and drinking, or depend upon weakness due to sedentary habits, acute diseases, old age, etc. Other forms of gastro-intestinal atony may be associated, on the one hand with *constipation*, or on the other with *diarrhœa*, and in either case pure strong coffee in small quantities will often afford relief. In constipation the coffee should be used early in the morning before any food has been taken. Partly with a view to promote digestion coffee has been much used during *convalescence* from acute diseases; but in this condition and also in acute febrile diseases of a *typhoid type*, it had long been employed with advantage before the present rationale of its operation was understood, according to which it restrains tissue change, and thus becomes a conservator of force. It, indeed, may take the place of alcohol in the adynamic conditions for which that stimulant is prescribed, or be associated with it, or exhibited alternately with alcohol. It has been found that in *typhus* fever coffee increases the elimination of urea, and in so far purifies the blood without increasing the destructive metamorphosis of tissue, and that it lessens coma and low delirium which it probably does by contracting the capillaries of the brain. Coffee, and also caffeina, have been used in the treatment of *intermittent fever*, and have cured it, as almost everything else has done, occasionally. The power of coffee to prevent and to moderate *alcoholic intoxication* is well known; one may drink more wine while taking coffee than without this association, and actual intoxication is often arrested by a cup of strong coffee. These effects tend to confirm what has been said above of the action of coffee on the brain. *Delirium tremens* is an indirect effect of alcohol, and comes on, it may be, days after intoxication has ceased, and involves an opposite state of the brain, one of anæmia, not of congestion. In this affection coffee is only an adjuvant; what good it does is through its primary stimulant impression upon the nervous system and the stomach, and by its limiting the waste which the exorbitant excitement and muscular effort, attendant upon the disease, entail. For these purposes it should be given in small and repeated doses. In *opium narcotism* the condition is much the same as in acute alcoholic intoxication, and in it coffee is equally efficient in preventing coma and its consequences. Experiments upon animals have also shown that coffee and tea are direct physiological antidotes to morphia. Coffee should be given in the manner just recommended, and by the rectum as well as by the mouth, but not to the neglect of other stimulants of the muscular system, such as flagellation and electricity. The stimulant action of strong coffee sometimes prevails against obstinate *hiccup*. The utility of coffee in *spasmodic asthma* has long been established. A competent authority in regard to this disease, Salter, says: "I should think, from my own experience, that coffee relieves asthma in two-thirds of the cases in which it is tried. The relief is very unequal, often merely temporary, and sometimes very slight; sometimes it is complete and permanent." It should be given in a very strong and hot infusion, either an hour in advance of the paroxysm, if it occurs periodically, or as soon as the first symptoms are felt. Its mode of action is not accurately known. It must be borne in mind, however, that the attack usually comes on at night, and especially during sleep, that is to say at a time when all convulsive diseases, except hysteria, are most apt to break out, and that the action of coffee is directly opposed to sleep; that the paroxysm may be relieved either by stimulants or by sedatives (belladonna, lobelia); and that, therefore, it seems probable that the cure of the paroxysm depends upon the removal of the congestion of the nervous centre which was its immediate cause. A similar mode of action probably explains certain cases in which *chordee* and also *dysury* were terminated by the same means. Some forms of *nervous headache* are apt to be relieved by coffee, by tea, and, as recent observations have shown, by Paraguay tea. It would seem that the most appropriate cases are those in which the face is flushed, and other signs exist of cerebral congestion; those, on the other hand, in which the face is pale, and the pain appears to be simply neuralgic, and not congestive, are thought to be aggravated by the medicine. It has long been known that certain strangulated *hernias* have been reduced under the influence of coffee, after the failure of the taxis. In many the reduction was spontaneous, in others easy. They were cases in which the protrusion was recent, and when there was no sign of gangrene, nor of inflammation in the hernial tumor. The mode of action may be inferred, from what was said above, to be, that coffee excites contraction of the intestinal muscles, by which the gas contained in the loop is expelled, and contraction of the bloodvessels by which the serous transudation is diminished. In favorable cases these two agencies suffice to reduce the bulk of the tumor and permit its reduction.

The *dose* of caffeina may be said to range from a quarter of a grain to two or three grains in powder, mixed with sugar.

CAHINCA.—Cahinca Root.

Radix caincæ s. cainanæ.—Cainça, Fr.; *Caincawurzel*, G.

The root of Chiococca racemosa, *Jacq. Nat. Ord.*—Rubiaceæ, Coffeineæ.

Origin.—The plant is a native of Southern Florida, the West Indies, Central America, and a portion of South America. It is a shrub with opposite shining, oval, ovate-oblong, or elliptic leaves, racemes of fragrant yellowish flowers, and small white berries with flattish ovate seeds.

Description.—The woody root exists in pieces 3 to 6 inches long, about

⅛ to ½ an inch thick, more or less bent, externally grayish-brown, with narrow transverse corky ridges, and on the thicker pieces with longitudinal, often very prominent ridges, produced by separated wood bundles, which have not been developed into separate branches of the root. The bark is thin, internally dark brown, of a resinous lustre, and disagreeable bitter taste. The wood is brownish-white, porous, and radiate by medullary rays.

The roots of Chiococca densifolia, *Mart.*, and Ch. anguifuga, *Mart.*, are of a reddish-brown color, often transversely fissured, and destitute of longitudinal ridges. The shrubs are indigenous to Brazil, and are known there as *cainana* or *caninana*.

Constituents.—The most important constituent of cahinca root is *cahincin* or *cahincic acid*, which, according to Rochleder (1867) has the composition $C_{40}H_{64}O_{18}$. It exists in the root partly free and partly as a calcium salt (François, Pelletier, and Caventou, 1829), forms white, silky, very bitter needles, is soluble in about 600 parts of cold water and ether, and crystallizes from its solution in hot alcohol. When boiled with hydrochloric acid it is split into sugar and *cahincetin* $C_{22}H_{34}O_3$, the alcoholic solution of which gelatinizes on the addition of water. Fused together with hydrate of potassium, cahincetin yields butyric acid and *cahincigenin* $C_{14}H_{24}O_2$. Rochleder and Hlasiwetz (1851) regard the tannin of cahinca root as being indentical with *caffeo-tannic acid.*

Medical Action and Uses.—When first introduced into American and European medicine, cahinca was reputed to be an efficient diuretic, as well as a tonic and laxative. There is no doubt of its diuretic virtues in *dropsy*, independent of acute renal disease. But it is now very rarely employed. It is best administered in a decoction made with two drachms of the root to a pint of water; or an electuary may be formed with powdered gum and syrup containing about fifteen grains of the powdered root.

CALAMUS, *U. S.*—CALAMUS.

Rhizoma calami, P. G.; *Radix calami aromatici*, *Radix acori.*—*Sweet flag*, E.; *Acore vrai*, *Acore odorant*, Fr.; *Kalmuswurzel*, G.

The rhizome of Acorus calamus, *Lin.* Woodville, Med. Bot. 248; Bentley and Trimen, Med. Plants, 279.

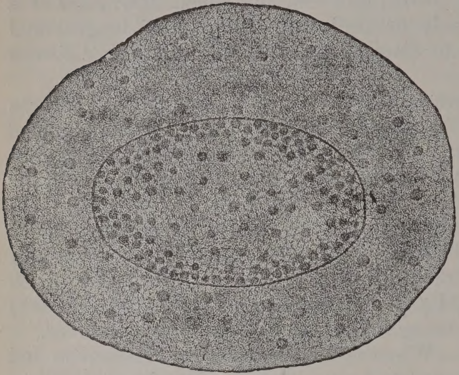
Nat. Ord.—Araceæ, Acoroideæ.

Origin.—An herbaceous perennial, with leaves resembling those of the flag (Iris), and green triangular flowering stems terminating with a cylindrical spadix of small sessile flowers, and a long two-edged bract resembling the leaves. The plant is indigenous to North America and Northern Asia, but has spread throughout Central Asia to India, and throughout Europe to the Pyrenees. In Burmah and Ceylon it is cultivated. It grows in the muddy margins of streams and swamps.

Description.—The rhizome grows to the length of several feet, is horizontal, subcylindrical; about ¾ of an inch in diameter: deprived of the brown outer coat it is whitish, but turns pinkish on drying, and longitudinally wrinkled. The leaf-scars are transverse and somewhat oblique; the lower surface of the rhizome shows the circular root-scars arranged in a single or sometimes double line, branching alternately to the right and left. It has a spongy texture, due to numerous small air-passages, and breaks with a short corky fracture, showing a pale reddish color internally. Upon the transverse section a fine darker line (nucleus sheath) separates a central portion from an outer layer, in width about one-fifth the diameter of the rhizome. The wood bundles are irregularly scattered, rather more numerous near the nucleus sheath; the oil-cells, which become more conspicuous on being moistened by an alkali, are likewise scattered and more numerous in the outer portion.

Calamus has an agreeable aromatic odor, which is best preserved by keeping the rhizome unpeeled. On drying it loses about 75 per cent. in weight. It is not subject to adulteration, and cannot easily be confounded with other rhizomes.

Fig. 20.



Transverse section of Rhizome of Calamus, magnified 3 diameters.

Constituents.—Bartels obtained from the fresh peeled rhizome $\frac{1}{4}$ per cent. of volatile oil, Martius 1 per cent. from the peelings. The yellowish oil has an agreeable odor, turns brown by ferric chloride, and contains, according to A. Kurbatow (1873), a hydrocarbon $C_{10}H_{16}$ of a terebinthinate odor, boiling at 159° C. (318.2° F.), and yielding with chlorine a crystalline mass which melts at 65° C. (149° F.). The portion boiling at a higher temperature is of a deep blue color, and not of a constant boiling point. Faust (1867) named the bitter principle *acorin*. It was obtained from the concentrated decoction by precipitating it successively with alcohol, acetate and subacetate of lead, removing the lead by sulphuretted hydrogen, neutralizing with soda, and agitating with ether, which leaves it as a soft brown-yellowish mass, soluble in ether and alcohol, having a faint alkaline reaction, and being precipitated from its solution in hydrochloric acid by tannin, phospho-molybdate of sodium, and iodo-hydrargyrate of potassium. It contains nitrogen, and when boiled with dilute sulphuric acid or baryta water, yields sugar and a resin-like body. Flückiger obtained a small quantity of crystals from its tannin precipitate.

Trommsdorff obtained from the fresh drug 1.6 starch, 5.5 gum, 2.3 per cent. of soft resin, and 21 per cent. of cellulose.

Pharmaceutical Uses.—A tincture and extract of calamus are employed in Europe, for which the German Pharmacopœia gives the following directions:—

TINCTURA CALAMI.—Digest 1 part of bruised calamus with 5 parts of alcohol spec. grav. .892 for eight days, express and filter. It has a brownish-yellow color.

EXTRACTUM CALAMI.—Bruised calamus is exhausted by digestion with diluted alcohol, the expressed liquid filtered and evaporated to the proper consistence.

Physiological Action and Medical Uses.—Calamus excites a sense of warmth in the stomach, promotes the appetite, and improves the digestion. It is said to quicken the pulse and increase the secretion of urine and perspiration. In excessive doses it may cause headache. It is added to bitter tonic infusions in atonic *dyspepsia* and other disorders producing abdominal flatulence. It may be used for the relief of flatulent *colic*, and as a very mild stimulant in some cases of the *typhoid condition*. It is often eaten prepared with sugar as a conserve, and it may be habitually chewed to relieve slight dyspeptic disorder. An infusion made with an ounce of calamus and a pint of hot water may be prescribed in the dose of a wineglassful.

CALCII BROMIDUM.—Bromide of Calcium.

Calcium bromatum.—Bromure de calcium, Fr.; *Bromcalcium*, G.
Formula $CaBr_2$. Molecular weight 200.

Preparation.—Bromide of calcium is readily prepared by dissolving pure calcium carbonate in hydrobromic acid and evaporating the solution. Bödeker has used a method which was described by Faust (1867), and is based upon the decomposition of bromide of sulphur, SBr_6, by lime, whereby bromide and sulphate of calcium are formed: $SBr_6 + 4CaH_2O_2$ yields $3CaBr_2 + CaSO_4 + 4H_2O$. He directs the dissolving of 20 parts of sulphur in 240 parts of bromine (300 parts are required by calculation), and the adding of it to thin milk of lime, which contains 140 parts of pure lime. After it has become colorless, the liquid is filtered, treated with carbonic acid gas and heated, to remove excess of lime, the filtrate is concentrated, mixed with twice its bulk of alcohol, to precipitate calcium sulphate, is again filtered and evaporated.

Properties.—Thus obtained, bromide of calcium is a whitish, granular, or pulverulent salt, having a pungent bitter taste. It is freely soluble in alcohol and water, the latter solution yielding with difficulty colorless needles. 100 parts of water dissolve at 0° C. (32° F.) 125 parts, at 20° C. (68° F.) 143 parts, and at the boiling point 105° C. (221° F.) 312 parts of the salt. According to Kremers (1857), solutions having at 19.5° C. (67° F.) the specific gravity

	1.044	1.089	1.139	1.194	1.252	1.315	1.385	1.461	1.594	1.641	
contain	5	10	15	20	25	30	35	40	45	50	p. c. $CaBr_2$.

The solution left in contact with lime forms an oxybromide of calcium, which has a strong alkaline reaction, and, on evaporation, is left behind as a very white salt.

Tests.—The neutral reaction of the salt and its ready solubility in water and alcohol exclude most impurities. The aqueous solution, rendered distinctly alkaline by ammonia, yields a white precipitate with nitrate of silver, and the filtrate, when acidulated with nitric acid, becomes merely opalescent, without yielding a curdy white precipitate (absence of chloride). On adding dilute sulphuric acid to the solution, it does not become colored from the liberation of bromine (absence of nitrate, bromate, etc.).

Medical Action and Uses.—In 1871 this salt was proposed by Dr. Hammond as producing the characteristic effects of the bromides more promptly than the analogous compounds, and also as inducing sleep where they failed to do so. He regarded it as peculiarly appropriate for relieving the *insomnia* caused by mental labor or excitement, and those exhausted and irritable states of the nervous system met with in *hysterical* women, and accompanied by headache, vertigo, insomnia, and extreme mental excitability. He also found that it cured *epilepsy* in very young infants, when bromide of potassium had failed. The best mode of administering it is said to be according to the following formula: ℞.—Calcii bromid. ℥j; Syr. lact.-phos. calcis, f℥iv.—M. S.—A teaspoonful three times a day in a little water, in epileptic cases. As an hypnotic for adults the dose is from twenty to thirty grains.

It has been objected to this, as well as to the other bromine salts, that their sedative action is due not to the bromine they contain, but to their alkaline or earthy bases. This strange notion is sufficiently condemned by the fact that uncombined bromohydric acid produces the same effects as its salts.

Iodo-bromide of calcium is reported to have maintained in quiescence the distressing symptoms of a case of *exophthalmic goitre*, and at last reduced the thyroid gland to its natural size.

CALCII CARBONAS PRÆCIPITATA, *U. S.*—PRECIPITATED CARBONATE OF CALCIUM.

Calcis carbonas præcipitata, Br.; *Calcaria carbonica præcipitata*, P. G.; *Carbonas calcicus præcipitatus*, *Creta præcipitata.*—*Precipitated carbonate of lime*, E.; *Carbonate de chaux précipité*, *Craie précipitée*, Fr.; *Präcipitirter kohlensaurer Kalk*, G.

Formula $CaCO_3$. Molecular weight 100.

Preparation.—Take of Solution of Chloride of Calcium five pints and a half; Carbonate of Sodium seventy-two troyounces; Distilled Water a sufficient quantity. Dissolve the carbonate of sodium in six pints of distilled water. Heat this solution and the solution of chloride of calcium, separately, to the boiling point, and mix them. After the precipitate has subsided, separate it from the supernatant liquid by decantation, and wash it with boiling distilled water, until the washings cease to be affected by a solution of nitrate of silver. Lastly, dry the precipitate on bibulous paper. *U. S.*

Take of Chloride of Calcium five ounces; Carbonate of Soda thirteen ounces; Boiling Distilled Water a sufficiency. Dissolve the chloride of calcium and carbonate of soda each in two pints of the water; mix the two solutions, and allow the precipitate to subside. Collect this on a calico filter, wash it with boiling distilled water until the washings cease to give a precipitate with nitrate of silver, and dry the product at the temperature of 100° C. (212° F.). *Br.*

In both processes a mutual decomposition of calcium chloride and sodium carbonate takes place, resulting in the formation of sodium chloride, which remains in solution, and calcium carbonate, which precipitates. The decomposition is illustrated by the equation $CaCl_2 + Na_2CO_3 = 2NaCl + CaCO_3$.

Properties and Tests.—Thus prepared, it is a white, minutely crystalline powder, free from grittiness, insoluble in water, but soluble in dilute muriatic and nitric acids, carbonic acid gas being copiously given off. The solutions neutralized with ammonia yield, with oxalate of ammonium, a white precipitate of oxalate of calcium, and, if well boiled to expel all carbonic acid, are not disturbed by the addition of saccharated solution of lime (absence of phosphate), or by barium chloride (absence of sulphate). A substitution of calcium sulphate for the carbonate has been occasionally, but rarely, observed. Chlorides would be indicated by a curdy white precipitate occurring in the nitric acid solution on the addition of nitrate of silver. If carbonate of calcium is precipitated in the cold, it is flocculent and quite voluminous, and with difficulty deprived of the mother-liquor by washing.

Off. Prep.—Trochisci bismuthi, *Br.*

Medical Action and Uses.—Chalk is astringent and antacid. In the form of prepared chalk it is much used as a dusting powder by females who have a coarse and greasy skin; and also to promote the healing of slight *abrasions*, *burns*, and *scalds*, certain cutaneous eruptions, etc. It is used in an ointment as a dressing for *ulcers* with flabby granulations and a profuse discharge. It is administered internally to check *diarrhœas*, especially those due to cold, and accompanied with acidity, as indicated by sour eructations or breath, colic, flatulence, and acid and greenish discharges. If there is any reason to suppose that the alimentary canal contains undigested food, a mild laxative should first be given. Chalk is generally prescribed to relieve diarrhœa in the form of the officinal chalk mixture, with the addition of an astringent, as tincture of catechu, of kino, etc., and a few drops of laudanum. There is no better medicine in the incipient stages of epidemic *cholera*. The *dose* of prepared chalk is from five to sixty grains, or more, suspended in thin mucilage.

CALCII CHLORIDUM, *U. S.*, *Br.*—CHLORIDE OF CALCIUM.

Calcaria muriatica, Chloridum calcium.—Chlorure de calcium, Fr.; *Chlorcalcium*, G.

Formula $CaCl_2$. Molecular weight 111.

Chloride of calcium prepared by fusion.

Preparation.—This compound is a by-product in many chemical processes, among others in the officinal process for solution of ammonia. It may be formed by neutralizing hydrochloric acid with marble or other calcium carbonate; $CaCO_3+2HCl$ yields $CaCl_2+CO_2+H_2O$. Iron being usually contained in these native carbonates, it is removed by digesting the solution with chlorinated lime and slaked lime, by which the iron is first converted into ferric chloride and then precipitated as ferric hydrate. The filtrate, which will be found to have an alkaline reaction, is neutralized with hydrochloric acid, evaporated and dried at a temperature of about 200° C. (about 400° F.).

Properties.—Calcium chloride is in white, dry, but very deliquescent masses. The U. S. Pharmacopœia describes it as colorless, slightly translucent, hard and friable masses, in which condition it is obtained by heating the salt to fusion at a red heat, for which no apparent necessity exists. It dissolves in alcohol and in two parts of water, the latter solution being not precipitated by the addition of lime-water (absence of soluble carbonate), of ammonia (absence of aluminium, iron, etc.), of barium chloride (absence of sulphates), or of ferrocyanide of potassium (absence of iron, etc.). Hydrochloric acid added to the salt evolves no chlorine odor (absence of hypochlorites). The hot concentrated aqueous solution yields, on cooling, large crystals of the formula $CaCl_2.6H_2O$, and when evaporated to dryness at a temperature not exceeding 150° C. (302° F.) a crystalline powder, $CaCl_2.2H_2O$, is obtained, which, on being mixed with two-thirds its weight of snow, produces a temperature of —45° C. (—49° F.).

Pharmaceutical Uses.—Chloride of calcium is used for the drying of gases and certain liquids, and in the preparation of various calcium salts. For the latter purpose it is directed only in the process for Calc. carbonas præcipitata.

Physiological Action and Medical Uses.—Chloride of calcium is an active irritant, and in excessive doses may occasion gastro-intestinal inflammation. In medicinal doses it is supposed to have a special action upon the glandular system, increasing secretions, removing infarctions, etc. It has been used very successfully to reduce *scrofulous* swellings of the external lymphatic glands, of the mesenteric glands, etc., and in strumous *diseases of the skin*, particularly *lupus*. In such cases it should be associated with iodine applied locally. It is also said to exhibit peculiar virtues in the *dyspeptic* disorders to which scrofulous children are subject, and which are popularly supposed to be of verminous origin, such as restless sleep, capricious appetite, irregular stools, foul breath, and enlarged tonsils. Physicians of authority have affirmed its curative power in cases of *uterine* and *ovarian tumors*. The only ones which contract under this or any other medicinal treatment are the so-called muscular tumors, which may be reduced by the loss of their liquid constituents. The use of the medicine is not unattended with risk. If persisted in for a length of time, it is apt, according to Wells, to bring about calcareous degeneration of the arteries generally. Whatever action it may possess in arresting the growth of fibroids probably depends upon this property. *Dose*, from ten to twenty grains, taken in milk, or dissolved in a large quantity of water. The old "solution of muriate of lime" (Ph. Edin.) contained eight ounces of the crystallized salt in twelve fluidounces of water. *Dose* for an adult from twenty to fifty minims, in water or milk. A syrup has been prepared which contains five ounces of the crystallized salt in twelve fluidounces of the excipient. *Dose*, a teaspoonful.

CALCII HYPOPHOSPHIS, *U. S.*—HYPOPHOSPHITE OF CALCIUM.

Calcis hypophosphis, Br. Add.; *Calcaria hypophosphorosa, Hypophosphis calcicus.*—*Hypophosphite of lime*, E.; *Hypophosphite de chaux*, Fr.; *Unterphosphorigsaurer Kalk*, G.

Formula $Ca2PH_2O_2$. Molecular weight 170.

Preparation.—Hypophosphite of calcium is obtained by heating phosphorus with milk of lime, inflammable phosphuretted hydrogen being given off, namely, $3Ca2HO+6H_2O+4P_2$ yields $3Ca2PH_2O_2+2PH_3$. Procter (1858) uses a deep boiler, in which a uniform milk is made with 4 pounds of burned lime and 5 gallons of water; 1 pound of phosphorus is added, and the whole boiled, boiling water being added from time to time to preserve the measure, until the phosphorus has been all oxidized and the strong odor of phosphoretted hydrogen has disappeared. The mixture is filtered, the residue washed with water, the mixed filtrates evaporated to six pints, filtered from the hydrate and carbonate of calcium, and again evaporated and crystallized or granulated. Nearly half the phosphorus is oxidized to phosphoric acid—probably by the decomposition of water, since the escaping gas contains free hydrogen (Wurtz) and remains with the excess of lime as calcium phosphate. E. Scheffer (1858) succeeded in avoiding much of this loss by using phosphorus which had been previously burned under water by passing atmospheric air into it, whereby it assumed a spongy appearance. It unites then with the lime even at the ordinary temperature, but more readily at 55° C. (about 130° F.), and very little spontaneously inflammable gas is generated. It is prepared on the large scale by adding granulated phosphorus to milk of lime, and exposing the mixture to the air and agitating frequently, until the phosphorus has disappeared. A small portion of phosphoretted hydrogen is evolved (Gmelin-Kraut's *Chemie*). It is well to precipitate the dissolved lime by passing carbonic acid gas through the warm filtrate and filter again.

Properties.—Hypophosphite of calcium crystallizes in thin flexible scales, but is usually met with as a white, crystalline salt, with a pearly lustre and a bitter, nauseous taste. Heated to redness in a retort it ignites, evolves water, spontaneously inflammable phosphoretted hydrogen, and a little phosphorus, and leaves nearly 80 per cent. of a reddish residue containing a little amorphous phosphorus and calcium pyrophosphate. The salt dissolves in 6 parts of cold and in a slightly less amount of boiling water; it is insoluble in strong and but slightly soluble in dilute alcohol (H. Rose).

Tests.—Its complete solubility in water proves the absence of phosphate and carbonate of calcium. The solution is not precipitated by lead acetate (absence of soluble phosphate), or by acidulated barium chloride (absence of sulphate). It yields white precipitates with silver nitrate and mercuric chloride, both turning dark, when heated, from a reduction to the metallic state. It gives a blue precipitate with ammonium molybdate, the precipitate appearing green, if phosphate is present, from the admixture with yellow phosphomolybdate.

Medical Action and Uses.—On purely theoretical grounds, the combinations of phosphorus with lime have been supposed to possess a power of stimulating and regenerating the nervous system and those tissues which contain lime. These views have led to the use of their combinations in *anæmia, scrofula, caries, tuberculosis*, and other cachectic conditions; in *chlorosis* and *menorrhagia;* in *fractures* uniting slowly or imperfectly, in *rickets*, and in *Pott's disease;* and in various chronic *profluvia* connected with a feeble and often strumous state of the system. The evidence of the efficacy of these preparations independently of other and more efficient medicines (iron, cod-liver oil) and hygienic influences, is too slender to be seriously entertained. *Dose*, five or six grains at meal times.

CALCII IODAS.—IODATE OF CALCIUM.

Iodate de chaux, Fr.; *Jodsaurer Kalk*, G.
Formula $Ca2IO_3.6H_2O$. Molecular weight 498.

Preparation.—The following process was proposed by W. Flight (1864): An alcoholic solution of iodine is gradually mixed with an excess of a filtered aqueous solution of chlorinated lime, care being taken to prevent the increase of temperature, so that the formation of chloride of iodine shall not be permitted. The chlorinated lime oxidizes the iodine, iodate of calcium being precipitated, while chloride of calcium and hydrochloric acid remain in solution; $5CaCl_2O_2+2I_2+2H_2O$ yields $2CaI_2O_6+3CaCl_2+4HCl$. Reichardt (1874) directs the use of iodine with an excess of chlorinated lime diffused in water. After decolorization the mixture is slightly acidulated with hydrochloric acid, heated to boiling, and the filtered solution crystallized.

Properties.—Iodate of calcium crystallizes from water in flat, colorless, shining needles, which are slowly efflorescent on exposure, require at 15° C. (59° F.) about 300 parts of water for solution, and are nearly insoluble in alcohol. The aqueous solution yields a white precipitate with oxalate of ammonium, and liberates iodine on the addition of sulphurous acid.

CALCII IODIDUM.—IODIDE OF CALCIUM.

Calcium iodatum, *Iodure de calcium*, Fr.; *Jodcalcium*, G.
Formula CaI_2. Molecular weight 294.

Preparation.—The salt is obtained on dissolving slaked lime in hydriodic acid and evaporating. Or 3 parts of iodine are digested with sufficient iron and water until a green solution of ferrous iodide is obtained. The liquid is filtered and mixed with one part of iodine, and, after this has been dissolved, it is boiled with milk of lime, prepared with one part of burnt lime, until the iron has been precipitated; the liquid is then filtered and evaporated.

Properties.—Iodide of calcium is a white salt which crystallizes with difficulty in pearly scales. It is freely soluble in alcohol and water, and is very deliquescent. 100 parts of water dissolve at 0° C. (32° F.) 192, at 20° C. (68° F.) 204, and at 92° C. (197.6° F.) 435 parts of the salt. On exposure to the air the solution is partly decomposed, carbonate of calcium being precipitated.

Tests.—The solution yields a white precipitate with oxalate of ammonium, and a bright red one with corrosive sublimate. On mixing the solution with sulphurous acid and sulphate of copper in excess, and heating the mixture, a grayish precipitate of cuprous iodide is produced, and the filtrate yields no precipitate on the addition of nitrate of silver (absence of chloride and bromide).

Medical Action and Uses.—Experiments seem to show that this salt arrests putrefactive fermentation, deodorizes fecal matter, and acts as an irritant upon the living tissues. Given internally, in doses of two or three grains three times a day, it is alleged to arrest *erysipelas*, diminish and deodorize *suppurative discharges*, and promote the cure of *ulceration*. These statements call for confirmation, and even more its claims to extraordinary efficacy in pulmonary *phthisis*.

CALCII PHOSPHAS PRÆCIPITATA, *U. S.*—PRECIPITATED PHOSPHATE OF CALCIUM.

Calcis phosphas, Br.; *Calcaria phosphorica*, P. G.; *Phosphas calcicus præcipitatus.—Precipitated phosphate of lime*, E.; *Phosphate de chaux hydraté*, Fr.; *Phosphorsaure Kalkerde*, G.

Formula Ca_32PO_4. Molecular weight 310.

Preparation.—Take of Bone calcined to whiteness and in fine powder four troyounces; Muriatic Acid eight troyounces; Water of Ammonia twelve fluidounces, or a sufficient quantity; Distilled Water a sufficient quantity. Macerate the bone in the acid diluted with a pint of distilled water until it is dissolved, and filter the solution. Add another pint of distilled water, and then, gradually, water of ammonia, until the liquid acquires an alkaline reaction. Mix the precipitate obtained, while yet in the state of magma, with twice its bulk of boiling distilled water, and pour the whole upon a strainer. Wash the precipitate with boiling distilled water, until the washings cease to be affected by a solution of nitrate of silver, acidulated with nitric acid. Lastly, dry the precipitate with a gentle heat. *U. S.*

The process of the British Pharmacopœia is identical with the above. By dissolving the bone earth in hydrochloric acid, acid calcium phosphate, $CaH_4 2PO_4$, and calcium chloride, $CaCl_2$, are formed; on the addition of ammonia, the result is ammonium chloride, water, and tricalcium phosphate, the latter of which precipitates; $CaH_42PO_4+2CaCl_2+4NH_4HO$ yields $4NH_4Cl+4H_2O+Ca_32PO_4$. The ammonium chloride is removed by washing with water. If the precipitation is effected in the cold, the calcium phosphate is very voluminous, and the washing is quite difficult.

Properties and Tests.—This preparation is often called *bone phosphate* to distinguish it from other calcium phosphates; it forms a light white amorphous powder, insoluble in water, but soluble without effervescence in dilute muriatic acid (absence of carbonate), also in dilute nitric and acetic acids. The solution in the latter, which is best obtained by adding to the nitric acid solution an excess of sodium acetate (a white precipitate indicates ferric phosphate), yields a white precipitate with ammonium oxalate (presence of calcium), a white one with ferric chloride, and a yellow one with ammonio-nitrate of silver (presence of phosphate). The solution of 10 grains of the phosphate in muriatic acid yields with ammonia a white precipitate, insoluble in boiling solution of potassa (alumina would be dissolved), and when washed and dried, weighs 10 grains. The phosphate contains small quantities of ammonio-phosphate of magnesium and calcium fluoride, derived from the bones.

Off. Prep.—Pulvis antimonialis, *Br.*

Medical Action and Uses.—If this preparation possesses medicinal virtues, they are chiefly those of the hypophosphite of lime, which is treated of elsewhere. It has, however, been used with reputed advantage in *mollities ossium*, and also to promote the consolidation of *fractures*, in which the formation of callus is slow or imperfect. The *dose* is from ten to thirty grains, and may conveniently be given in carbonic acid water.

CALCII SULPHAS.—SULPHATE OF CALCIUM.

Gypsum, E.; *Sulfate de chaux*, *Gypse*, Fr.; *Schwefelsaurer Kalk*, *Gyps*, G.

Formula $CaSO_4.2H_2O$. Molecular weight 172.

Origin.—This compound is met with in nature in the form of transparent prisms, known as *selenite*, and in opaque or semi-opaque masses, which are called *alabaster* and *gypsum*. On adding sulphuric acid or a sulphate to a solution of a calcium salt, the same compound is precipitated.

Properties.—Sulphate of calcium is white, crystalline or amorphous, insoluble in alcohol, soluble in about 380 parts of cold water, and in 450 parts of boiling water; an aqueous solution, saturated at the ordinary temperature, becomes turbid on being heated to boiling. When heated to between 100° and 200° C. (212° and 392° F.), it becomes anhydrous.

CALCII SULPHAS USTA; s. Calcaria sulfurica usta, *P. G.;* Plaster of Paris, *E.;* Plâtre, *Fr.;* Gebrannter Gyps, *G.*—It is obtained from native gypsum in the manner indicated above, and after grinding constitutes a white amorphous powder, which, when made into a paste with water, combines with it and solidifies in a few minutes, at the same time slightly expanding in volume. Gypsum which has been dehydrated at 400° C. (752° F.), or at a higher temperature, is *overburnt*, and does not exhibit the property of rapidly recombining with water. Plaster of Paris should be preserved in well-closed vessels, to prevent the gradual absorption of moisture from the atmosphere.

Surgical Uses.—Plaster of Paris is used for making casts of deformities and surgical injuries, and as one of the articles adapted for applying the so-called immovable apparatus intended to retain broken bones in a fixed position. "A roller of coarse, soft muslin must have dry plaster of Paris thoroughly rubbed into its meshes; some cold water is then to be poured upon either end of it so as to moisten it through. A dry roller having been previously applied to the limb, the wetted plaster bandage must be smoothly rolled upon it, the surgeon taking care that no reverses are made. . . . It hardens in the course of a few minutes, and, as it dries, forms a solid, hard, and light casing to the limb. It has the advantage over the starch apparatus of being lighter, and especially of drying and hardening quickly." (Erichsen.)

CALCII SULPHIS.—SULPHITE OF CALCIUM.

Sulfite de chaux, Fr.; *Schwefligsaurer Kalk*, G.
Formula $CaSO_3.2H_2O$. Molecular weight 156.

Preparation.—Four parts of slaked lime are intimately mixed with one part of water, the mixture is spread out in thin layers, and sulphurous acid gas passed into the vessel or chamber, as long as it is absorbed. Or, the gas is passed into milk of lime, and the resulting precipitate dried.

Properties.—Sulphite of calcium is a white powder, requiring 800 parts of cold water for solution; it dissolves readily in aqueous sulphurous acid, and crystallizes from this solution in hexagonal prisms. It has a slight sulphurous taste, and on exposure is gradually converted into sulphate of calcium.

Medical Action and Uses.—The local action of this sulphite appears to be very slight, since when administered to dogs in very large doses it did not occasion any signs of gastro-intestinal irritation. This fact is referable, in part at least, to the great insolubility of the compound. It appears to be absorbed and excreted without changing the urine. It limits *fermentation* and *putrefaction* in the digestive organs, like other compounds of sulphurous and hyposulphurous acids (v. Acidum sulphurosum), and may be applied externally for the same purposes, and to stimulate indolent *ulcers*, etc. The very large quantities which are considered necessary for securing its effects render its internal administration as difficult as it is, indeed, superfluous, considering the number of soluble sulphites and hyposulphites available.

CALENDULA.—MARIGOLD.

Fleurs de tous les mois, Souci, Fr.; *Ringelblume*, G.

The ray florets of Calendula officinalis, *Lin.*

Nat. Ord.—Compositæ, Cynareæ.

Origin.—The garden marigold is an annual plant, a native of Southern Europe and the Levant, and is frequently cultivated for ornament. It has a spreading stem, alternate, sessile, rather fleshy, oblong and entire leaves, and terminal heads of yellow flowers, with rough, strongly incurved or coiled akenes. The plant has a rather disagreeable odor.

Description.—The ray florets are pistillate, strap-shaped, about three-quarters of an inch long, one-eighth of an inch wide, veined, three-toothed at the apex, and vary in color from pale-yellow to orange. Occasionally the heads are collected; they have the scales of the involucre nearly equal and in two rows, the receptacle flat and naked, the numerous disk florets sometimes ligulate (double), but usually tubular, five-toothed, and staminate, and the akenes without pappus. The flower-heads have a heavy odor, and a bitter, somewhat saline taste. On exposure to the sunlight, calendula changes its yellow color to a whitish tint.

Substitution.—In 1867 we called attention to the fact that the flower-heads of Tagetes erecta, *Lin.*, were sold as calendula, and we believe that most of the *fluid extract of calendula* at present in the market is really obtained from the species named, and from Tag. patula, *Lin.* These two plants are indigenous to Mexico and tropical America, but are often cultivated under the names of *French* or *African marigold*. They have pinnatifid leaves and showy flowers, with the scales of the involucre united to form a tube, the receptacle naked, and the ray florets broadly ligulate, toothed, light or deep orange-colored, sometimes (*T. patula*) striped with red; the akenes are flattish, slender, and crowned with a few chaffy or awned scales.

Composition.—Calendula was analyzed by Geiger (1878), who, besides the usual constituents of herbs, found in it an amorphous, bitter principle and *calendulin*, which is yellowish, tasteless, insoluble in ether, soluble in alcohol, and swelling with water into a transparent jelly.

Medical Action and Uses.—The leaves and the unexpanded flowers were at one time supposed to possess stimulant and resolutive virtues, and were used in congestions of the *liver*, *jaundice*, *amenorrhœa*, *scrofula*, and even in *typhoid* febrile states. Both internally and externally it was employed in the treatment of *cancer*, and was thought to dispose cancerous ulcers to heal. A solution of the extract and a decoction of the herb were employed for this purpose. A saturated tincture of the flowers is said to promote the cure of *contusions*, *wounds*, and simple *ulcers*. The extract is alleged to have been very efficient in allaying chronic *vomiting*.

CALLITRICHE.—WATERSTARWORT.

Callitriche verna, *Lin.* *Nat. Ord.*—Callitrichaceæ.

Description.—The plant is a native of Europe and of North America, from Pennsylvania and New Jersey northward. It grows in stagnant waters and sluggish rivulets, has a stem one to two feet long, radiating at the nodes, and nearly sessile, obovate, entire, and three-nerved floating leaves, which are crowded in a tuft, and about one-third of an inch long; the submersed leaves are longer and linear, the flowers monœcious and inconspicuous.

A closely allied species, *Call. heterophylla*, Pursh, which is common in the

Southern United States, has broadly spatulate and petiolate floating leaves, and is used for the same purposes as the northern waterstarwort.

Medical Action and Uses.—Waterstarwort is esteemed in the Southern States as a diuretic in *dropsy*, and is administered in the form of tincture, or in spirits saturated with the plant. It is given to horses in decoction to promote diuresis.

CALUMBA, *U. S.*—COLUMBO.

Calumbæ radix, Br.; *Radix colombo*, P. G.; *Radix columbo.*—*Colombo, Calumba*, E.; *Colombo*, Fr.; *Kolombowurzel*, G.

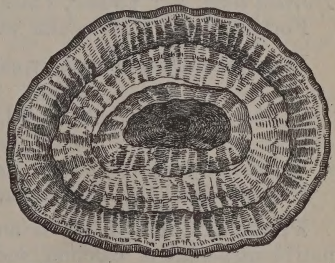
The root of Jateorrhiza palmata, *Miers*, s. Cocculus palmatus, *De C.;* and of Jateorrhiza calumba, *Miers*, s. Cocculus palmatus, *Wallich, non De C.* Bot. Mag., 2970, 2971. Bentley and Trimen, Med. Plants, 13.

Origin.—The distinctive characters of the plants, supposed to depend upon the shape of the basal lobes of the leaves and the presence or absence of hairs in the male inflorescence, were proven by Hanbury to be unimportant and to exist on the same stem; hence he suppressed the name of a supposed species, retaining that of J. palmata. Bentley agrees with these views, but retains the name of J. calumba. The name is derived from *Kalumb*, the African name of the root.

The plant is indigenous to the forests of Mozambique, in the southern portion of Eastern Africa, quite abundant along the lower Zambesi River, and cultivated in some African and East Indian islands. It is a hairy perennial climber, which reaches the summits of lofty trees, has large, nearly orbicular, cordate, and palmately lobed leaves, and diœcious flowers. It grows from a short, thick, and irregular rhizome, and this gives off numerous fusiform roots, which are the portion collected during the dry season, cut into transverse slices, and dried in the shade.

Description.—Columbo root exists in commerce in nearly circular disks, having a diameter of 1 to 2½ inches, and a thickness of about ¼ to ½ inch. From the considerable shrinking of the parenchyma the central portion is quite depressed, but the meditullium shows two or three circles of projecting and radiating vascular bundles, and upon a fresh section the dark-colored cambium line becomes plainly discernible, together with the numerous radiating dark colored and narrow bast-wedges. The fresh section is of a light or grayish-yellow color, more yellowish-brown in the outer bark, which externally shows a gray-brown cork. The root breaks very readily in all directions with a short and mealy fracture; its odor is slight, more prominent and characteristic on powdering or moistening; the taste is slightly aromatic, persistently bitter, and, at the same time, mucilaginous. As imported it is often more or less worm-eaten.

Fig. 21.



Calumba root.—Transverse section.

Columbo root enters commerce directly from Zanzibar, or through Bombay and other Indian ports. From 10,000 to 15,000 lbs. are annually received in the United States.

Constituents.—Columbo root has been analyzed by Planche, Wittstock, Buchner, Lebourdais, and Boedeker. *Columbin* was obtained by Wittstock (1830) by evaporating the ethereal tincture of the root. Boedeker (1849) prefers to obtain it by shaking the turbid aqueous solution of the alcoholic extract with ether. It forms colorless, inodorous, and very bitter prisms and needles, and is soluble in alkalies and acetic acid, less so in cold alcohol and ether. Boedeker also found the yellow color of the cell-walls due to *berberina*, which exists probably in combination with the straw-yellow bitter *columbic acid;* the latter is almost insoluble in cold water, sparingly soluble in cold ether, freely in alkalies and alcohol; the last two principles are probably formed from the first. Columbin is $C_{42}H_{44}O_{14}$; the addition of ammonia NH_3 may result in the formation of berberina $C_{20}H_{17}NO_4$, columbic acid $C_{22}H_{24}O_7$ and $3H_2O$. Buchner (1831) found in calumba root also 35 per cent. of starch, 17 of pectin, 4.7 of gum, 5 of yellow resin, and a little wax.

Substitutions.—The roots of bryonia and of Frasera walteri, which have been occasionally sold as columbo, have scarcely any resemblance to it, and are readily distinguished by their color and by the absence of the dark cambium zone and radiating lines.

Off. Prep.—Extractum calumbæ, *Br.;* Extr. calumbæ fluid., *U. S.;* Infus. calumbæ, *U. S.*, *Br.;* Mistura ferri aromatica, *Br.;* Tinct. calumbæ, *U. S.*, *Br.*

Medical Action and Uses.—Columbo is a pure stimulant stomachic tonic, increasing the appetite and improving the digestion. It does not constipate. In India it has long been used in the treatment of *diarrhœa*, *cholera morbus*, and *dysentery;* and in Europe it has been found an efficient remedy for the *vomiting* and *purging* incident to teething, for gastro-intestinal atony, the vomiting of pregnancy, etc. In order to preserve the infusion it may be prepared as follows: Take an ounce of powdered columbo, half an ounce of powdered orange-peel, two ounces of brandy, and fourteen ounces of water. After maceration for twelve hours it should be filtered. Or it may be prepared more quickly by displacement. If a laxative operation is desired, rhubarb may be added to the materials. The dose of columbo in powder is from ten to thirty grains. In this form it may be associated with carbonate of iron and a little ginger or orange-peel.

CALX, *U. S.*, *Br.*—LIME.

Calcaria usta, P. G.; *Calcaria*, *Calx viva*, *Calx usta*, *Oxydum calcicum.*—*Burned lime*, E.; *Chaux*, *Chaux vive*, Fr.; *Kalk*, *Gebrannter Kalk*, G.

Formula CaO. Molecular weight 56.

Lime recently prepared by calcination.

CALCIS HYDRAS, *Br.*—SLAKED LIME.

Calcaria hydrica.—*Chaux éteinte*, *Chaux hydratée*, Fr.; *Gelöschter Kalk*, G.

Formula CaH_2O_2. Molecular weight 74.

Preparation.—Lime is an alkaline earth, which is obtained by calcining native carbonate of calcium, such as chalk, limestone, or marble, by which carbonic acid gas is given off, oxide of calcium remaining behind; $CaCO_3$ is decomposed into CO_2+CaO. Prepared on the large scale from native carbonates it contains also the impurities naturally existing therein, such as magnesia, ferric oxide, alkaline salts, silica, and clay. If the latter is present in sufficient quantity, it will slake feebly or not at all, and is then called *poor* or *over-burnt*. To obtain pure lime, pure calcium carbonate should be employed, and, if the calcining has been done in a crucible the resulting mass should be moistened with water and again calcined to expel the carbonic acid gas completely. The same effect is produced on the large scale by constructing the lime-kiln in such a manner that the products of combustion pass over the limestone.

SLAKED LIME.—The British Pharmacopœia gives the following directions for preparing it: Take of Lime two pounds, Distilled Water one pint (imperial).

Place the lime in a metal pot, pour the water upon it, and when the vapor ceases to be disengaged cover the pot with its lid, and set it aside to cool. When the temperature has fallen to that of the atmosphere, put the slaked lime on an iron wire sieve, and by gentle agitation cause the fine powder to pass through the sieve, rejecting what is left. Put the powder into a well-stopped bottle, and keep it excluded as much as possible from the air. Slaked lime should be recently prepared.

Properties.—Burnt lime is a grayish-white friable mass, of the specific gravity 3.1 to 3.2. It is fusible with difficulty only before the oxyhydrogen blowpipe, giving off a splendid red light. Exposed to the air it absorbs water and carbonic acid, and is converted into hydrate and carbonate of calcium.

Slaked lime forms a soft white powder of spec. grav. 2.08, and of a strong alkaline taste and reaction. At the ordinary temperature it requires about 750 parts of water for solution; but at 100° C. (212° F.) over 1300 parts are necessary; hence a solution of lime saturated in the cold becomes turbid on being heated. When lime is slaked, or slaked lime is mixed with sufficient water to form a thin magma, the mixture is called *milk of lime.*

Slaked lime decomposes most of the alkaline and metallic salts by combining with their acids and forming *calcium salts*, which are colorless, unless the acid be colored, have a neutral reaction upon test-paper, and impart to the flame of the blowpipe a yellowish-red color. Lime salts soluble in water are not precipitated by ammonia, but yield white precipitates with carbonate, phosphate, and oxalate of ammonium and with sulphuric acid, the latter precipitate being soluble in a large quantity of water, and the former ones in acetic acid with the exception of the oxalate. Those salts which are insoluble in water are dissolved by dilute muriatic acid, and this solution is not disturbed (that of calcium oxalate excepted) when solution of sodium acetate is added in excess; but if to this liquid a solution of ammonium oxalate is added, all the calcium will be precipitated as calcium oxalate.

Pharmaceutical Uses and Preparations.—On account of its affinity for water, lime is employed in preparing absolute alcohol and strong ether; its affinity for acids renders it useful in the preparation of alkalies (ammonia, potassa, soda), alkaloids (quinia, strychnia, etc.), and certain organic acids and allied compounds (santonin). It is employed in preparing precipitated sulphur, in the manufacture of chlorinated lime and chlorate of potassium, and in many other chemical processes. Liquor calcis, *U. S.*, *Br.*, is a solution of it in water, and Potassa cum calce, *U. S.*, contains it as one of its active constituents.

Physiological Action and Medical Uses.—Owing to its strong affinity for organic elements, unslaked lime causes the decomposition of organized matter, and thus in soils favors the solution of their animal and vegetable constituents. In like manner it is used to arrest putrefactive fermentation in cesspools, sewers, slaughter-houses, dissecting-rooms, etc. It is used by tanners to remove the hair and cuticle from hides. It has a less affinity for water than the alkalies, and is, therefore, a less energetic caustic. It is so, however, in such a degree that when taken internally in large doses, it inflames the mucous membrane of the throat, œsophagus, etc., and even causes ulceration and gangrene of these organs and of the stomach, and death. As a caustic, quicklime has been employed from time immemorial, and was usually mixed with sulphuret of arsenic, in the treatment of indolent and unhealthy *ulcers*, and for removing superfluous *hair* from the skin. Quicklime may also be used to destroy *nævi* and to establish *issues*, for which purposes a fragment of freshly prepared lime should be laid upon the skin protected by adhesive plaster with a proper opening in it, and moistened with a few drops of water. The heat produced is estimated at 350° F., and so rapidly destroys the organization of the skin, that the lime ought to be removed before it is entirely exhausted, in order to prevent too deep an eschar.

CALX CHLORINATA, *U. S.*—CHLORINATED LIME.

Calx chlorata, Br.; *Calcaria chlorata*, P. G.; *Chloris calcicus, Chloruretum calcis, Calcii hypochloris.—Chloride of lime, Hypochlorite of calcium, Bleaching powder*, E.; *Chlorure de chaux, Poudre de Tennant, ou de Knox*, Fr.; *Chlorkalk, Bleichkalk*, G.

Preparation and Composition.—Well-slaked lime, free from dampness, is rubbed through a sieve, and the powder thus obtained is spread upon shelves which are placed in boxes or chambers into which chlorine gas is conducted from the top, as long as it is absorbed.

The oldest view concerning the composition of chlorinated lime admits of a direct combination and the formation of $CaOCl_2$, and since the whole amount of slaked lime cannot be thus converted, a portion of it was supposed to form a double compound with it, having the composition $2(CaOCl_2.H_2O)+CaH_2O_2$. But it seems now to be pretty generally admitted that a decomposition takes place, the precise nature of which is by no means fully established. It is, perhaps, most generally assumed that the reaction occurs between two molecules each of calcium hydrate and chlorine, $2CaH_2O_2+2Cl_2$ may form $CaCl_2+Ca2ClO+2H_2O$, that is calcium chloride, calcium hypochlorite, and water, which have been by some supposed to be merely mixed together, while others have regarded them to be combined, forming $CaCl_2.Ca2ClO,2H_2O$. If this be the true composition of chlorinated lime, it should contain about 49 per cent. of available chlorine, while in fact it contains much less. This deficiency has been ascribed to various causes, but mainly to the difficulty or impossibility of exactly forming calcium hydrate without excess or deficiency of water, both of which act injuriously; the formation of some calcium chlorate under certain circumstances likewise accounts for some of the loss. Recently (1876) C. Stahlschmidt expressed the view that chlorinated lime may be considered as a calcium hydrate, in which one atom of hydrogen is replaced by Cl, and that its formation is explained by the equation $3CaH_2O_2+2Cl_2=2CaHClO_2+CaCl_2+2H_2O$, which requires an amount of chlorine equal to nearly 39 per cent. of the product, which result may be attained in practice. In certain cases, however, nearly 43 per cent. of chlorine has been reached, and this is accounted for by the presence of some moisture, by which the above chloro-hydrate of calcium, as it may be called, is decomposed into hypochlorite and hydrate of calcium, $CaCl_2O_2+CaH_2O_2$, the latter of which, by more chlorine, yielding again chloro-hydrate; but to complete the conversion into hypochlorite (and chloride) of calcium, a much larger amount of water seems to be necessary than could be retained by dry chlorinated lime. That aqueous solutions of chlorinated lime contain calcium hypochlorite, was proven by Kingzett, who obtained this salt from concentrated solutions of the former placed in a freezing mixture, or evaporated in a vacuum over sulphuric acid.

Properties.—Chlorinated lime is a whitish powder, or in friable lumps, dry or but slightly damp, with a feeble odor of chlorine, partly soluble in water and wholly soluble in dilute muriatic acid with the evolution of chlorine and the production of calcium chloride: $Ca2ClO.CaCl_2+4HCl$ yields $2Cl_2+2CaCl_2+2H_2O$. If chlorinated lime contains a larger percentage of calcium chloride than is indicated by the formula, its chlorine will not be liberated, and is therefore not *avaliable chlorine* for bleaching purposes. The same decomposition is effected by all acids, except carbonic, which liberates hypochlorous acid. The aqueous solution mixed with binoxide of manganese, mercuric, ferric, and other oxides, evolves oxygen (Mitscherlich), and if ammonium sulphate be added, nitrogen is given off (Calvert, 1870). The solution, in the presence of carbonic or other acid, rapidly destroys vegetable colors, and this property finds extensive application in the arts. Distilled with alcohol, wood-spirit, some volatile oils, etc., chlorinated lime generates chloroform, and when it is mixed with certain organic substances in the dry state, a gradual decomposition and development of heat take plate, and may result at last in an explosion. The spontaneous explosions of chlorinated lime which are on record, may probably be referred to such a cause.

Tests.—Chlorinated lime is assayed by ascertaining the amount of chlorine liberated from it on the addition of an acid, as shown above. This gas being a powerful oxidizer, 10 grains of it will readily convert 78 grains of ferrous into ferric sulphate, thus: $Cl_2 + 2FeSO_4 + H_2SO_4 = Fe_2 3SO_4 + 2HCl$. The U. S. P. orders the "trituration of 40 grains of chlorinated lime with 1 fluidounce of distilled water, and the thorough shaking of the mixture with a solution of 78 grains of crystallized ferrous sulphate and 10 drops of sulphuric acid in 2 fluidounces of distilled water; the liquid thus obtained should not yield a blue precipitate (of Turnbull's blue) with ferridcyanide of potassium." The test indicates the presence of at least 25 per cent. of available chlorine, the precise amount of which may be ascertained by a slight modification of the manipulation; the 40 grains of chlorinated lime may be diffused in sufficient water to make the mixture measure 100 cubic centimeters; this mixture is then gradually added to the ferrous solution, which is well stirred and from time to time tested by bringing a drop of it upon a plate into contact with a drop of the solution of the ferridcyanide; as soon as the production of a blue color ceases, the oxidation has been completed, and the number of cubic centimeters actually used, multiplied by $\frac{2}{5}$, indicates the number of grains of chlorinated lime, containing 10 grains of available chlorine, from which the percentage of the latter may be readily calculated. This may be directly obtained by dividing 2500 (the product of 100 c. c. with 25 per cent.) by the number of cubic centimeters used.

The British Pharmacopœia requires a chlorine strength of not less than 30 per cent. and gives the following directions: "10 grains mixed with 30 grains of potassium iodide and dissolved in 4 fluidounces of water, produce, when acidulated with 2 fluidrachms of hydrochloric acid, a reddish solution which requires for the discharge of its color at least 850 grain measures of the volumetric solution of hyposulphite of sodium." In the first part of this process, iodine is liberated from the potassium salt, thus causing the red color of the solution; the addition of the hyposulphite causes the formation of tetrathionate and iodide of sodium, the red color disappearing as soon as all the free iodine has been converted into the latter salt. By some modifications, as in the preceding case, the test may be used to ascertain the true percentage of available chlorine.

Pharmaceutical Uses and Preparations.—Chlorinated lime is largely employed in the arts for bleaching purposes; it is used in preparing chloroform and Liquor sodæ chlorinatæ, *U. S.*; as Vapor chlori, *Br.*, it is used in the moist condition; and Liquor calcis chloratæ, *Br.*, is a solution of it in water.

Physiological Action and Medical Uses.—The action of chlorinated lime resembles that of chlorine with a superadded causticity derived from the lime in its composition. In moderate doses it appears sometimes to act as an irritant to the stomach and bowels; and if the quantity taken be large, it produces heat in these organs, nausea, vomiting, and diarrhœa. If used as a mouth-wash it removes acid, bitter, or metallic tastes. Externally it is an active irritant, and is sometimes moderately caustic. It dries suppurating surfaces, and prevents gangrenous ulceration.

In a solution of the strength of 20 or more grains to the ounce of water it has been regarded as a useful stimulant in purulent *ophthalmia.* Applied in solution on lint it is efficacious in *frost-bite*, and as an injection in *gonorrhœa.* In various forms of *ulceration of the mouth*, scorbutic, gangrenous, or arising merely from debility, it promotes cicatrization, and is to be recommended for this affection in scarlatina. Indolent and specific ulcers of other parts, and *burns*, are favorably modified by its use. It may be included among the means of curing *itch*, when applied on cloths in a solution containing from a sixtieth to a fortieth of chlorinated lime. But care must be taken lest it irritate the skin unduly.

In *typhus fever* it is thought to moisten and cleanse the tongue, allay delirium, and revive the functions of the skin. It tends to reduce excessive mucous secretions, and has been used with marked advantage in the treatment of *phthisis* and *chronic bronchitis* with profuse purulent secretion. When this is fetid the action of the medicine is peculiarly efficient; and it may be prescribed in atomized inhalations as well as by the stomach. It has been used with success in the treatment of *scrofulous glands*, both internally and in an ointment. Even in some cases of enlarged mesenteric glands its action has appeared to be salutary.

As a *disinfectant* chlorinated soda has been employed under a great variety of circumstances to suspend the decomposition of organic matter and neutralize the resulting foul effluvia. Besides being used for this purpose in privies, close-stools, dissecting-rooms, sewers, etc., it has proved to be very efficacious in correcting *foul odors* connected with putrefaction in the living body, as in cases of *retained placenta* or uterine clots, *cancer of the uterus* and of other parts, *ozæna*, *mercurial salivation*, and *foul breath* due to the decomposition of glandular secretions in the fauces, the fetor exhaled by the *armpits*, *feet*, etc. A false analogy led to its use to prevent contagion by the sick and by infected fomites; but there is no reason to believe that its influence exceeded that of the various measures of purification which were associated with its use. Chlorinated lime decomposes hydrosulphuric acid, hydrosulphuret of ammonia, sulphuret of potassium, and hydrocyanic acid, and may therefore be used as a chemical *antidote* to these poisons. Persons *poisoned* by privy and by sewer gases have been restored by holding a cloth wet with a solution of this substance before the nostrils. A similar expedient has been used to protect persons in an atmosphere saturated with *sulphuretted hydrogen*.

The *dose* of chlorinated lime is from one to five grains in solution. From ten to sixty grains dissolved in from four to eight ounces of water, and filtered, may be given in twenty-four hours. As a mouth-wash one part dissolved in one hundred of water may be used. For external use, the most energetic form of the preparation is that of a semi-fluid paste; the feeblest, to be at all useful, may contain one drachm of chlorinated lime to eight ounces of water. An ointment for dry atonic ulcers may be made with equal parts of this preparation and lard; for enlarged glands, etc., the proportion of one drachm to an ounce of lard is sufficient.

CAMPHORA, *U. S.*, *Br.*—CAMPHOR.

Camphre, Fr.; *Kampfer*, G.
Formula $C_{10}H_{16}O$. Molecular weight 152.

A concrete volatile oil obtained from the wood of Camphora officinarum, *Nees*, s. Laurus camphora, *Lin.*, Woodv. Med. Bot., plate 155, and purified by sublimation.

Nat. Ord.—Lauraceæ.

Origin.—The camphor laurel is a handsome tree with thin reddish or yellowish branches, and evergreen, smooth, and shining leaves, which are glaucous beneath. It is indigenous to Eastern and Southeastern Asia, from Cochinchina north through China, and in Japan and Formosa. It grows very readily in tropical and sub-tropical countries, and is cultivated in Italy as an ornamental tree. All parts of the tree have a camphoraceous odor and taste; but the camphor is obtained from the root, trunk, and branches, by chipping the wood and either boiling it with water in an iron vessel which is covered with a rude earthen or wooden head, lined on the inside with straw, in which the camphor condenses, or, as in Formosa, where the chips are merely exposed to the vapor of water which is boiled in a wooden trough, lined on the outside with clay, earthen pots, ten in number, serving as the heads of the rude still. The camphor is scraped out from time to time, placed in suitable vats, to drain off much of the adhering oil, and then packed.

Commerce.—*Japan* or *tub camphor*, formerly also called Dutch camphor, is imported in tubs containing about 125 pounds, covered by matting, and surrounded by another tub. It is in white granular masses, usually with a reddish tint, and dry to the touch. *Formosa* or *Chinese camphor*, generally imported in lead-lined chests, is occasionally as handsome in appearance as the preceding, but frequently is in smaller granules, darker, sometimes even blackish in color, or damp from adhering oil or moisture. Crude camphor dissolves completely in alcohol with the exception of from 1 to 5 or 6 per cent. of foreign matters, sand, etc. In the fiscal year 1866–1867, 432,075 pounds of crude and 30,526 pounds of refined camphor passed through the custom houses of the United States, and in the year 1876–1877, 1,022,535 pounds of crude and 208 pounds of refined camphor.

Refining.—This was formerly done exclusively in Europe, but it has for some years been successfully carried on in the United States. It is stated that the apparatuses used in Europe are still the old-fashioned *bomboloes*, large, somewhat depressed, glass globes, with a short neck and an aperture through which the watery vapors find egress; some charcoal or lime is introduced into the vessels, which are placed in a sand-bath, and this is rapidly heated, first to expel the water, after which the sand is lowered and the heat gradually increased to between 200° and 205° C. (392° and 401° F.); after the camphor has sublimed and condensed at the top, the vessels must be broken in order to recover the purified camphor. Similar subliming vessels are in use in the United States, but they are so arranged that they can be taken apart and used over again, and provision has even been made by a firm in Philadelphia to recover the volatile oil contained in the camphor. The operation requires a careful regulation of the heat for subliming, and judicious provision for cooling the top so as to obtain the camphor in solid crystalline cakes. Another Philadelphia firm sublimes the crude camphor slowly from retorts, and condenses the vapors in a large chamber, whereby it is condensed in a fine crystalline powder, which is afterwards, by hydraulic pressure, formed into solid cakes, thus lessening the surface of exposure and the rapidity of evaporation.

Properties.—Refined camphor forms orbicular, slightly convex cakes, with a circular hole in the centre, corresponding to the aperture of the subliming vessel. It is white, translucent, crystalline in texture, fissured in the interior, tough and not pulverizable, except after moistening it with alcohol, ether, chloroform, or a volatile oil. It evaporates slowly at the ordinary temperature, and condenses in the form of hexagonal plates or prisms. Various contrivances have been suggested to keep camphor in the powdered condition, such as precipitation by water in the presence of magnesia, trituration with a fixed oil, glycerin, or sugar; but the most satisfactory method appears to be that proposed by J. C. Lowd (1871), of condensing the hot camphor vapors in a large chamber. When kept in a cool place, the powder thus obtained may be preserved for some years, and even if it should cake together, may readily be reduced to the pulverulent condition.

Camphor fuses at 175° C. (347° F.), and boils at 205° C. (401° F.); its specific gravity at 15° C. (59° F.) is 0.99. It is freely soluble in alcohol, ether, chloroform, glacial acetic acid, wood-spirit, volatile and fixed oils. It has a peculiar penetrating odor and an aromatic, somewhat cooling taste. The odor of camphor is destroyed by Tolu balsam, asafœtida and similar umbelliferous resins. Thrown upon water, camphor shows a peculiar rotating motion, which is probably caused by its rather rapid evaporation and slow solubility. It turns polarized light to the right.

Its composition is represented by the formula $C_{10}H_{16}O$. When distilled with chloride of zinc or phosphoric anhydrid, it is gradually converted into cymol, $C_{10}H_{14}$; and by oxidation with nitric acid into *camphoric acid*, $C_{10}H_{16}O_4$; and, finally, into *camphoronic acid*, $C_9H_{12}O_5$. Schwanert's *camphresinic acid* (1863) is a mixture of these two. Camphor combines and forms also substitution compounds with chlorine, iodine, and bromine.

Other Kinds of Camphor.—The crystallizing stearoptens of volatile oils are sometimes designated as camphors.

SUMATRA *s.* BORNEO CAMPHOR, or BARUS CAMPHOR, is found in fissures of the wood of Dryobalanops camphora, *Colebr.* (D. aromatica, *Gaertn.*), *Nat. Ord.* Dipterocarpaceæ. Its odor is somewhat different from that of ordinary camphor; its crystals are slightly heavier than water, and but sparingly volatilized at ordinary temperatures. Its composition is $C_{10}H_{18}O$, and by treatment with nitric acid it is converted into ordinary camphor. The stately tree yielding this drug is indigenous to Sumatra and Borneo, and requires cutting down to obtain the camphor, which in the East is sold at a high price, and therefore never enters commerce at large. This camphor is dextrogyre.

NGAI CAMPHOR is obtained in Burmah and China by the distillation of Blumea balsamifera, *D. C.*, *Nat. Ord.* Compositæ, a tall weed of Southeastern Asia, and commands there a higher price than ordinary camphor. It has the composition of the preceding, $C_{10}H_{18}O$, but turns polarized light to the left, and yields with nitric acid a camphor having the composition of ordinary camphor, but levogyre in optical behavior. It was examined in 1874 by Hanbury, Plowman, and Flückiger.

Pharmaceutical Uses and Preparations.—Camphor is used in preparing monobromated camphor, and is a constituent of the following officinal preparations: Aqua camphoræ, Ceratum (Unguentum) plumbi subacet., *U. S.*, *Br.;* Linim. aconiti, Linim. belladonnæ, *Br.;* Linim. camphoræ, *U. S.*, *Br.;* Linim. camphoræ comp., Linim. chloroformi, Linim. hydrargyri, Linim. iodi, Linim. opii, *Br.;* Linim. saponis, *U. S.*, *Br.;* Linim. saponis comp., Linim. terebinthinæ, Linim. terebinth. comp., *Br.;* Mistura chloroformi, *U. S.;* Spiritus camphoræ, Tinct. opii camphorata (camph. comp.), *U. S.*, *Br.;* Ung. hydrarg. comp., *Br.*

Physiological Action. *On Vegetables and Animals.*—Camphor at first stimulates, but ultimately destroys plants, causing them to fade and wither. It does not appear to prevent the germination of seeds. It destroys insects; in birds it produces an excited intoxication, followed by stupor and convulsions; in frogs it manifests, in small doses, a depressing influence upon reflex motility, and a stimulant action upon the heart; but in large doses paralyzes that organ. Given in full doses, and by the mouth, to dogs, it occasions general excitement, with signs of gastric distress, which are followed by tremor, lowering of temperature, convulsions, and death. It appears to increase the arterial blood-pressure. After death the stomach is found injected, the venous system and the heart are distended with bad blood.

On Man.—The local action of camphor upon the living tissues is that of a stimulant and an irritant. A piece of it held in the mouth irritates, and may even ulcerate the lining membrane; the same effect is produced in the stomach. Internally the action varies with the dose. In large doses it causes a burning pain at the pit of the stomach, diminished frequency and force of the pulse, followed by its intermission, giddiness, and dimness of vision, muscular debility, paleness and coolness of the skin, with a cyanotic hue in grave cases, spasms, and rigidity of the muscles, and general convulsions. These phenomena, which show that camphor in large doses is a direct and powerful sedative, are followed by a reaction in which there is more or less excitement and fever. In no instance does camphor seem to have directly caused the death of a healthy person. In smaller, but still excessive doses, it produces a peculiar intoxication, with delirium, in which great mental vivacity and muscular activity are displayed—a condition compared to that which is apt to be produced by champagne wine; but these effects are transient, and are followed by depression, pallor, coldness, profuse sweating, and dysuria. In medicinal doses (gr. ij to gr. xv) camphor stimulates the nervous and vascular systems, and through them all the functions; the pulse becomes stronger and more frequent, the skin grows warmer and moister, and there is a consciousness of more or less exhilaration. Such effects are of short duration, and are not succeeded by exhaustion or depression. Small doses appear to irritate the genital organs, but full medicinal doses to allay morbid excitement in them. It appears, then, that camphor stimulates in small, and depresses in large doses, and that its operation is very transient, almost as much so as that of alcohol, which in some other respects it resembles.

Medical Uses.—The ancients do not appear to have used camphor in febrile affections, but in the eighteenth century it acquired a reputation in the treatment of *typhoid conditions* which it has never lost. It was held to be less heating than ammonia, less stupefying than opium, and, along with the latter, a powerful sudorific. It was considered, and is in fact, an appropriate remedy for the condition which includes exhaustion, stupor, and nervous derangement shown by muscular trembling and subsultus, and by low delirium, the phenomena belonging to the malignant or typhoid state in which the nervous system tends to collapse because the blood has become impure. In this condition stimulants sustain nervous power until the depuration and reorganization of the blood are accomplished; and camphor in small and repeated doses has the advantage over some other appropriate remedies, of inducing no injurious secondary effects. The typhoid state, it should be remembered, may be an incident of inflammatory affections as well as of idiopathic fevers. In *spasmodic diseases* camphor has been largely employed, in whooping-cough, chorea, and even epilepsy; but its power in these affections is of very subordinate importance. In minor disorders of this class, such as nervous headache, nervous palpitation, hiccup, spasmodic dysphagia, etc., camphor in small and repeated doses shows the same power as other nervous stimulants. In full sedative doses it has proved an antidote to strychnia. The Arabians and their followers in Europe were familiar with the power of camphor in large doses to repress *sexual excitement*, and they, as well as nearly all successful imitators of them, prescribed from twenty to sixty grains a day. The doses of two or three grains sometimes directed for this purpose are worse than useless. They are perhaps more useful in certain cases of genital excitement produced by local irritation—by cantharides, for example. It is usual to incorporate powdered camphor with blistering plasters to prevent *strangury*, but the evidence of the efficiency of this expedient is not very strong. A poultice saturated with camphor, and applied to the perineum, will relieve this symptom, and also prevent *chordee*. In some cases of *mania*, large doses of camphor have proved efficient, particularly in the puerperal form; it very probably would be more eligible than the excessive doses of opiates which are sometimes employed. This medicine has been used successfully to expel *lumbricoid worms*, and by enema to destroy *ascarides* of the rectum. It has been resorted to internally and locally with good effect in hospital *gangrene*. *Ulcers* that are slow to heal, owing to a depressed state of the system, are benefited by camphor in powder; the same may be said of specific ulcers of the genitals. Camphor dissolved in ether or chloroform, or even alcohol, and applied on cotton within the cavity of a carious tooth, mitigates materially the *toothache*. This is one of the most ancient uses of the medicine. Snuffed into the nostrils, camphor, like other local irritants, will sometimes arrest a forming *coryza*. In an ointment or liniment it forms one of the best cures for the *itch*, and is said to prevent the maturation of *variolous* pustules.

Camphor may be administered in substance in the pilular form when the dose is small, but larger doses are best given in emulsion, which should be flavored with the extract or the syrup of liquorice. As a stimulant, the *dose* is from one to five grains, repeated every three or four hours in mild cases; but in low fevers it should be from ten to twenty grains, and repeated according to the indications. In cases of maniacal nervous excitement not less than twenty grains should be given, repeated as often as may be required. In cases of poisoning by camphor, alcohol may be given in small and repeated doses.

CAMPHORA MONOBROMATA.—MONOBROMATED CAMPHOR.

Camphre monobromé, Fr.; *Monobromcampher*, G.
Formula $C_{10}H_{15}BrO$. Molecular weight 231.

Preparation.—Laurent obtained (1840) bibromide of camphor, $C_{10}H_{16}OBr_2$, by uniting bromine with camphor, and stated that, on distillation, it afforded bromine, camphor, a little hydrobromic acid, and a bromated oil. Swarts (1861) heated camphor bibromide in sealed tubes, and obtained monobromated camphor. W. H. Perkin (1865) subjected the oily bromide of Laurent to distillation, and found the distillate, collected above 265° C. (509° F.), after crystallization from alcohol, to be monobromated camphor. We have found (1872) the following process to give satisfactory results: Break 13 oz. of camphor into pieces of suitable size, put this into a quart retort, first filling the neck, raise the latter somewhat, and then introduce through the tubulure, by means of a funnel-tube, 4 oz. of bromine, washing the last down with 20 or 30 minims of alcohol. A brisk reaction will commence in about 15 or 20 minutes; after it has subsided and the retort has become cool, introduce 8 to 9 oz. of bromine in four portions, waiting after each addition until the reaction has ceased. The addition of alcohol is not requisite, but facilitates the reaction; and the bromine may be added in larger quantities, if provision be made for condensing the vaporized bromine and returning it to the retort. This is now slowly heated to about 132° C. (270° F.), allowed to cool, the contents dissolved in warm petroleum benzin, the solution allowed to crystallize, and the crystals purified by recrystallization from hot alcohol or petroleum benzin. On evaporating the mixed mother-liquors, an oily mass is obtained which, heated to 260° C. (500° F.), becomes black, and contains monobromated camphor, to be obtained by recrystallization as before. Gault (1874) heats at first in a water-bath, crystallizes from strong alcohol, and heats the oily mass contained in the mother-liquor to not over 220° C. (428° F.). A similar process is recommended by Dubois, who states that, by confining the heat to 100° C., no by-products of any consequence are formed. J. U. Lloyd (1875) recommends the camphor bibromide to be heated with water in a retort placed in a sand-bath, and the product to be crystallized from alcohol. T. C. Linthicum (1876) considers the reaction very unsatisfactory at 100° C.

In the above processes bibromide of camphor, $C_{10}H_{16}OBr_2$, is first formed, and this, on being heated, is decomposed into hydrobromic acid, HBr, and monobromated camphor, $C_{10}H_{15}BrO$, the latter representing a molecule of camphor, in which one atom of hydrogen is replaced by one of bromine. During the operation one-half of the bromine used is given off as hydrobromic acid, and may be collected in water or combined with a base.

Properties.—Monobromated camphor is in colorless needles or prisms, insoluble in water, freely soluble in alcohol, ether, and hot petroleum benzin, also in fixed oils. It is permanent in the air and light, has a somewhat camphoraceous odor and taste, fuses near 70° C. (158° F.), and boils at 274° C. (525° F.), with partial decomposition.

Pharmaceutical Uses.—If a liquid preparation is desired, monobromated camphor is conveniently given in the form of emulsion, after dissolving it in 6 or 8 times its weight of expressed oil of almond or other bland oil. Munday (1877) has proposed an *elixir of monobromated camphor*, containing 1 per cent. by weight of the latter, by dissolving with the aid of a gentle heat 3 grm. of it in a mixture composed of 120 grm. of 90 per cent. alcohol, 80 grm. of water, and 100 grm. of glycerin.

Physiological Action.—From a number of experiments upon animals, Bourneville drew the following conclusions: 1. Bromated camphor diminishes the number of the heart-beats, and contracts the bloodvessels of the ears and eyelids. 2. It renders the inspirations less frequent. 3. It lowers the temperature steadily, and in fatal cases until death; in those animals which recover, the temperature rises to its original point, but more slowly than it fell. 4. It is unquestionably hypnotic, and seems to act chiefly upon the brain. 5. It does not appear to induce tolerance; and cats and guinea-pigs lose flesh rapidly while using it. On the other hand Trasbot, experimenting upon dogs, never observed in them either somnolence or the lowering of the pulse or temperature. On the contrary, in doses varying from seven to fifteen grains, this preparation induced convulsions identical with those caused by strychnia. Again, Valenti y Vivo inferred from his experiments that it may be considered an antidote to strychnia, although it must be freely exhibited for this purpose. The experiments of Mr. Lawson upon man tend to confirm the conclusions of Bourneville in regard to the influence upon the pulse and temperature, both of which were depressed under the action of the compound; but in doses of ten grains it did not show any soporific influence.

Medical Uses.—Bromated camphor has been used with some advantage in *epilepsy*, not only in the convulsive form of the disease, but in epilepsia minor, and in cases of epileptic delirium in females. It has appeared to arrest *convulsious* depending upon dentition. In several cases of inveterate *chorea*, and of *paralysis agitans*, it is reported to have mitigated the convulsive movements in a notable degree, and to have controlled the excitement of *hysteria*, and also of *delirium tremens*. In *insomnia*, connected with cerebral hyperæmia, or with heart lesions, it has proved beneficial; and *palpitation* of the heart due to the latter cause, or to organic disease, has been relieved by it. The same is true of its use in *headache* occasioned by over-stimulation of the brain by mental excitement. It has also palliated *nervous cough*, and nocturnal *incontinence of urine*, relieved anal and vesical *tenesmus*, especially when this symptom depended upon nervous irritability and not upon substantial disease of the affected organs, and has also subdued *priapism*. It will be observed that all of these affections are such as are apt to be relieved by the alkaline bromides; and it is more than probable that a solution of one of them in camphor water, if not in simple watery solution, would answer the same purposes. This substance has usually been administered in sugar-coated pills, and in doses of from two to five grains, repeated several times a day, or oftener. Its insolubility, and unpleasant taste and smell, render any other liquid vehicle than oil less appropriate for its administration. A formula for an elixir is given above.

CANELLA, *U. S.*—CANELLA ALBA.

Canellæ albæ cortex, Br.—*Cannelle blanche*, Fr.; *Weisser Zimmt*, *Weisser Canel*, G.

The bark of Canella alba, *Murray*, s. Winterania canella, *Lin.*, s. Canella winterana, *Gaertn.* Woodville, Med. Bot. 237. Bentley and Trimen, Med. Plants, 26.

Nat. Ord.—Canellaceæ.

Origin.—The *white wood* or *wild cinnamon* tree is indigenous to many of the West Indian islands and the southern section of Florida. It grows to about

40 feet, has evergreen, blunt, lanceolate leaves, and pale violet-colored, highly aromatic flowers in terminal corymbs. The silver-gray, corky layer of the bark is mostly removed by beating, and subsequent cutting, before the bark is collected.

Description.—The bark is in quills or half-quills, varying in length from a few inches to 2 or 3 feet, and in diameter from ¼ to 1½ inches. The external surface is of a pale yellowish-red color, with transversely elongated scars of the suberous warts and occasionally with whitish patches of the inner bark, laid bare by the removal of the reddish layer; inner surface white, finely striate; fracture short, white, with numerous bright orange-yellow dots of resin cells. The odor is agreeably aromatic, cinnamon-like; the taste aromatic, somewhat bitter, and biting.

Substitutions.—The bark of Cinnamodendron corticosum, Miers (Bentley and Trimen, Med. Plants, 27), a small tree of the same natural order as the preceding, is indigenous to Jamaica, and is there employed like Canella alba. It has oblong lanceolate, acute leaves, and red flowers in axillary clusters of 2 to 4. The bark is of a ferruginous gray-brown, darker upon the outer surface, spotted by scars of the nearly circular suberous warts, smooth and finely striate upon the inner surface, and agreeing in odor and pungent taste nearly with the preceding. Both barks have been frequently sold as Winter's bark.

Constituents. — The analyses of Henry (1821) and of Petroz and Robinet (1824) proved the existence of volatile oil, resin, bitter principle, mucilage, starch, albumen, and salts. The *canellin* of the last-named chemists is identical with mannit, according to Meyer and Von Reiche (1843), who obtained 8 per cent. of it, and separated from the volatile oil eugenic acid, an oil having the odor of cajuput and another fraction not further examined. From 0.5 to 0.94 per cent. of volatile oil have been obtained from the bark. The Cinnamodendron bark has probably similar constituents, but contains in addition some tannin, which is not present in Canella alba.

Off. Prep.—Pulvis aloes et canellæ, *U. S.;* Vinum rhei, *U. S.*, *Br.*

Medical Action and Uses.—Canella is tonic and stimulant, and may be employed to relieve simple gastric debility. It is seldom used alone, but rather with bitter tonics, and with purgatives that tend to debilitate, as scammony and jalap, or that have a local action which it is designed to increase, as in the case of aloes, when given for *uterine disorders.* The *dose* in powder is from ten to forty grains.

CANNA, *U. S.*—CANNA.

Amylum cannæ.—Tous-les-mois, E., Fr.; *Amidon de canne, Fécule de Tolomane,* Fr.; *Cannastärke,* G.

The fecula prepared from the rhizome of an undetermined species of Canna.

Nat. Ord.—Marantaceæ (s. Cannaceæ).

Origin and Preparation.—This starch is obtained in the same manner as Maranta starch from the creeping rhizome of a species of Canna, probably C. edulis, *Ker* (Bot. Mag. 2498; Bentley and Trimen, Med. Plants, 266). Dymock (1876) found the commercial article to be identical with the starch of C. lutea, in which it is associated with scarcely any coloring matter, which is contained to a much greater extent in C. indica and C. discolor. These plants are herbaceous perennials with handsome and showy flowers, and are indigenous to tropical countries.

Properties.—Tous-les-mois or *Toulema,* which is chiefly obtained from the West Indian island St. Kitts, is a white powder having a satiny lustre; its granules are the largest among the commercial starches, flattish, usually oblong or ovate, but variable in outline, with the inconspicuous nucleus or hilum mostly near the narrowed end, and with numerous concentric rings. The granules of potato starch have a similar shape, but are smaller and have coarser concentric rings. Canna starch contains about one-sixth of its weight of hygroscopic water, and, according to Shier, yields with 20 parts of boiling water a jelly which is considerably more tenacious, but less clear and transparent, than that of arrowroot. Its composition is the same as that of other starches.

Medical Action and Uses.—Canna is a fecula which has the nutritious and demulcent qualities of starch in general. It is used in the same manner as arrowroot.

CANNABIS AMERICANA, *U. S.*—AMERICAN HEMP.

Chanvre américain, Fr.; *Amerikanischer Hanf*, G.

The flowering tops of Cannabis sativa, cultivated in North America.

CANNABIS INDICA, *U. S.*, *Br.*—INDIAN HEMP.

Herba cannabis Indicæ, P. G.—*Chanvre indien*, Fr.; *Indischer Hanf*, G.

The flowering tops of the female plant of Cannabis sativa, *Lin.*, var. Indica. Berg u. Schmidt, Off. Gewächse, plate xix, b.; Bentley & Trimen, Med. Plants, 231.

For medicinal use, that which is grown in India and from which the resin has not been removed, is alone to be employed.

Nat. Ord.—Urticaceæ, Cannabineæ.

Origin.—The hemp plant is indigenous to Asia, from India north to Western China and the Caspian Sea; it grows likewise in tropical Africa, has been naturalized in some parts of Brazil, and is cultivated in many parts of the world. It is an annual, with an angular roughish stem, 4 to 8 and even 10 feet high, with opposite or alternate petiolate and digitate leaves, composed of 5 to 9 lanceolate, acute, and serrate leaflets, and with diœcious flowers. The Indian plant has the lower leaves alternate, the stem is more branched and the bast fibres are coarser; but the characters vary and are not sufficiently important to constitute it a distinct species.

Description.—The American hemp consists usually of the barren plant, which has the characters given above, the staminate flowers being in loose, pedunculate, axillary clusters, which are rather crowded near the summit. The fertile plant has the pistillate flowers mostly in pairs, axillary, sessile, and with slender protruding stigmas.

The Indian hemp found in the market is that known in India as *gunjah* or *ganja*, and in London and elsewhere as *guaza;* as collected, it consists of the tops of branches, which are 2 to 3 inches long, compressed, of a brownish-green color, with few leaves, a large number of female flowers, and some ripe or nearly ripe fruits, the whole more or less agglutinated by resin, but nevertheless quite brittle; odor narcotic, not unpleasant; taste slightly acrid. In the bazaars it is also seen in bundles, which are composed of the upper branches, two to three feet long, several inches in diameter, and showing more or less of the resinous exudation.

Another form is used in India under the name of *bhang* or *siddhi*, the *hashish* of the Arabs, which consists of leaves and small stalks, coarsely broken and mixed with few fruits; it is smoked with or without tobacco, and is chiefly employed in the preparation of various electuaries and beverages. The resin is collected in India in a very primitive manner and impure condition, and is known as *charas* or *churrus*. It is either the dusty powder obtained on storing the dry plant, or by rubbing the fresh tops between the hands and scraping off the adhering resin, or by removing it from the leather garments of men, who run through the hemp fields brushing against the plants. The plants grown at an altitude of from 6000 to 8000 feet are stated to produce this resin, while those grown in the plains yield little or none.

Constituents.—G. Martius (1856) obtained from this plant besides gum and sugar, nitrate of potassium and other salts and resinous matter; dried at 100° C. (212° F.) the herb yielded 18 per cent. of ashes containing silica and phosphates as the main constituents. European hemp had been previously examined by Schlesinger and Bohlig (1840); both found considerable malic acid, and the latter 0.3 per cent. of a yellow aromatic oil having faintly narcotic properties. Personne (1857) claimed the volatile oil obtained from Indian hemp to be the sole active principle; he separated it into liquid *cannabene*, $C_{18}H_{20}$, and solid *cannabene hydride*, $C_{18}H_{22}$. According to Bohlig, the essential oil contains oxygen. The *hashiscin* of Gastinel is merely the alcoholic extract of gunja, deprived of the principles soluble in water. The *cannabin* of T. and H. Smith (1846) is much purer; it is obtained by exhausting the gunja with water and solution of sodium carbonate, then washing the residue with water, drying, exhausting with alcohol, treating the tincture with milk of lime, precipitating the lime with sulphuric acid, treating the filtrate with animal charcoal, filtering, concentrating, and precipitating by water; it constitutes a brown amorphous resin which burns without leaving any ash. Procter (1864) observed that the resin is converted by hot nitric acid into an orange-red substance resembling gamboge, and Bolas and Francis (1871) obtained from this residue *oxycannabin*, $C_{20}H_{20}N_2O_7$, which crystallizes from methylic alcohol in large prisms. Preobraschensky (1876) claims to have obtained *conia* from Bucharian hashish and from gunja.

Off. Prep.—Extract cannabis Amer., *U. S.;* Ext. cannabis Indicæ, Tinct. cannabis (cannab. Indic.), *U. S.*, *Br.*

Physiological Action.—The action of American hemp is identical in kind with that of the East Indian species, but its activity appears to be less. Like some other narcotics, Indian hemp, when given by the stomach to carnivorous animals, produces its characteristic effects, but graminivorous animals and fish exhibit only vacillating movements and a dull aspect. Upon man its action varies according to temperament and tendencies. Some it inspires with pugnacity, others it inclines to dreamy contemplation, to motiveless merriment, or to maudlin sensibility; some it makes unnaturally active and restless, and plunges others in a drowsy stupor; but more than any other agent, not even excepting belladonna, it perverts the natural perception of objects and their normal condition and relations. Time, distance, and sound are especially apt to form the subjects of hallucinations. As in dreams, the events of days or weeks may be compressed into an actual period of a few minutes; objects near at hand may seem to form a limitless perspective; and whispered tones may have the reverberation of thunder. These, and an infinite variety of fantastic pictures, are evoked by smoking the drug, as it is employed in Asia, generally associated with opium. During its influence the physical condition of the experimenter exhibits changes in acceleration of the pulse, warmth of skin, restless muscular movements, more or less insensibility to touch and pain, and sometimes impaired power of locomotion, the limbs feeling as if weighted with lead. It does not increase, but, on the contrary impairs, the venereal propensity and power. The habitual use of cannabis in excessive doses causes the face to become bloated, the eyes injected, and the limbs weak and tremulous; the mind grows imbecile, and ultimately death by marasmus is apt to occur. Acute poisoning by large doses is marked by various and dissimilar symptoms in different cases. In some there is loss of consciousness, with collapse, or stupor, insensible pupils, a pale, clammy, and insensible skin, extreme debility, and a small, feeble pulse. In others a cataleptic condition, spasms, or convulsions; and in all there is marked anæsthesia. The last-named effect led to the use of cannabis in China in certain surgical operations.

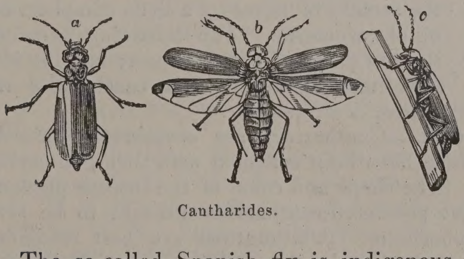
Medical Uses.—The effects of cannabis as just described would not suggest its employment in *tetanus*, and yet in the traumatic variety of a disease notoriously of fatal issue, its virtues have been demonstrated by physicians entirely competent to test them. It is of little use in *neuralgia*, *rheumatism*, and *chorea*. Its anæsthetic virtues are shown in its allaying the intense itching of *eczema*, so as to permit the patient to sleep; it is said to have been used with advantage to diminish *hallucinations* of sight and hearing, in certain forms of *insanity* and in *delirium tremens*, but in such sensorial aberrations its action is by no means uniform. It is alleged that extract of cannabis used habitually in the dose of one-third of a grain twice a day will prevent or greatly mitigate attacks of recurrent *headache*, or *migraine*. During the attack the dose should be increased to half a grain or more. It seems to be peculiarly efficient in various conditions of the brain involving a positive or relative anæmia of that organ, such as *delirium after fever*, *softening of the brain*, *thickening of the meninges*, *obstinate nervous vomiting*, etc. It appears capable, directly or indirectly, of causing uterine contraction, as in many cases of *uterine hemorrhage;* and it is also said to provoke this act during *labor* with as much energy as ergot, but its effects are less persistent. The *dose* of extract of cannabis is from halt a grain to two grains; but since the preparation is often quite inert, none should be used medicinally that has not previously been tested. Lemon juice tends to neutralize its effects. Tobacco and coffee are said to increase and prolong the action of the drug.

CANTHARIS, *U. S.*, *Br.*—CANTHARIDES.

Cantharides, P. G.; *Muscæ Hispanicæ.*—*Spanish flies*, E.; *Cantharides*, Fr.; *Spanische Fliegen*, *Canthariden*, G.

Cantharis vesicatoria, *DeGeer*, *Hist. des Insectes;* s. Lytta vesicatoria, *Fabricius*, s. Meloe vesicatorius, *Lin.* The beetle collected chiefly in Hungary and Southern Russia. Class, Insecta; Order, Coleoptera,—Beetles.

Fig. 22.



Cantharides.

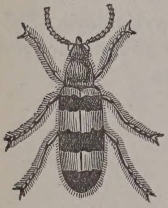
Description.—The so-called Spanish fly is indigenous to Southern and Central Europe, and is found eastward as far as Western Asia; it frequents chiefly trees and shrubs of the Oleaceæ and Caprifoliaceæ, such as the ash, lilac, elder, and honeysuckle. The beetle is from one-half to one inch long, and one-eighth to one-quarter inch broad, flattish cylindrical in shape, of a shining-brass or copper-green color above and below, and finely punctate above. Head subcordate, with a longitudinal furrow; eyes 2, lateral; antennæ filiform, of 11 joints, the lowest 3 green, the upper black; thorax of the same width as the head, longitudinally channelled; wing-cases covering the body, with two fine longitudinal ridges: wings ample, membranous, brownish transparent; tarsi of the hinder legs with four, and of the others with five joints; claws bifid. They have a strong and disagreeable odor.

Collection and Commerce.—Cantharides are collected early in the morning, by spreading cloths under the trees and shrubs, which are then shaken or beaten with poles; the insects are then plunged into hot water, afterwards spread out and dried. A better method for killing them is by means of a little ether or oil of turpentine, after inclosing them in a tight vessel. They are collected for exportation in Spain, Italy, Hungary, and Southern Russia, and packed in boxes and casks. Those coming from Russia are of a copper color, larger than those of Western Europe, and are most esteemed. 6000 pounds of cantharides were imported in the year 1866–67: more recently the importation reached 14,000 to 19,000 pounds per annum, including Chinese blistering beetles.

Allied Species.—Several of the American species, allied to the Spanish flies, have been found to possess efficient vesicating properties, and among these may be mentioned: *Cantharis vittata* or potato fly, which has a black thorax and wing-cases, with three yellow stripes upon the former, and the latter margined with yellow and with a yellow stripe down the middle. *C. cinerea*, black, closely punctured, and covered with ash-gray hairs; *C. marginata*, elytra black, with the margin ash-colored; *C. atrata*, only about one-third of an inch long, uniformly black. Attention has also been called among others to *C. Nuttalli*, which resembles the Spanish fly, but has golden-purple wing-cases striped with green; it is very abundant in Kansas and Colorado. An interesting paper treating of many of the North American blistering beetles and of the development of Meloe, by Mr. W. Saunders, may be found in the *Proceedings of the American Pharmaceutical Association*, 1876, p. 505.

Mylabris cichorii, Fabr., and M. phalerata, Pall., two vesicating insects, indigenous to Eastern and Southern Asia, and to some parts of Africa, have recently been imported as *Chinese blistering flies;* the insects are black, with two orange-colored bands, and two spots of the same color upon the wing-cases. They yield a blackish-gray powder, destitute of the green glossy particles observable in powdered cantharides, and are quite efficient as a vesicant.

Fig. 23.



Mylabris cichorii.

Preservation.—All blistering beetles should be kept in a well-dried condition and in close vessels, protected against the attacks of mites by a little camphor, ether, chloroform, or oil of turpentine. The blistering principle resides mainly in the soft parts of these insects; but the idea, which has been sometimes advanced, that cantharides increase in strength when attacked by mites, is erroneous.

Adulterations.—Cantharides are occasionally mixed with beetles of a similar color, which have been collected with them, but evidently not for fraudulent purposes. The shape and color of the insects prevent them from being adulterated. But powdered cantharides are said to be sometimes ground together with euphorbium. Adulterations are best recognized by determining the amount of cantharidin by the modifications of Procter's process mentioned below.

Constituents.—Robiquet's analysis (1810) indicated the presence of cantharidin, free acetic and uric acids, fatty matters (stearin, palmitin, and olein, according to Goessmann), yellow viscid matter, soluble in water and alcohol, yellow substance soluble in ether and alcohol, black extractive, and magnesium and calcium phosphates. Pocklington (1873) regards the green coloring matter as chlorophyll. *Cantharidin*, $C_{10}H_{12}O_4$, is most readily obtained by Procter's process (1851), as modified by Mortreux (1864), and Fumouze (1867); this method consists simply in exhausting the powder with chloroform, evaporating spontaneously, and freeing the residuary crystals from fat and coloring matter by washing them with bisulphide of carbon. Galippe (1875) recommends the substitution of acetic ether for the chloroform. Beguin gives preference to the same menstruum, and believes that the solvents mentioned completely extract the cantharidin, and that therefore it cannot be contained in the beetles partly in combination, as was stated by Bluhm (1865), Rennard (1871), and others. The experiments of R. Wolff (1877) made with *Lytta aspersa* of South America, indicate, however, that ammonium compounds may be present and gradually increase in quantity, through the agency of moisture and the magnesium salts of the beetles, whereby sparingly soluble compounds are formed, all of which, as far as examined, are decomposed by acetic ether with the liberation of cantharidin: hence the larger yield when old cantharides are treated with acetic ether. The amount of cantharidin found by different authors in cantharides varies between 0.17 and 0.57. Boiraux and Léger (1875) obtained as much as 1 per cent. by using hot coal oil (boiling between 80° and 120° C.). W. R. Warner (1856) obtained from C. vittata 0.40, R. Wolff from Lytta aspersa 0.85, Prestat (1876) from Mylabris interrupta of Algiers 0.858, and Maisch (1872) from Chinese flies 1.016 per cent.; the latter vary on keeping probably as much as the officinal species, for Warner obtained only 0.43 per cent. According to Nentwich (1871) full-grown cantharides only are vesicating.

Cantharidin crystallizes in colorless prisms and scales, and is soluble in alcohol, methylic alcohol, ether, chloroform, acetic ether, glacial acetic acid, fixed and volatile oils. It is rendered soluble in water through a yellow matter contained in cantharides (Robiquet); but according to Rennard, hot and cold water dissolve nearly one-third and one-fifth per cent. of cantharidin, and this vaporizes when distilled with water, more particularly with the first portions, with chloroform even at 60° C., and in the dry state at and above 85° C. (185° F.). When dry it fuses near 210° C.(410° F.), and sublimes more freely at that temperature, condensing again in glossy prisms or needles. It unites with bases after assimilating H_2O, forming salts, *cantharidic acid* having the composition $C_{10}H_{14}O_5$, but on being decomposed by an acid, cantharidin is again separated (Dragendorff, 1867). Krafft (1877) gives the formula $C_{20}H_{24}O_8$ to cantharidin, and states that the latter heated with hydriodic acid spec. grav. 1.8 is gradually converted into the monobasic *cantharic acid*, which has the same composition, is crystalline, soluble in 120 parts of cold and 12 of boiling water, sparingly soluble in ether, and not vesicating when its glycerine solution is applied to the skin. A process for increasing the activity of cantharides plaster, based upon the described behavior of the cantharidin as an acid, and its partial presence in cantharides as a cantharidate, was found by Rother (1872) to yield an ineffectual preparation, unless the powder was finally kept moist for several days with chloroform or oil of turpentine, whereby, however, the activity of cantharides powder was likewise increased.

Off. Prep.—Acetum cantharides, *Br.;* Ceratum (emplastrum) cantharidis, Charta cantharidis (epispastica), *U. S., Br.;* Ceratum extr. canthar., Collodium cum cantharide, *U. S.;* Emplast. picis cum cantharide (calefaciens), *U. S., Br.;* Linim. cantharidis, *U. S.;* Liquor epispasticus, *Br.;* Tinctura cantharidis, Unguentum cantharidis, *U. S., Br.*

Physiological Action. *On Animals.*—When given to dogs in large doses its effects are vomiting, debility, dilated pupils, pain, bloody urine and feces, coldness, convulsions, and death. In doses not fatal, irritation of the sexual organs is manifested. Injected into the veins, the symptoms are essentially the same. Half a grain of cantharidin, used in this manner, killed a dog in half an hour, and one-seventh of a grain destroyed a cat in the same time. After death from cantharides, vascular injection of the intestine, the kidneys, and the bladder is found. As chloroform and the fixed oils dissolve the active principle, they should not be used when the stomach contains any preparation of the drug.

On Man.—Internally, if the quantity be large, cantharides occasion a burning heat in the throat, stomach, and bowels, cause nausea and vomiting, often of blood, and produce fibrinous and sometimes bloody stools, griping, and tenderness of the abdomen. With such symptoms death may take place. If there is time for the absorption of the cantharidin, there is also strangury, with burning pain in the kidneys and bladder; the urine is albuminous or bloody; the local irritation is apt to occasion erection of the penis; sometimes, though rarely, with erotic excitement and seminal emissions; and, in the female, genito-urinary stimulations, which may induce abortion. Gangrene sometimes attacks the genitals. It is said that venereal excitement is more apt to follow the action of cantharides in substance than that of cantharidin, and the difference is ascribed to an essential oil which the former contains, and which gives it its characteristic nauseous and pungent odor. The general symptoms of cantharidal poisoning consist of a frequent and small pulse, hurried breathing, vascular injection of the face, heat of skin, thirst, pain in the head, delirium, trembling, tetanic spasm, and coma. The smallest fatal dose of cantharides on record is twenty-four grains, but the patient was a pregnant female who aborted. An ounce of the tincture has been fatal to a boy of seventeen. Cantharidin does not appear to stimulate so energetically when taken internally; indeed, some Italian writers declare it to be a direct and powerful sedative of the nervous and circulatory systems. After death from cantharides the gastro-intestinal and urinary mucous membranes are congested, bloody, inflamed (with exudation), or gangrenous. Applied to the skin in cerates, ointments, etc., or as cantharidin, this agent produces a stinging and burning pain, with redness, followed by vesication. The serum contained in the elevated cuticle is pale yellow, alkaline, and albuminous; the chorion is pale red, and its papillæ are prominent; or, if the action have been energetic, the chorion is highly inflamed, and may be coated with a fibrinous layer. When a blister is very large, and long applied, it is apt to produce strangury, and the urine is covered with an albuminous pellicle. It may also cause general nervous excitement and fever, inflammation of the lymphatics and their glands, or a diffuse erythema, and even gangrene of delicate parts, or of such as are weakened by blood diseases. Hence a blistering plaster of large size should rarely be kept upon the skin until complete vesication occurs. Cantharidin does not appear to cause toxical effects as readily as cantharides.

Medical Uses. *Internally.*—Cantharides in the form of the tincture have been given in low forms of *fever*, and in cases of exhaustion from protracted *hectic*, with alleged advantage; but there is nothing to render this method eligible. The same is true in regard to *dropsy* and chronic *bronchitis*. In scaly *diseases of the skin* it has been found very useful, and should not be forgotten when arsenic and the application of tar, etc., have failed. In various forms of *debility of the bladder*, such as produce incontinence of urine in children and old men, and in the latter *dysury*, this medicine has been often efficient. Sometimes, indeed, when directly injected into the bladder, long standing *gleets* have been cured by it, and also by its internal administration. In chronic *vesical catarrh* it deserves more confidence than it is apt to receive. *Diabetes insipidus* has also been cured by it. In all of these cases, except the last, it acts by producing a substitutive irritation. Its irritant action upon the pelvic organs is illustrated by its use in *amenorrhœa* depending upon atonic conditions, and in passive *seminal emissions* of the same nature.

Externally the uses of cantharides, especially in blisters, are very numerous. They are employed—1st. To stimulate the whole or a particular part of the system. 2d. To promote the absorption or prevent the accumulation of inflammatory exudations. 3d. To recall suppressed discharges. 4th. To promote the cure of internal diseases by counter-irritation of the skin. The direct remedial influence by stimulation is seen in cures of indolent *ulcers*, *fistulæ*, and several inveterate diseases of the skin, as *lepra*, *psoriasis*, and *lupus;* and even in certain acute ones, as *zona* and *erysipelas.* Liniments containing tincture of cantharides are among the best means of curing *alopœcia.* The revulsive operation of blisters is that most usually invoked; and, on the whole, the most useful. Wherever there is a local tendency to congestion, the timely and due application of a blister modifies and may arrest it; thus it may prevent serious *congestion of the brain*, or its increase if already existing, or its consequences through effusion, if this have occurred, by depleting the neighboring skin. Many cases of *dropsy of the brain* have been palliated by blistering the scalp; many of *general dropsy* by blisters cautiously applied to the legs; many also of *hydrocele*, of *hydrarthrosis*, and, most of all, cases of *chronic pleurisy*, in which nothing is more efficient than a succession of large blisters for removing the effusion. A similar action is no doubt exerted by blisters when applied along the under surface of the penis for *gleet*, and to the sacrum for *leucorrhœa*, to prevent *abortion*, and to relieve *dysmenorrhœa;* to hinder the suppuration of deep-seated *buboes* and other glandular inflammations. In the last-mentioned cases, if the inflamed organ is very superficial, or the action of the blister is deep, suppuration will be hastened. *Abscesses* of various sorts may be conveniently evacuated by blistering, and especially cold abscesses, if the skin over them is already thin.

The action of blisters in *fevers* is probably both stimulant and revulsive, and, to a certain extent, depletory. The clinical facts of the matter are simply these, that blisters, especially to the nape of the neck, are generally useful in *typhus* and *typhoid* fevers, whether the condition be one of excitement or of coma, or simply denote a tendency to the one or the other. They are not equally beneficial under analogous conditions in scarlatina, or variola, or during acute inflammations of the lungs, heart, or bowels. Their stimulant action is the one most frequently sought, *i. e.*, when the symptoms are moderately comatose, in which case the vesicant should not remain applied longer than from two to four hours, its fuller effect being secured by a dressing of simple ointment, or a poultice. In cases of profound stupor, a more prolonged operation is necessary. When coma is due to an *apoplectic* condition, whether hemorrhagic or only congestive, the active depletory operation is to be secured by a more prolonged application of the blister, and, if necessary, to the scalp as well as to the back of the neck. In such cases, also, the discharge should be maintained by means of stimulant dressings. In all forms of inflammation of the *eyes*, blisters are invaluable as revulsives, applied to the nuchæ, behind the ear, or on the forehead. The utility of blisters in acute inflammation of the pleura and of the lungs (*pleurisy* and *pneumonia*) depends upon their being applied long enough only to vesicate superficially, and so as to cover a large portion of the affected lung. Smaller blisters may relieve a stitch in the side, but will not so distinctly influence the progress of the inflammation within, as denoted by a diminution of the cough, oppression, and fever. Small blisters are of essential use in those limited pleurisies which occur during chronic phthisis, and they should not be disregarded in analogous pneumonias. In *pericarditis*, blisters should never be omitted; they allay pain, probably limit effusion, and certainly promote its absorption. The revulsive action of blisters is also a precious resource in the treatment of *phlegmasia alba*, of *phlebitis*, and especially of *chronic fluxes of the bowels.* Nothing is more efficient in the last than a succession of large and superficial blisters. The treatment of acute articular *rheumatism* by blisters applied upon the affected joints has been attended with a large degree of success; but it is doubtful whether the benefit is due so much to the revulsive or counter-irritant operation as to the alkalinity of the secretions induced by blistering. As the use of alkalies, internally and locally, usually cures acute articular rheumatism, it does not seem worth while to employ a remedy which accomplishes no more, while it inflicts much pain. In cases of retrocedent rheumatism or gout, it has been advised to blister the joints last affected; but less severe revulsives are doubtless as useful. Of all the local methods of treating *neuralgia*, that by blisters is the most efficient. It consists in applying small blisters over the superficial portions of the affected nerves, especially where they emerge from bony or tendinous openings, or distribute their terminal branches to the skin. The vesication should be slight when the nerves are superficial, energetic when the trunks lie deep. The nerves of the head, face, and chest require the former method, the sciatic nerve the latter. In cases requiring superficial vesication, the operation should be repeated, as often as the skin heals, if the pain continues to return; when the nerves lie deep the discharge from the blistered surface should be constantly maintained until the cure is perfect. The revulsive action of blisters is also employed in *convulsive disorders* for the purpose of reducing the morbid irritability of the cerebro-spinal centres. It has long been used upon the spine in *tetanus*, and with unequivocal advantage, and in all diseases attended with tetanoid rigidity or convulsions. It is notably a valuable element of the treatment in *epidemic meningitis*, when the phenomena dependent upon nervous disorder exceed those which depend upon alterations of the blood. The blisters should cover the occiput and extend along the spine to the end of the cervical vertebræ at least, and should vesicate thoroughly. *Spasms* of particular muscles are often moderated by blistering the affected part, as in *scrivener's spasm;* and the nutrition of *wasting muscles* after rheumatism, injuries, etc., is generally improved by a course of blistering. *Vomiting* is often arrested by blistering the epigastrium.

A blister should, in general, be applied as near as possible to the part which it is intended to benefit. It is usually undesirable to allow it to remain upon the skin until vesication has been accomplished. Usually from three to six hours, or until vesication commences, will be long enough. It will act more promptly if the part has first been cleansed with warm water and soap, and bathed with vinegar. Fever renders the action of blisters more rapid, and coldness and nervous insensibility of the skin retard it. They act more promptly when the skin is delicate, hence, more so in children and females than in other persons; consequently, especial care should be used to prevent their excessive action in such patients, either by diluting the blistering cerate, or by interposing a piece of tissue paper or fine muslin between the plaster and the skin. If it is desired to heal a blister soon, the raised cuticle should be cut freely, so as to evacuate the serum, and a dressing of carded cotton secured with a roller. If it is intended to maintain the discharge, the cuticle should be removed, and a dressing, first of simple cerate, and, within twenty-four hours, one of basilicon ointment, applied. Under such stimulation, the discharge grows purulent and may be maintained by savine cerate or mezereon ointment. As a general rule, blisters should be very cautiously employed in old and in young persons; in the former they act slowly and often leave intractable sores; in the very young they are prone to excite excessive reaction and occasion gangrene. During epidemics of diphtheria, blisters are very apt to become covered with false membrane; during other epidemics, they are likely to be attacked with erysipelas or with gangrene, or to be followed by abscesses or by an eruption of boils.

Poisoning by cantharides recently taken should be treated by a vegetable emetic, with copious draughts of warm water, and afterwards by the free use of mucilaginous or albuminous liquids. General warm baths and emollient cataplasms on the abdomen should be used, and opiate enemata.

CAPSICUM, *U. S.*—CAPSICUM FRUIT.

Capsici fructus, Br.; *Fructus capsici*, P. G.; *Piper Hispanicum.*—*Cayenne pepper*, *African pepper*, *Pod pepper*, E.; *Capsique*, *Piment des jardins*, *Piment rouge*, *Poivre de Cayenne*, Fr.; *Spanischer Pfeffer*, G.

The dried fruit of several species of Capsicum, mainly of C. fastigiatum, *Blume*, and C. annuum, *Lin.* Woodville, t. 80; Bentley and Trimen, Med. Plants, 188, 189.

Nat. Ord.—Solanaceæ.

Origin.—Several species have long since been cultivated in tropical countries, and are supposed to be indigenous to South and Central America. In the course of time many varieties have been produced through cultivation.

Description.—C. FASTIGIATUM, *Bl.*, is a small shrub which grows wild in Southern India, tropical Africa and America, and produces in each fork 2 or 3 fruits which are less than an inch in length, of a conical shape, supported by a flattish, 5-toothed calyx, bright scarlet in color, become shrivelled on drying, and consist then of a thin, translucent, and fragile pericarp, inclosing two cells containing, attached to the central placenta, the flat, reniform, yellowish seeds, which are about one-eighth inch in diameter and have a semicircular embryo inclosed in a fleshy albumen. The odor of the fruit is peculiar; its taste extremely hot and biting. This kind is known in commerce as *African* or *bird pepper*, and in Great Britain as *chillies* and *Guinea pepper*. It is the only kind permitted by the British, and is preferred by the U. S. Pharmacopœia.

C. ANNUM, *Lin.*, is herbaceous, and extensively cultivated in the temperate zone. The fruit grows singly in the forks of the stem, is much larger than the preceding, and varies in shape between straight or curved, conical, erect, or pendulous, and more or less globular; it attains a length of 2 to 3 inches, is sometimes yellow, but generally red, and after drying brownish; otherwise it resembles the preceding. It is known in England as *pod pepper*, but also sold as *chillies*.

The fruits of C. cerasiforme, *Willd.*, of the size and shape of a cherry, and of C. chlorocladum, *DeC.*, small and oblong, are occasionally, though not often, met with.

The powder is of a dark orange-red color, and when prepared from the second species is not unfrequently attacked by insects.

Constituents.—Since the analyses made (1816) by Bucholz and Braconnot, the name of *capsicin* has been given to various liquid or soft preparations, all of which were more or less impure though containing the fiery principle, which at last was isolated by J. C. Thresh (1876), who found it to be a crystallizable body, which has been called *capsaicin*, is with difficulty obtained pure, and, according to Dr. Buri, has the composition $C_9H_{14}O_2$. It is present in small quantity only, and intimately associated with a red fatty matter, which consists chiefly of palmitic acid. Buchheim's *capsicol* (1873) is a red oily liquid containing capsicin. The latter is fusible, volatile, and dissolves in alcohol, fixed oils, ether, amylic alcohol, benzol, and alkalies, but slowly in turpentine, carbon bisulphide, and petroleum. It yields crystalline compounds with barium, calcium, and mercury, and when oxidized with nitric acid produces an oily body, oxalic and succinic acids, and another crystalline acid whose nature has not been determined. The red coloring matter of capsicum is but slightly soluble in boiling alcohol, but dissolves readily in oils, sulphide of carbon, petroleum, amylic alcohol, ether, and chloroform. Felletár (1868) isolated from capsicum a volatile alkaloid which has the odor of conia, but was found to differ from this alkaloid by Dragendorff (1871) in the different shape of the crystals of its hydrochlorate, and from lobelina in not being colored by Fröhde's reagent.

Off. Prep.—Infusum capsici, Oleoresina capsici, *U. S.;* Tinctura capsici, *U. S., Br.*

Physiological Action.—Capsicum is an irritant and a stimulant. Applied to the skin it causes redness and ultimately vesication. In proper quantities it excites a grateful warmth in the throat and stomach, and quickens the appetite and digestion. It tends particularly to prevent flatulence from vegetable food, and for this purpose is freely used as a condiment in hot climates. In large doses it causes a general glow, with thirst, but does not accelerate the pulse. If too lavishly used it sometimes brings on torpor of the digestive functions; but often it seems not to be injurious.

Medical Uses.—Capsicum is of use in enabling feeble stomachs to digest food, and hence is much used in atonic *dyspepsia* Freely taken it is said to cure *hemorrhoids*, as black pepper, and still other stimulants, are known to do. It sometimes cures *intermittent fever*, and in obstinate cases is a good stimulant to conjoin with quinia. In common with other agents of the same nature, it tends to prevent or to relieve *sea-sickness.* In *delirium tremens* it is of great use in enabling the patient to retain and digest food; indeed, we have seldom in this disease found it necessary to employ other internal remedies than a strong soup well seasoned with red pepper. As a local stimulant it is particularly useful in *tonsillitis.* The simple form may sometimes be arrested in its forming stage by a capsicum gargle; and in that form which occurs in *scarlet fever* and in *diphtheria*, no application is so efficient as a strong gargle or wash made with this substance.

The *dose* of powdered capsicum is from five to ten grains. An infusion is made by adding forty grains of capsicum to half a pint of boiling water; of this a tablespoonful may be given at a dose. An infusion used with remarkable success in an epidemic of *angina maligna* (diphtheria?) is thus described: Take two tablespoonfuls of red pepper and the same quantity of fine salt, beat them into a paste, and add half a pint of very sharp vinegar. Of this the dose for an adult is said to be a tablespoonful every hour. It is excessively acrimonious, but it is alleged to hasten the separation of the false membranes and sloughs from the fauces.

CARBO.—CARBON.

Symbol C. Atomicity mostly quadrivalent, sometimes bivalent. Atomic weight 12.

Origin.—This element is extensively diffused in nature; combined with oxygen as carbonic anhydrid CO_2, usually called carbonic acid gas, it exists to a small extent as a constant ingredient of the atmosphere; it is found in the mineral kingdom in a free state as well as in various combinations, most notably as carbonates; and it is invariably present in all organized beings and organic compounds, which, when heated with a limited access of air, usually become black from carbonization, *i. e.*, the separation of carbon.

Description.—It exists in the following three allotropic modifications:—

1. DIAMOND is found chiefly in India near Golconda, Borneo, Southern Africa, and Brazil, and is in colorless and variously colored octahedrons of 3.5 to 3.6 specific gravity. It is a non-conductor of electricity, and the hardest substance known. Lavoisier proved it to be pure carbon; when burned it usually leaves between 0.05 and 0.2 per cent. ashes; amorphous diamond, which is used for polishing the crystalline, may leave up to 2 per cent.

2. GRAPHIT, *Plumbago* or *Black Lead*, has been found in many countries, crystallizes in hexagonal plates varying in specific gravity between 1.8 and 2.5, is of a black-gray color, fatty to the touch, quite soft, and a good conductor of

electricity, and leaves between 0.2 and 5 per cent., occasionally even as much as 46 per cent. of ashes.

3. AMORPHOUS CARBON exists in nature as *coal*, of which there are three principal varieties, namely *lignite*, *bituminous coal*, and *anthracite*, which contain respectively about 66, 80, and 90 per cent. of carbon, partly in the form of organic compounds. Artificially prepared it constitutes *wood charcoal*, *animal charcoal*, *coke*, and *lampblack*, the latter being obtained by the incomplete combustion of resinous matters; after it has been heated in covered vessels to expel the volatile organic compounds, it constitutes a nearly pure carbon.

Coke is the residue left from the dry distillation of coal, and consists of amorphous carbon contaminated with the mineral constituents of the coal.

When burned with an insufficient supply of oxygen, carbon is converted into *carbonic oxide*, CO; with a full supply of air it yields *carbonic acid*, CO_2. The chemistry of carbon in its various combinations constitutes what is known as organic chemistry.

CARBO ANIMALIS, *U. S.*, *Br.*—ANIMAL CHARCOAL.

Boneblack, *Ivory black*, E.; *Charbon animal*, *Noir d'os*, Fr.; *Thierkohle*, *Knochenkohle*, *Beinschwarz*, G.

Charcoal prepared from bones.

CARBO ANIMALIS PURIFICATUS, *U. S.*, *Br.*—PURIFIED ANIMAL CHARCOAL

Charbon animal purifié, Fr.; *Gereinigte, Knochenkohle*, G.

Preparation.—Boneblack of commerce is obtained by roasting bones in iron cylinders until vapors cease to be given off, when charcoal is left intimately mixed with from nine to ten times its weight of the inorganic constituents of bones, and containing a little nitrogen, probably as nitrogen carburet. The volatile products of this dry distillation are various gases, an ammoniacal aqueous liquid, called *bone-spirit*, and a blackish-brown tar called *bone oil.*

Purified animal charcoal is prepared by digesting for two days 12 troyounces of animal charcoal with a mixture of 12 troyounces of muriatic acid and 12 fluidounces of water, then washing it well to completely remove the acid liquid, drying, heating the remaining charcoal to redness, and preserving it in well-stopped bottles (*U. S.*). The process of the British Pharmacopœia is similar, 16 ounces of boneblack, 10 fluidounces of hydrochloric acid, and 20 fluidounces of water being used, and a closely covered crucible being very properly directed for the final heating to redness.

Properties.—Boneblack, like purified animal charcoal, is a dull black, rather dense, and nearly tasteless mass, which, for uses in the arts, is either granulated or powdered. It has the remarkable property of removing organic coloring matters from their neutral or somewhat acid solutions, and is employed for that purpose in the refining of sugar and in many chemical operations, for many of which its previous purification is requisite to avoid contamination with earthy matters which would be dissolved by the organic acids. The compounds removed in its purification are the inorganic constituents of the bones, and consist mainly of calcium phosphate, with some calcium carbonate and magnesium compounds.

Tincture of litmus diluted with twenty times its bulk of water, agitated with purified animal charcoal and thrown upon the filter, passes through colorless. When burned at a high temperature with a little red oxide of mercury and free access of air, it leaves only a slight residue (*Br.*). It removes from their aqueous solutions tannin, alkaloids, bitter principles, basic lead and other metallic salts, iodine, lime, etc., a property which it shares more or less with boneblack. This property is due to the finely divided state of the carbon and the surface attraction resulting therefrom, and may be imparted to wood charcoal if, previous to charring, the vegetable substances are intimately mixed with flint, lime, or other earthy matters; a mixture of 10 parts of pipe clay, 50 parts of finely powdered coal, and 2 of tar yields, after carbonization, a charcoal possessing excellent decolorizing properties, depending in part upon the presence of alumina. By reheating purified animal charcoal with potassium carbonate, its decolorizing power, which was impaired by the treatment with acid, is greatly increased, and similar active charcoals are obtained from blood, horn, leather, etc., by mixing them with the salt mentioned, carbonizing the mixtures and exhausting the residues with water.

The value of animal charcoal as a decolorizer is best ascertained by treating known weights of it with diluted solutions of indigo or litmus, and ascertaining the bulk which may be completely decolorized by slow percolation. Corenwinder (1853) proposed treatment of the charcoal with diluted solutions of lime and sugar, and determining by titration the amount of lime remaining in solution. When the decolorizing power of the charcoal has been exhausted, it cannot be restored by heating to redness, because a dense charcoal, resulting from the absorbed substances, will then be deposited in the pores; but, if allowed to ferment, this substance will be destroyed, and, by washing the charcoal with water, drying, and igniting, it becomes again a good decolorizer. Pelouze (1854) proposed to effect the revivification of spent animal charcoal by treating it with caustic alkalies or alkaline carbonates; according to Renner (1862) the process is a tedious one.

For pharmaceutical uses the *purified* animal charcoal should alone be employed. The German Pharmacopœia directs for this purpose a *Carbo carnis*, or meat charcoal, which is prepared by cutting three parts of veal, freed from fat, in small pieces, mixing it with one part of small bones, and roasting in a covered vessel until inflammable vapors cease to escape; the residue, when cold, is powdered.

Pharmaceutical Uses.—The chief use of animal charcoal is for decolorizing the aqueous or alcoholic solutions of organic principles.

CARBO LIGNI, *U. S.*, *Br.*—CHARCOAL.

Carbo pulveratus, P. G.; *Carbo præparatus*, *Carbo e ligno*.—*Wood charcoal*, E.; *Charbon végétal*, Fr.; *Holzkohle*, *Präparirte Kohle*, G.

Charcoal prepared from wood.

Preparation.—Wood heated to about 300° C. (572° F.) leaves charcoal as a residue. On a large scale this is effected in iron cylinders (see Acidum aceticum pyrolignosum), in closed chambers of brick, or by the method of pile burning, in which the heat developed by the combustion of a portion of the wood effects the charring of the rest. Two and sometimes three stacks of billets of wood of even length are piled up around some stakes driven into the ground, until a flattish cone of from 30 to 40 feet in diameter has been formed, which is covered by sod and earth, openings being left near the base for the escape of the water which is at first expelled. After the heap has been kindled in the centre, the top opening is closed, and when the wood has become perfectly dry, the open space at the base is likewise closed and the pile left to smoulder for several weeks. The charcoal is finally withdrawn and extinguished by water, dry sand, or charcoal dust. The yield varies with the kind and dryness of the wood. Karsten found that a wood which lost at 100° C. 57 per cent. and at 150° C. (302° F.) additional 10 per cent. of its weight, would yield only 14 per cent. of charcoal, while the same wood dried yielded 25 per cent. The difference is explained by the formation of carburetted hydrogen on the passing of aqueous vapors over red-hot charcoal, and the same cause accounts for the smaller yield in the dry distillation of wood when the cylinders are rapidly heated so that the wood near the iron is charred, while the pieces in the centre still contain water.

Properties.—Charcoal has the shape and shows the texture of the wood from which it was obtained; it is black, inodorous, tasteless, very porous and brittle, insoluble and infusible. Prepared by pile burning it is considerably denser than when obtained in retorts; the latter kind is therefore preferable for medicinal use, particularly that made from soft woods, which is more porous than that obtained from hard wood. Charcoal made from young shoots of the willow, poplar, or linden, is for these reasons most esteemed. It contains the inorganic constituents present in the wood, and these amount in well-prepared charcoal to about 1 per cent.

Like other porous bodies, wood charcoal possesses the property of absorbing gases, the volumes of which exceed many times the volume of the recently ignited charcoal, being for oxygen 10, for carbonic acid 35, for sulphuretted hydrogen 55, and for ammonia about 100 volumes to 1 of the former. Considerable heat is generated thereby and also by the oxidation of some of the gases by the absorbed oxygen, and may increase to spontaneous ignition; and the increase in weight of pile-burned charcoal may amount to from 10 to 15 per cent. by the absorption of watery vapors. This property explains the uses of charcoal as a deodorizer, for which purpose it should be freshly burned or reheated to expel the gases condensed in its pores. Odorous principles are not only absorbed by it from the atmosphere, but likewise from solutions in water and weak alcohol; its employment for the removal of the fusel oil from spirits is well known (see Alcohol). It acts in a manner similar to animal charcoal in precipitating from their aqueous solutions metallic salts, or even the metals, most bitter principles and coloring matters; but for the latter purpose is much inferior to the former.

Pharmaceutical Uses.—Wood charcoal is an ingredient of certain dentifrices, and is employed in some chemical processes for its deoxidizing action, as in the preparation of sulphurous acid and in the reduction of bromates and iodates to bromides and iodides. It is used in making Cataplasma carbonis, *Br.*

Physiological Action.—Charcoal in the stomach absorbs more or less of the gases and liquids contained in that organ. Unlike alcohol, salt, and some other substances, it does not retard the decomposition of organic matter, but, on the contrary, hastens it, while it renders latent the gases evolved during the process. Its power of absorption depends upon its remarkable porosity, and, as it is indestructible, this property is lasting, and can be revived in its original power by heating the charcoal anew. It seems probable that the minute subdivision and insolubility of powdered charcoal, and consequently its great superficial extent, enable it to present a very large surface of the decomposing material to the oxygen of the air, and thus to insure its destruction. In point of fact, the most fetid gases disengaged by putrefaction are among those which, on the one hand, are most abundantly absorbed by charcoal, viz., ammonia, sulphuretted hydrogen, and sulphurous acid; and, on the other hand, oxygen, which combines with the other substances and generates new and inodorous compounds. That a portion of this action is owing to the minute subdivision of the charcoal, is shown by the analogous effects of dry earth, sand, and gravel upon decomposing organic compounds; and whether its action is due to any other cause is more than doubtful. It is not determined absolutely whether charcoal prepared from ivory or bone, or box-wood, or that which is prepared from poplar or other light porous wood, is the more efficient; but it is certain that charcoal of any kind is most active when freshly prepared.

Medical Uses.—For all forms of *flatulence* charcoal is one of the most certain remedies; and at the same time for those other *dyspeptic* phenomena which sometimes attend it, particularly nausea, fetid breath, foul taste in the mouth, constipation, palpitation of the heart, etc. It is remarkable that it does not tend to produce *constipation*, but rather to moderate it when it exists. The cases in which it is said to accumulate in the bowels, and obstruct them, are not well authenticated. Its power of relieving flatulence is not confined to that of the stomach and small intestine, it has proved efficient when the colon was alone distended and a stricture existed near the caput coli. It has seemed to be a remedy for intestinal *worms* in some cases of intestinal indigestion with colic, flatulence, and irregular dejections. In epidemic *dysentery* it has proved very serviceable when administered by the stomach and also by the rectum, allaying the tormina and tenesmus, and correcting the fetor of the stools, while it lessened their frequency and rendered them more feculent. As an application to *gangrenous* and foul *ulcers*, incorporated largely in a poultice made with flaxseed, bread crumbs, or with yeast, nothing is more efficient in correcting the smell and in hastening a separation of the dead tissue. As an ingredient of dentifrices for cleansing the *teeth* and purifying the breath, the use of charcoal is familiar. Its deodorizing power has caused it to be employed in the arts and for sanitary purposes, such as preventing the generation of *putrid gases* in graves, vaults, sewers, privies, and innumerable analogous places, and notably for the filtration of *foul drinking-water*, which it not only deprives of its smell but also of its organic constituents, and renders it pure and clear. These two properties are extensively employed in the arts.

The *dose* of charcoal is one or more teaspoonfuls. It should be as freshly prepared as possible. If intended to correct digestive fermentation, it should be taken directly after meals, and is best administered in water, the portion adhering to the mouth being washed down by a mouthful of water alone. It has been prepared and given in gelatine capsules. This method insures a more active preparation than one that has been exposed to the air.

CARBONEI BISULPHIDUM.—BISULPHIDE OF CARBON.

Carboneum sulfuratum, Alcohol sulfuris, P. G.—*Carbon sulphide*, E.; *Sulfure de carbone*, Fr.; *Schwefelkohlenstoff*, G.

Formula CS_2. Molecular weight 76.

Preparation.—Bisulphide or bisulphuret of carbon is made on the large scale by heating fragments of charcoal or coke to redness and occasionally dropping through a tube to the bottom of the retort, pieces of sulphur, which is vaporized and unites with the red-hot charcoal. The condensed liquid is freed from the compounds having a disagreeable odor, by prolonged agitation with milk of lime, litharge, certain metals, or powdered corrosive sublimate, decanting, adding about 2 per cent. of a bland fixed oil and rectifying in a water-bath.

Properties.—Thus obtained it is a very mobile colorless liquid having a high refracting power, and when quite pure, an agreeable ethereal odor, but often it is of a more or less fetid odor from the presence of other volatile compounds. It has the specific gravity 1.269 at 15° C. (59° F.), boils at 47.7° C. (117.8° F.), evaporates rapidly at the ordinary temperature, and on passing a rapid current of dry air over its surface, partly congeals. It is very inflammable, has a burning aromatic taste, is nearly insoluble in water, soluble in alcohol, dissolves freely phosphorus, sulphur, bromine, iodine, fats, volatile oils, caoutchouc, and other compounds. It unites with some of the sulphur bases forming *sulphocarbonates* which correspond to the carbonates containing sulphur in place of oxygen. Dissolved in alcohol and heated in the presence of ammonia, *sulphocyanide* (also called *sulphocyanate*) *of ammonium* and hydrosulphuric acid are produced; $CS_2 + 2NH_3$ yields $NH_4CNS + H_2S$. It should not change the color of moistened litmus paper, and when agitated with solution of lead acetate, should not produce a brown or black color.

Bisulphide of carbon should be kept in a well-stopped bottle and in a cool place.

Uses.—In the arts it is largely employed for the extraction of fats and in the vulcanization of caoutchouc, and has been proposed as a solvent for obtaining the delicate perfumes of flowers.

Physiological Action.—This substance was introduced mainly by Simpson, who described it as a very rapid and powerful anæsthetic; but in several instances it produced depressing and disagreeable visions, and was followed by headache, giddiness, and obstinate vomiting. It rendered the pulse very frequent. Its anæsthetic effect, also, was very transient; and another objection to its use was found in its very unpleasant odor, which was compared to that of putrid cabbage. Applied topically, it blunts the sensibility of the skin. Its deleterious effects have been observed in manufactories, where it was employed as a solvent for caoutchouc. They have been enumerated by several physicians (Delpech, Heurtaux), and consist of feebleness of mind, confusion of ideas, and even delirium, with sleeplessness, faintness, headache, nervous pains, muscular cramps, debility, and atrophy, amaurosis, and sexual impotence. Anorexia, nausea, vomiting, constipation or diarrhœa, palpitation, and shortness of breath, are also observed. Taken internally, in the dose of two or three drops, it burns the mouth and throat, occasions nausea, vomiting, flatulence, and dysuria. It does not appear to be decomposed in the blood.

Medical Uses.—This anæsthetic is never used internally, but it has been found useful for producing insensibility in the seat of limited surgical operations, such as *opening abscesses*, the *evulsion of nails*, etc. It has also been applied locally for the relief of *headache*, *neuralgia*, and *toothache;* and for lessening the swelling of enlarged *lymphatic glands*, of *goitre*, and of *lupoid* and *syphilitic* growths. For these purposes it may be used in an ointment containing one part of the preparation to from five to ten of lard. For producing local anæsthesia it is applied as an atomized vapor.

CARBONEI TETRACHLORIDUM.—TETRACHLORIDE OF CARBON.

Chlorocarbon, E.; *Bichlorure de carbone*, *Formène perchloré*, Fr.; *Chlorkohlenstoff*, G.

Formula CCl_4. Molecular weight 154.

Preparation.—Chlorocarbon was discovered by Regnault in 1839, and is produced by the action of chlorine upon marsh gas, CH_4, or upon chloroform, $CHCl_3$, hydrochloric acid being also formed in both cases. It is best prepared by passing well-dried chlorine gas through bisulphide of carbon, and afterwards through a porcelain tube wrapped in sheet copper, and filled with fragments of porcelain maintained at a red heat, whereby tetrachloride of carbon and chloride of sulphur are produced; CS_2+3Cl_2 yields $CCl_4+S_2Cl_2$. The vapors are condensed by the aid of ice or a refrigerating mixture, and the liquid thus obtained is slowly added to an excess of potassa solution or milk of lime, whereby the chloride of sulphur is decomposed and dissolved. The chlorocarbon separates at the bottom, and is purified by distillation.

Properties.—It is a colorless, thin, oily liquid, of an agreeable aromatic odor, insoluble in water, soluble in alcohol and ether, and not decomposed by contact with aqueous solution of potassa, which, however, will remove any bisulphide of carbon that may be present. Chlorocarbon has the spec. grav. 1.599, and boils at 78° C. (172.4° F.). Geuther (1858) observed that by the action of nascent hydrogen, it is gradually converted into hydrochloric acid and chloroform or methylene chloride, CH_2Cl_2, according to the temperature at which the reaction takes place.

It may be regarded as a chlorinated derivative of marsh gas (see Methyleni bichloridum); according to its elementary composition it is a tetrachloride of carbon, or, according to the old notation, a *bichloride of carbon*, CCl_2 or C_2Cl_4, which name is still occasionally used.

Physiological Action and Medical Uses.—Experiments on animals, by Laffont, show that this preparation produces anæsthesia, preceded by excitement and tonic and clonic convulsions, great debility of the heart and vascular tension. From ten to fifteen grammes were required to induce anæsthesia in dogs. When inhaled by man it produces a sense of coolness in the fauces and of general warmth, followed by speedy anæsthesia and a complete return of consciousness. It was used with success in relieving *neuralgia* and various local pains, including *dysmenorrhœa* and the pains of *parturition;* but at present it is seldom, if ever, employed.

CARDAMINE.—Cuckoo-Flower.

Herba nasturtii pratensis.—*Cresson des prés*, Fr.; *Wiesenkresse, Kukukskraut*, G.

Cardamine pratensis, *Lin.* *Nat. Ord.*—Cruciferæ, Siliquosæ.

Origin.—This perennial plant grows in wet meadows and boggy places, and is a native of Europe, Northern Asia, and North America, but is rather scarce in the United States south to New Jersey, and westward to Wisconsin.

Description.—The ascending stem is about a foot high, and nearly smooth. The leaves are pinnate, with seven to thirteen leaflets; those of the lower leaves are on short stalks, roundish, entire, or somewhat toothed, the terminal one largest and nearly reniform; those of the upper leaves are linear and mostly entire. The flowers are showy, white, or rose-colored, and the pods linear, flattened, and with veinless valves. The fresh plant has a pungent and bitterish taste.

Constituents.—According to Lepage (1846), the seeds contain myrosin, but no myronic acid. Winkler found in the herb of Cardamine amara an acid containing nitrogen and sulphur, and yielding with myrosin a volatile oil resembling that of mustard.

Allied Plants.—The following Cruciferæ have sensible properties similar to those of the preceding plant, and have been occasionally used for similar purposes:—

Cardamine hirsuta, *Lin.*, *small bittercress*, common in Europe and North America; resembles the preceding, but is smaller, has small white flowers, and slender, ascending pods.

Card. amara, *Lin.*, *bittercress*, indigenous to Europe, has pinnate leaves, with seven or nine roundish, ovate, stalked leaflets, showy white flowers and purplish blue anthers. It is less pungent and more bitter.

Barbarea vulgaris, *R. Br.*, *wintercress*, common in Europe and North America, has lyrate leaves, with large, round or ovate, sometimes heart-shaped terminal lobes, the upper leaves obovate, toothed; flowers numerous, yellow; pods somewhat spreading.

Dentaria, *Pepperroot* or *toothwort.*—The rhizomes have a very pungent taste, and are cylindrical in D. diphylla, *Lin.* (N. America), and D. bulbifera, *Lin.* (Europe), but composed of several tubers in D. enneaphylla, *Lin.* (Europe), and in the North American species D. maxima, *Nutt.*, D. heterophylla, *Nutt.*, D. laciniata, *Muhl.*, and D. multifida, *Muhl.*

Medical Action and Uses.—This plant contains an acrid principle, when fresh, which causes it to resemble water-cresses and scurvy-grass in taste. Like them it is sometimes eaten as a salad, and has a popular reputation as a "purifier of the blood." The flowers were once claimed to display a certain efficacy in gout, and even in chorea, hysteria, and epilepsy, and to possess expectorant and diuretic virtues. Its use is now obsolete, even in Europe.

CARDAMOMUM, *U. S.*, *Br.*—CARDAMOM.

Fructus (Semen) Cardamomi minoris, P. G.; *Cardamomum minus, Cardamomum Malabaricum.—Malabar cardamoms*, E.; *Cardamomes*, Fr.; *Cardamomen, Kleine Kardamomen*, G.

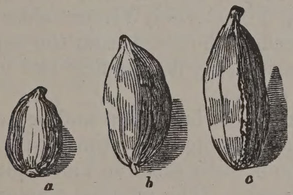
The fruit of Elettaria Cardamomum, *Maton*, s. Alpinia (Amomum, *White;* Matonia, *Smith;* Renealmia, *Rosc.*) Cardamomum, *Roxb.* Bentley and Trimen, Med. Plants, 267.

Nat. Ord.—Zingiberaceæ.

Origin.—This perennial plant is indigenous to Hindoostan, more particularly to the mountainous region of the Malabar coast, where it is also extensively cultivated in clearings made in the forests, so that the plants will enjoy sufficient shade, or in the betel-nut plantations, as in Mysore. It grows to the height of 6 to 10 feet, from a thick horizontal rhizome, has lanceolate leaves which are 1 to 2 feet long, and almost sessile upon the long hairy sheaths, and produces 3 or 4 nearly horizontal scapes which bear several short racemes of greenish-white flowers. It flowers during the rainy season, and the inferior capsules are collected from and after October, before they are quite ripe, to avoid their splitting, and dried by artificial heat. The drug is exported in chests from Bombay, Madras, and other East Indian ports. About 30,000 pounds of cardamom are now annually imported into the United States.

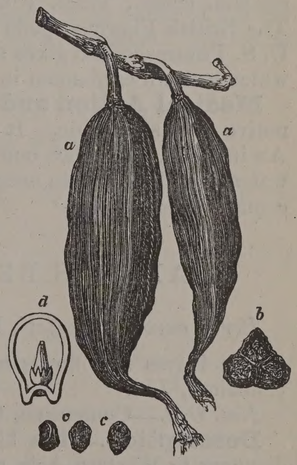
Description.—Cardamom fruits vary in length from $\frac{1}{2}$ to nearly 1 inch, and are commercially divided into *shorts* and *short-longs* or *mediums* and *longs*. They are ovoid or oblong, obtusely triangular, rounded at base, beaked above, of a pale buff color, and longitudinally striate. The capsular integuments are thin, leathery, the three cell-partitions starting from the centre of the valves. The seeds are attached to a central placenta in two rows, brown, slightly glossy, angular, transversely rugose, with a depressed hilum and a channelled raphe on one side, and contain a horny albumen; each seed is inclosed in a thin membranous nearly colorless arillus. The integuments are nearly inodorous and tasteless; the seeds have an agreeable odor and a warm aromatic and pungent taste.

Fig. 24.



Malabar Cardamom.
a, short; *b*, medium; *c*, long.

Fig. 25.



Ceylon Cardamom.
a, capsules; *b*, transvere section of capsule; *c*, seeds; *d*, section of seed with embryo, magnified.

Good cardamoms should be full and plump, and yield 75 per cent. of their weight in seeds. Malabar and Aleppy cardamoms are usually ovoid, and have a short beak; Madras cardamoms are more oblong and acuminate.

Other Varieties of cardamoms are used in the East Indian islands and China, but are rarely met with in our commerce. The *Ceylon* or *long cardamoms* are occasionally seen in commerce; they are obtained from Elettaria major, *Smith*, which is now usually regarded as a variety of the officinal plant, and is indigenous to Ceylon. The fruit is about 1½ inches long, lanceolate oblong, acutely triangular, with flat sides and a long attenuated apex. It is usually of a darker color, and the seeds are less agreeable in odor and taste. The *round cardamoms* of Siam, Java, and other islands, are the fruits of Amomum cardamomum, *Lin.*, of the size of a cherry, globular, or somewhat ovate in shape, the three sides convex; the taste of the seeds is more camphoraceous. The *Bengal cardamoms*, obtained from Am. aromaticum, *Roxb.*, are an inch long, oblong or oval, rounded below, terminated by a short nipple, and near the apex provided with 9 wings. Similar in appearance, but terminating above in a long beak-like calyx, is the *Nepal cardamom*, the origin of which is not known. The *large* or *winged Java cardamom* is the nearly globular capsule of *Am. maximum*, *Roxb.*, about 1 inch long, obtusely triangular, each side provided with 3 or 4 firm short membranaceous wings, which are best observed after soaking the fruit in water. The *round Chinese cardamoms*, which are rounded on the side, are probably produced by Am. globosum, *Lour.*

Constituents.—Trommsdorff (1834) obtained 4.8 per cent. volatile oil, 10.4 fixed oil, and smaller quantities of starch, malate (?) of potassium, gummy extractive and coloring matter. The volatile oil has a spec. grav. of .93 to .94, the odor and taste of the seeds, is colorless or yellowish, dextrogyre, and contains oxygen. Flückiger (1872) found nearly 11 per cent. of moisture and 15 per cent. of ash in the air-dry fruit, and in the ash 0.79 per cent. of manganese, which he also observed to be present in the leaves and fruits of other zingiberaceæ.

Off. Prep.—Extractum colocynthidis comp., Pulv. aromaticus (cinnam. comp.), *U. S.*, *Br.;* Pulv. cretæ comp., *Br.;* Tinct. cardamomi, *U. S.;* Tinct. cardam. comp., Tinct. gentianæ comp., Tinct. rhei, Vinum aloes, *U. S.*, *Br.* The British Pharmacopœia directs the seeds to be freed from the pericarps; the U. S. Pharmacopœia gives the same direction only for the first two preparations, which contain cardamom in the form of powder.

Medical Action and Uses.—Cardamom is a warm and agreeable carminative and stomachic. It may be added to tonic and stimulant preparations. An infusion, made with one drachm of the bruised seeds in half a pint of boiling water, may be given in doses of a wineglassful. The officinal tinctures are more commonly employed.

CARDUUS BENEDICTUS.—Blessed Thistle.

Herba cardui benedicti, P. G.—*Chardon bénit*, Fr.; *Benedictendistel*, G.

The leaves and flowering tops of Cnicus benedictus, *Gaertn.*, s. Centaurea benedicta, *Lin.*

Nat. Ord.—Compositæ, Cynareæ.

Description.—The blessed thistle is an annual woolly plant, which is indigenous to Western Asia and Southeastern Europe, and has been naturalized in other parts of Europe, and sparingly so in the United States. It is about 18 inches high, has a reddish angular branching stem, and alternate, oblong or ovate lanceolate, sinuately pinnatifid, and dentate leaves, each tooth bearing a soft spine. The flower-heads are terminal, with large bracts, imbricate scales, prolonged into a yellowish spine, numerous tubular yellow florets and terete akens, which are crowned with 10 short teeth and with a pappus consisting of 10 long and 10 alternate short bristles, the latter forming an inner row. When dry the leaves have a grayish-green color. The taste is strongly bitter.

Constituents.—Analyzed by Morin, the widely diffused constituents of herbs were found associated with a brown-yellow amorphous bitter principle. The latter was obtained pure by Nativelle (1839), and ascertained by Scribe (1842) to be present in allied plants. This *cnicin* is prepared like salicin, crystallizes in colorless needles, is very bitter, freely soluble in alcohol and wood-spirit, slightly so in cold water and ether, and dissolves in strong hydrochloric acid, with a green, and in sulphuric acid with a red, color.

Pharmaceutical Uses.—The *extractum cardui benedicti* of European pharmacopœias is made by exhausting the herb with hot water.

Allied Plants. CENTAUREA CALCITRAPA, *Lin.; Star thistle, E.;* Chardon étoilé, *Fr.;* Sterndistel, *G.*—A European annual, which is sparingly naturalized in some places of the United States near the coast. The pinnately lobed leaves have the teeth prolonged into a thin spine, the involucre is spinous in the middle, the flowers are tubular and purple, and the akenes without pappus; the herb has a bitter taste.

CENTAUREA CYANUS, *Lin.;* Blue bottle, *E.;* Bluet, *Fr.;* Kornblume, *G.*—A European annual, somewhat naturalized in North America, also cultivated. It has a globular involucre, with appressed fringed scales and bright blue-colored tubular florets, the marginal ones being largest. The nearly tasteless florets are employed in fumigating powders.

Medical Action and Uses.—The blessed thistle was anciently, and even until quite recent times, held in high esteem as a remedy for all manner of diseases, including fevers and pulmonary, urinary, hepatic, and digestive disorders. It appears to have acted mainly as a bitter tonic, but in large doses it produced nausea, vomiting, and diarrhœa. Its active principle, cnicin, in the dose of five or six grains, causes a burning sensation and constriction in the pharynx and œsophagus, warmth in the stomach, and sometimes nausea, vomiting, colic, and diarrhœa. It has really no virtues differing from those of numerous other bitter tonics, and resembles dandelion and colombo in its operation. It may be used in atonic *dyspepsia*, preferably, perhaps, in cases attended with hepatic congestion. The infusion is prepared with from half an ounce to an ounce of the herb to eight fluidounces of water. The decoction is apt to nauseate. An extract has been employed.

CAROTA, *U. S.*—CARROT FRUIT.

Fructus dauci s. carotæ.—*Wild carrot fruit,* E.; *Fruits de la carotte sauvage,* Fr.; *Möhrenfrucht,* G.

The fruit of Daucus carota, *Lin.* Woodville, t. 50; Bentley and Trimen, Med. Plants, 135.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—A biennial plant, indigenous to Northern Asia and the greater part of Europe, and naturalized in this country, growing in dry fields and along roadsides, and cultivated to a considerable extent for its fleshy root. The furrowed stem is bristly, 1 to 3 feet high, branching; the leaves are bi- or tri-pinnatifid, the segments with lanceolate or linear incisions; the involucre consists of 9 to 12 long pinnatifid leaves; the umbels are on long naked peduncles, at first level, finally concave; the flowers white or whitish, the central one often abortive and dark purple; fruit very hispid.

Description.—*The fruit,* which for medicinal purposes is collected from the wild plant, is about one-eighth inch long, oval, dorsally compressed, and gray-brownish; each mericarp has five hispid filiform primary ribs, two of which are lateral, the remaining three upon the back; between these are four secondary ribs, two lateral and two upon the back, each one beset with long spiny bristles, and covering one oil tube, two additional oil tubes being upon the nearly flat face. The fruit has a slight aromatic odor, and a pungent aromatic taste.

The root of the wild plant is thin, spindle-shaped, woody, white, of an aromatic odor, and a pungent bitter taste; but cultivated it becomes conical, thick, fleshy, red or yellow, and acquires an agreeable odor and a pleasantly sweet taste.

Constituents.—The fruit contains a small quantity of oxygenated volatile oil; 324 grains of it were obtained from 100 lbs. of the fruit. The root has been analyzed by Vauquelin, Wackenroder, and C. Schmidt, who found little volatile oil (0.011 per cent.), uncrystallizable sugar, mannit, starch, pectin, albumen, fixed oil, malic acid, and a coloring principle named *carotin*, which exists in the root in red crystals, is tasteless, insoluble in water, slightly soluble in alcohol, ether, and chloroform, freely soluble in carbon bisulphide, benzol, the fixed and volatile oils; its formula is $C_{18}H_{24}O$. Husemann (1860) found it to be accompanied in the root by *hydrocarotin*, $C_{18}H_{30}O$, which is colorless, tasteless, and obtained from boiling alcohol in silky crystals.

Action and Uses.—Carrot fruit is diuretic and stimulant, and has long been used for exciting the *menstrual* flow, for the cure of *dropsy*, and for the relief of *strangury*. It generally excites diuresis. Its medicinal properties appear to depend upon its volatile oil. The root, reduced to a pulp by scraping or grating, forms an admirable poultice for indolent, gangrenous, and cancerous *ulcers*. The juice, used as a wash, is said to relieve *itching* in several diseases of the skin. The powdered fruit may be given in the *dose* of from thirty to sixty grains. An ounce of the bruised fruit to a pint of hot water forms an infusion which may be taken within twenty-four hours.

CARTHAMUS, *U. S.*—SAFFLOWER.

Flores carthami.—African or dyer's saffron, False (American) saffron, E.; *Carthame*, Fr.; *Safflor*, G.

The florets of Carthamus tinctorius, *Lin.* *Nat. Ord.*—Compositæ, Cynareæ.

Origin.—An annual plant which is indigenous to India, and extensively cultivated there, in Eastern and Western Asia, Northern Africa, and Southern and Central Europe. It is two to three feet high, with sessile or clasping spinulous leaves, and rather large ovate flower heads terminating the branches. The florets are collected after the shedding of the pollen, and are freed from the ovaries.

Description.—The florets of safflower are less than an inch long, tubular, with the limb divided into five nearly linear lobes; the tube of the anthers protrudes from the throat, and is surmounted by the long filiform yellow style. The florets are at first yellow, but become red, and after drying of a brown-red color. They have a faint, peculiar, rather disagreeable odor, and an insipid bitterish taste.

Constituents.—The analyses of Dufour and Salvétat proved the presence of the usual constituents of plants, and in addition, a yellow and a red coloring principle, the former being exhausted by water, after which the latter is obtained in solution by treatment with solution of sodium carbonate, and precipitated by acids.* Schlieper (1846) gives to this *carthamin* or *carthamic acid*, the formula $C_{14}H_{16}O_7$. The value of safflower as a dye-stuff depends upon the carthamin, which dissolves in alcohol with a handsome purple color, the solution becoming yellow by heat. The alkaline solutions of carthamin decompose and decolorize rapidly.

Medical Action and Uses.—Safflower passes for being diaphoretic, if administered in a warm infusion made with two drachms of the flowers and a pint of boiling water. It may be used to dissipate commencing *catarrh* and muscular *rheumatism*, and to favor the efflorescence of *eruptive fevers*. In large doses it is said to be laxative.

CARUM, *U. S.*—CARAWAY.

Carui fructus, Br.; *Fructus carvi*, P. G.—*Caraway fruit (seed)*, E.; *Carvi*, *Cumin des prés*, Fr.: *Kümmel*, G.

The fruit of Carum carui (carvi), *Lin.* Woodville, Med. Bot., plate 45; Bentley and Trimen, Med. Plants, 121.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—A biennial plant, which is indigenous to the Western Himalaya and the Caucasus, and is found throughout Siberia and the greater portion of Europe, but is scarce in the southern part of that continent. It is extensively cultivated in Norway, Russia, Germany, Holland, England, Morocco, and also in the United States. The hollow cylindrical stem is one to three feet high, branched; the leaves bi- and tri-pinnate, with the ultimate divisions linear; involucre filiform; involucel none; umbels numerous; flowers small, white. The fruit splits when mature into the two mericarps, and finds its way into commerce from the countries named above. During the fiscal year 1866–67, 216,000 pounds of caraway were imported into the United States; in 1876–77 the amount was 732,714 pounds, including coriander.

Description.—The half fruits are from one-eighth to one-sixth of an inch long, somewhat curved, slightly narrowed at both ends, with a rounded stylopod above, five pale-colored filiform ridges, and between them on the back four grooves of a dark-brown color, which contain four large oil tubes, two additional vittæ being on the flat face. Mogador caraway corresponds with this description, except that it is larger, attaining a length of fully one-fourth of an inch. Caraway has an agreeable aromatic odor and a sweetish and spicy taste.

Constituents.—Besides volatile oil (see *Oleum carui*) Trommsdorff found in caraway a green fixed oil, a little wax, resin, sugar, mucilage, and some tannin. The medicinal properties are due to the volatile oil.

Off. Prep.—Aqua carui, Confectio opii, Conf. piperis, Pulv. opii comp., *Br.;* Tinct. cardamomi comp., *U. S.*, *Br.;* Tinct. sennæ, *Br.*

Medical Action and Uses.—Anciently caraway was held to be diuretic and carminative. It is used at present chiefly to expel wind and allay pain in the flatulent *colic* of infants. An infusion is prepared with one or two drachms of the bruised seeds and half a pint of boiling water, of which the dose is a teaspoonful for infants and a tablespoonful for adults.

CARYOPHYLLUS, *U. S.*—CLOVES.

Caryophyllum, Br.; *Caryophylli*, P. G.; *Caryophylli aromatici.*—*Girofle*, *Gérofle*, *Clous aromatiques*, Fr.; *Gewürznelken*, *Nägelein*, G.

The unexpanded flowers of Caryophyllus aromaticus, *Lin.*, s. Eugenia caryophyllata, *Thunb.*, s. Eug. aromatica, *Willd.*, s. Myrtus caryophyllus, *Spreng.* Bot. Mag., vol. liv., plates 2749, 2750; Woodville, Med. Bot. 193; Bentley and Trimen, Med. Plants, 112.

Nat. Ord.—Myrtaceæ.

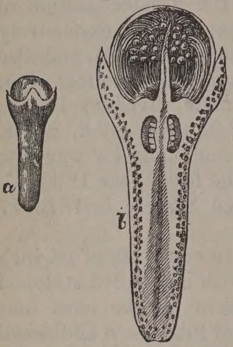
Origin.—This handsome evergreen tree is supposed to have been indigenous only to the five small islands near the island of Jilolo, to which the name of Molucca or Clove Islands was formerly exclusively applied. The tree has been entirely destroyed there, but is now cultivated in many of the islands of the

Indian Ocean, in tropical Africa, Brazil, and the West Indies. It attains a height of about 30 feet, and is considerably branched, the branches forming an elegant pyramidal crown, and being terminated by cymes composed of 15 to 25 flowers, producing berry-like fruits.

Collection.—As soon as the buds change in color from green to red, they are either picked by hand or detached from the trees by beating the branches with long bamboos, the buds being gathered upon cloths spread beneath the trees; they are afterwards dried by exposure to the sun, whereby the color changes to brown. Between 800,000 and 900,000 pounds of cloves are annually consumed in the United States.

Description.—Cloves consist of a nearly cylindrical calyx, somewhat tapering below and above divided into four ovate lobes; these lobes clasp the four arched and imbricate petals, which form a globular head and cover the numerous bent stamens. The ovary is contained in the upper part of the adherent calyx, is divided into two cells, each containing about 20 ovules, and is crowned by a quadrangular disk, in the centre of which the simple style is placed. Cloves are about $\frac{1}{2}$ inch long, and, as obtained from different localities, vary somewhat in the shade of their brown color; the large, plump, and deep-brown cloves, as obtained from the Moluccas, Zanzibar, etc., are preferred, the smaller, shrivelled, and light-colored varieties, such as are often exported from Cayenne and the West Indies, being considered inferior. Cloves have a somewhat fatty appearance, a strong and highly aromatic odor, and a very pungent, warm, and aromatic taste. A large number of oil-cells are observed in the petals, and in the outer tissue of the calyx; the latter are placed in two or three irregular circles beneath the epidermis, and yield some of their oil upon pressure with the finger nail. Cloves partly deprived of their volatile oil are said to be occasionally used for adulteration; they are quite moist and usually without heads.

Fig. 26.

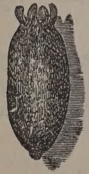


Clove.—*a*. Natural size. *b*. Longitudinal section magnified.

Other Parts.—Clove Stalks, Griffe de girofle (*Fr.*); Nelkenstiele, Nelkenholz (*G.*), *Festucæ caryophyllorum* s. *Fusti*, are sometimes met with, and consist of the branching flower stalks, about $\frac{1}{8}$ inch in thickness, which are of a light-brown color, and have a distinct though not strong odor and taste of cloves; they contain 4 to 5 per cent. of volatile oil, and are sometimes employed for adulterating powdered cloves, and sometimes for distilling the volatile oil. 88,000 pounds of clove stalks were imported into this country during the year 1875–1876; in the following year, only 15,128 pounds.

Mother Cloves, Mères de girofle, Clous matrices (*Fr.*), Mutternelken (*G.*), *anthophylli*, are the clove fruits, generally collected before they are quite ripe; they are about an inch long, oval, crowned with the four-lobed calyx, have one or two seeds in each cell, and resemble cloves somewhat in appearance and properties, but are lighter and weaker.

Fig. 27.



Mother clove.

Constituents.—Tromsdorff found in air-dried cloves 18 per cent. of volatile oil, 13 of tannin (which has not been further investigated), 13 of gum, 18 of water, 6 of tasteless resin, and 4 of extractive. Bonastre (1833) obtained from the watery distillate *eugenin* in white pearly scales of a slight clove odor, having the composition $C_{10}H_{12}O_2$. Ostermeyer isolated a green wax, and Lodibert (1825), inodorous and tasteless silky needles, *caryophyllin*, of the composition $C_{10}H_{16}O$, which crystallize from the concentrated tincture of cloves; they are colored blood-red by cold sulphuric acid, and, according to Mylius (1873), yield, with fuming nitric acid, crystals of *caryophillinic acid*, $C_{20}H_{32}O_6$. For the composition of oil of cloves see *Oleum caryophylli.*

Off. Prep.—Infus. aurantii comp., *Br.;* Infus. caryophylli, *U. S.*, *Br.;* Mist. ferri arom., Pulv. cretæ arom., *Br.;* Spiritus lavandulæ comp., Syrupus rhei arom., *U. S.;* Vinum opii, *U. S.*, *Br.*

Medical Action and Uses.—Cloves are general stimulants. They were formerly described as emmenagogue and aphrodisiac, as suitable for expelling wind, allaying vomiting, and promoting digestion. They continue to be used for most of these purposes, but less as a medicine than as a condiment to promote the digestion of fatty and crude food. Clove tea, made by infusing two or three drachms of bruised cloves in half a pint of boiling water, may be given in tablespoonful doses for the relief of *colic*. Powdered or bruised cloves wet with alcohol may be applied between cloths upon the epigastrium to allay *nausea* or *vomiting*, and expel *flatus*, and upon the abdomen to relieve *colic;* but for these purposes the aromatic powder is preferable.

CASCARILLA, *U. S.*—CASCARILLA BARK.

Cascarillæ cortex, Br.; *Cortex cascarillæ*, P.G.; *Cortex eluteriæ*, *Cortex thuris.*—*Cascarille*, *Ghacrille*, *Écorce éleuthérienne*, Fr.; *Cascarilla*, *Kaskarillrinde*, G.

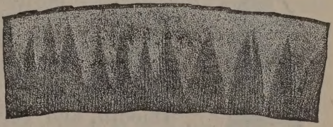
The bark of Croton eluteria, *Bennett* (s. Clutia eluteria, *Lin.*). Journ. Proc. Lin. Soc.; *Pharm. Journ.*, 2d ser. vol. iv. p. 150; Woodville, Med. Bot. 223; Bentley and Trimen, Med. Plants, 238.

Nat. Ord.—Euphorbiaceæ.

Origin.—This plant is a low or even a tree-like shrub, producing small white highly odorous flowers, in terminal and axillary spikes. It is indigenous to the Bahama Islands, where also Croton cascarilla, *Benn.* (s. Clutia cascarilla, *Lin.*) and some other species of the same genus are met with, the barks of which may possibly sometimes be collected and sold as cascarilla. It is shipped in bags from Nassau, Bahamas.

Description.—It is in quills or channelled pieces, 1 to 3 inches in length, about $\frac{1}{2}$ inch in diameter, and about a line in thickness, mostly, however, in small fragments. It is covered with a thin, grayish, easily detached, corky layer, upon which are smaller or larger white patches of a minute lichen (Verrucaria albissima, *Ach.*), the perithecia of which appear as black dots; the external layer, particularly of the older barks, is longitudinally and transversely fissured, presenting rectangular spaces with elevated edges, or is partly wanting. The inner bark is somewhat thicker, has a brownish color, and a smooth, brown-gray, inner surface. The bark breaks with a short, somewhat resinous or horny fracture, exhibiting in the outer layer some scattered oil or resin cells, and presenting a radially striate bast layer in which but very few true bast fibres are observed. It is rather fragrant when examined in bulk, but emits a strongly aromatic odor when burned; its taste is warm, aromatic, and very bitter.

Fig. 28.



Cascarilla Bark.—Transverse section magnified.

Constituents.—Trommsdorff obtained from cascarilla 1.6 per cent. of volatile oil, 15.1 per cent. of resin, besides gum, potassium chloride, etc. The volatile oil consists of a carbohydrogen $C_{10}H_{16}$ (Gladstone, 1872), and of an oxygenated portion. The resin is partly soluble in alkalies. Duval (1845), who isolated the bitter principle, *cascarillin*, in a crystalline state, announced also the presence of some tannin, pectin, wax, fat, starch, and albumen. Cascarillin is obtained by concentrating the filtrate from the precipitate, which is produced in an infusion by sugar of lead; it forms colorless needles or scales, is inodorous, bitter, fusible, not precipitated by lead salts, or tannin, more soluble in alcohol and ether than in cold water; sulphuric acid imparts to it a purple color. C. and E. Mylius observed it (1873) in an extract separated in granules, and give its composition as $C_{12}H_{36}O_4$.

Off. Prep.—Infusum cascarillæ, *U. S.*, *Br.;* Tinctura cascarillæ, *Br.*

Medical Action and Uses.—Cascarilla is stimulant rather than tonic, and its fumes when inhaled are intoxicating. The infusion occasions a sense of warmth in the stomach, but in excessive doses nauseates and purges. Cascarilla was originally used to enhance the febrifuge powers of cinchona, and, independently, in the *typhoid state* of various diseases, especially epidemic *dysentery.* It is now chiefly employed in the treatment of *dyspeptic* conditions due to gastric or intestinal atony, and attended with flatulence or vomiting. The dose in powder is about thirty grains. The infusion is preferable.

CASSIA FISTULA, *U. S.*—PURGING CASSIA.

Fructus cassiæ fistulæ.—*Casse officinale, Casse en batons,* Fr.; *Purgiercassie, Fistelkassie, Röhrencassie,* G.

The fruit of Cassia fistula, *Lin.*, s. Cathartocarpus fistula, *Pers.;* Bactyrilobium fistula, *Willd.* Woodv. t. 160; Bentley and Trimen, Med. Plants, 87.

Nat. Ord.—Leguminosæ, Cæsalpineæ.

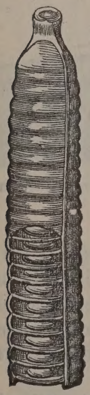
CASSIÆ PULPA, *Br.*—CASSIA PULP.

Pulpe de casse, Casse mondée, Fr.

The pulp obtained from the fruit of Cassia fistula, *Lin.*

Origin.—A tree, 30 to 50 feet high, with large pinnate leaves appearing simultaneously with the long pendulous racemes of fragrant golden-yellow dark-veined flowers. Indigenous to the East Indies, it is now met with, spontaneous and under cultivation, in Egypt and other parts of Africa, the West Indies, and Brazil.

Fig. 29.



Cassia fistula, part of pod.

Description.—The fruit is an indehiscent, nearly cylindrical, woody legume, one to two feet long and about an inch thick, blackish-brown, with fine transverse veins and two bands, running from the short thick stalk to the blunt apex. These bands are about one-quarter inch broad, somewhat paler in color, smooth, and correspond to the dorsal and ventral sutures, the former being marked by a fine ridge, the latter by a shallow groove in the centre of the bands. The seeds are numerous, about one-third of an inch long, flattish, ovate or oval, orange-brown, glossy, with a long filiform funiculus, a firm albumen and fleshy veined cotyledons; each seed is imbedded in a blackish-brown sweet pulp, and separately inclosed in a cell, the thin woody dissepiments being formed by the transverse distension of the placenta after fructification. The odor suggests that of prunes.

Other Varieties.—A lighter-colored purging cassia is occasionally met with, which is from 12 to 18 or 20 inches long, about one-half inch in diameter, slightly pointed, and has a reddish-brown sweet and somewhat astringent pulp, but otherwise resembles the officinal drug. It is usually referred to Cassia bacillaris, *Lin. fil.* (Cathartocarpus bacillus, *Pers.*), a tree indigenous to Surinam: but Hanbury's investigations (1863) render it certain that it is partly if not wholly obtained from Cassia moschata, *H. B. K.* (Cathartocarpus moschatus, *Don*), a tree found in Panama and the northern part of South America.

Cassia brasiliana, *Lam.* (C. mollis, *Vahl.*, C. grandis, *Lin. fil.*, Cathartocarpus, *Pers.*), yields a large purging cassia, sometimes known as *horse cassia*, which is 2 feet and more long, often curved, laterally compressed, 1½ inch broad, rather coarsely veined, and has the dorsal suture indicated by one ridge, and the ventral suture by two prominent obtuse ridges.

Constituents.—Purging cassia treated with water should yield about 30 per cent. of pulp, which, according to the analyses by Vauquelin and Henry, consists principally of sugar—about 60 per cent.—with some mucilage, pectin, salts, etc. In view of this composition, it is difficult to understand why the drug should be unfit for medicinal use when the pulp has become dry and the seeds remain loose in their cells; it would seem, however, to be not indispensable.

Off. Prep.—Confectio sennæ, *U. S.*, *Br.*

Medical Action and Uses.—Anciently used as a laxative to which especial cooling virtues were attributed, and as a cleansing gargle for ulcerated sore-throat, purging cassia is still esteemed as a mild and certain *laxative*, tending to promote the secretion of bile. It gives a brownish or greenish tinge to the urine. It is seldom used alone, owing partly to its tendency to occasion colic and flatulence. With manna it forms an active but mild laxative; and in hot climates and seasons it is usefully associated with tamarinds or with mild salines, especially in the treatment of *bowel complaints*. As a laxative the dose is from one to two drachms, as a purgative, one or two ounces.

CASSIA MARILANDICA, *U. S.*—AMERICAN SENNA.

Folia sennæ Americanæ.—*Séné Américain*, Fr.; *Amerikanische Senna*, G.

The leaflets of Cassia marilandica, *Lin.*

Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—A perennial plant, which is found in low grounds and along streams from the New England States and New York, south to the Carolinas and west to the Mississippi. It produces erect branching stems 3 to 5 feet high, has pinnate leaves upon petioles 1 to 2 inches long and with a nearly sessile gland near the base on the upper side, 6 to 9 pairs of leaflets, numerous pedunculate erect racemes near the top of the branches, showy yellow or whitish flowers with dark veins and, at first woolly, finally smooth legumes which are linear, compressed, usually curved and somewhat sinuate on the raised edges; the ovate oblong seeds are separated by transverse dissepiments. It flowers in August and ripens its fruit in October. It belongs to the subgenus *Chamæsenna*, which differs from the allied *Senna* mainly in the narrow legumes, which are dehiscent.

Description.—The leaflets are one and occasionally two inches long, about one-half inch wide, on short foot-stalks, smooth, ovate oblong to elliptic, obtuse, uneven at the base, green above and paler beneath. Collected in summer the leaflets have an herbaceous odor, but if collected in September or the beginning of October, after the plant is out of bloom, they acquire, on drying, a distinct senna odor. They are thinner in texture and larger than Alexandria senna. Yellow and discolored leaflets should be rejected.

Constituents.—The analyses of J. J. Martin (1835), and E. L. Perot (1855), did not throw any light upon its active principle, assuming that it contains such. The usual constituents of leaves, a minute quantity of volatile oil, some fat, resin, mucilage, etc., were found, in addition to a complex body resembling the formerly so-called cathartin of senna.

Medical Action and Uses.—American senna is identical with Alexandria senna in the mode of its operation, but a dose one-third larger of it is required. At best, it is but a poor substitute for the African drug.

CASTANEA, *U. S.*—CHESTNUT LEAVES.

Folia castaneæ.—Feuilles de châtaignier, Feuilles de marronier, Fr.; *Kastanienblätter,* G.

The leaves of Castanea vesca, *Linn.* (C. edulis, *Gaertn.*).

Nat. Ord.—Cupuliferæ.

Origin.—A stately tree, 80 to 100 feet high, indigenous to Western Asia, Southern Europe, and to the United States from Maine to Michigan southward. The whitish staminate flowers, which appear in May and June, form slender, pendulous aments 6 to 8 inches long; the pistillate flowers form clusters of 3 or 4 in an ovoid involucre, which finally becomes globose and covered with sharp prickles, and incloses two or three one-seeded nuts.

Description.—The leaves are from 6 to 10 inches long, about 2 inches wide, upon petioles less than an inch in length, oblong lanceolate, acuminate, mucronate, sinuate-serrate, smooth throughout, shining above, neatly feather-veined beneath. The leaves of the American chestnut (Cast. Americana, *Mich.*) differ from those of the Oriental only in being rather acute at the base. They are nearly inodorous, and have a somewhat astringent taste. They should be collected in the fall, in September or October, while still green.

Constituents.—Chestnut leaves have not been analyzed, but the usual constituents of leaves will doubtless be met with, besides tannin, to which they owe their taste. A *fluid extract* (1871) is made by repeatedly digesting for twelve hours, until exhausted, 16 troyounces of the bruised leaves with sufficient water to cover them, and expressing; to the mixed and strained solutions are added 4 fluidounces of glycerin and 6 troyounces of sugar. The mixture is now evaporated to 16 fluidounces.

Medical Action and Uses.—We are not acquainted with any experiments which denote the physiological operation of castanea; but, judging from its apparent action in *whooping cough,* its sedative influence upon the respiratory nerves may be inferred. In the disease just mentioned it appears to control the paroxysms in a remarkable manner, in some cases suspending them entirely after the lapse of a few days. It may be given without limit in the form of an infusion made with an ounce of the dried leaves in a pint of boiling water; or more accurately in the dose of from half a fluidrachm to one fluidrachm of the fluid extract every three or four hours. Its taste is not unpleasant, and its administration requires no special circumspection.

CASTOREUM, *U. S., Br.*—CASTOR.

Castoreum Canadense, P. G.; *Castoreum anglicum s. Americanum.—American castor,* E.; *Castoréum de Canada,* Fr.; *Canadisches Bibergeil,* G.

The dried preputial follicles and their secretion, obtained from the beaver, Castor fiber, *Linn.* (Castor americanus, *Cuvier*), and separated from the somewhat shorter and smaller oil-sacs which are frequently attached to them.

CASTOREUM SIBIRICUM, *P. G.*—SIBERIAN CASTOR.

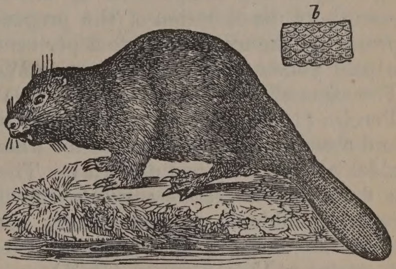
Castoreum Moscoviticum, Rossicum, Polonicum, Germanicum, Europæum.—Castoréum de Sibérie (*de Russie, de Norwége*), Fr.; *Sibirisches* (*Europäisches*) *Bibergeil*, G.

The preputial follicles, with their secretion, of Castor fiber, *Linn.*, inhabiting Europe and Siberia.

Class Mammalia. *Order* Rodentia.

Origin.—This animal inhabits the continents of the northern hemisphere between 33° and 68° N. Lat., but is disappearing in the southern parts of these regions. It is from 2 to 2½ feet long, with a horizontally flattened tail, which is 3 to 4 inches wide, hairy at the base, and scaly above. The head resembles that of the rat, with no canine teeth, but with 2 incisors, and on each side 4 molars, in the upper and lower jaw. The fur consists of two kinds of hair: one rather bristly, the other denser and downy; its color is brown; but black, white, and spotted beavers are also met with. The feet have 5 toes, the anterior being short and close, the posterior longer and palmated. Anus, genitals, and follicles communicate in both sexes with one canal or cavity located near the tail. In the male a pair of oil-sacs, containing the formerly officinal *axungia castoris*, terminates in the cloaca; the castor sacs located near the former open by a common aperture in the preputial canal. The female has the castor sacs below the os pubis on each side of the vagina.

Fig. 30.



Castor fiber, *Lin.*—*b.* Scale of the tail.

The beaver feeds on roots and barks, and builds houses about 10 feet wide and 6 feet high, the entrance being under the water, the depth of which they increase by the building of dams composed of billets of wood and earth; in more densely populated districts where they are disturbed, the beavers burrow on the banks of rivers and creeks.

Description.—When fresh, castor sacs are flesh-colored, soft, more or less pyriform; after drying they are brown. They consist of four distinct coats; the outer one is cellular, resembles hog's bladder in texture, and incloses a fibrous layer, which is followed by a vascular, and this by an iridescent glandular, coat, with many folds and numerous semilunar scales upon the inner surface, the whole being covered by a thin epithelium. The contents of the recent follicles are a thin, yellowish, odorous liquid, which, after drying, leaves a brownish mass. Castor is commercially distinguished by the countries from which it is obtained, the most highly valued being

RUSSIAN OR SIBERIAN CASTOR.—The sacs are oval or globular pyriform, united at the narrowed end in pairs, the contents of a dull rather light brown color and a strong peculiar odor. The sacs vary in weight from about 3 to 8 or occasionally even 14 oz., and, if not too dry, the two outer coats may be readily separated. This kind is mostly collected in Siberia and Eastern Russia, the sacs from Western Russia and Germany being usually smaller and rarer. It is rarely, if ever, met with in our commerce.

CANADIAN OR AMERICAN CASTOR.—The sacs are more elongated, flatter, and usually more wrinkled and folded than those of the preceding; they vary from club-shaped to narrow pyriform, are united in pairs, mostly between 1 and 4 oz., rarely 8 oz., each in weight; the outer coats adhere pretty firmly; the contents are often slightly glossy; the odor is aromatic, but weaker than the preceding; the taste about the same, bitter and rather nauseous.

Russian and American castor are distinguished from each other by the characters indicated; the former yields about 60 per cent. of its weight to alcohol, the latter between 45 and 50 per cent. The tincture of the former yields with much water a milky mixture, which becomes nearly clear on the addition of ammonia. The mixture obtained from the tincture of American castor is brownish, the precipitate being only partly soluble in ammonia.

Adulterations.—Castor is said to be occasionally adulterated with artificial mixtures of blood, earthy and resinous matters, inclosed in some animal tissue; such substitution is easily detected by the absence of nearly all the characters described above.

Constituents.—The numerous older investigations have not thrown much light upon the composition of castor, which, according to E. H. Weber, is essentially the secretion of the prepuce and clitoris. The *volatile oil* of castor present to the extent of 1 to 2 per cent. has the odor of that substance, and is of a pale yellow color; according to Woehler (1844), it contains *carbolic acid.* The same chemist noticed also (1848) the presence of *salicin* and *benzoic acid.* Pereira (1851) believes the volatile oil to be mainly derived from the salicin, and observed that distilled castor water gradually acquired the odor of salicylaldehyd (oil of Spiræa ulmaria). The bitter and acrid taste of castor is due to a dark brown *resinous substance* which is insoluble in water and ether, but readily soluble in alcohol; it has not been further investigated. A peculiar crystalline body, *castorin*, was obtained by Bizio on cooling the strong alcoholic decoction. Valenciennes (1861) prepared it by boiling castor with milk of lime, and treating the dried precipitate with hot alcohol; it forms colorless, readily fusible needles having a slight odor of castor and little taste; it volatilizes slowly with boiling water, is soluble in concentrated potassa, ether, and hot olive oil and oil of turpentine. Lehman believes that the carbolic acid if present is obtained only from the smoke of the fire by which castor is dried; he found also *derivatives of bile*, *cholesterin*, and a *protein compound*, the last two of which had already been obtained by Brandes. The inorganic constituents are carbonates, with some phosphates and sulphates of calcium, magnesium, potassium, and ammonium. Pereira obtained from Canadian castor 3.6 per cent. of ashes.

Off. Prep.—Tinctura castorei, *U. S.*, *Br.*

Medical Action and Uses.—It seems doubtful whether castor, any more than musk, has a definite action upon the healthy nervous system, but there is just as little doubt that, like the other animal product just named, it is a stimulant to the nervous system disordered through exhaustion, direct or indirect. *Hysterical spasms*, those associated with *uterine colic*, *scanty menstruation*, and *tympanites*, and the muscular twitchings, tremblings, etc., which occur in the *typhoid state*, are palliated by this medicine. But for all purposes it is less efficient than musk, and scarcely superior to valerian, camphor, ether, and some forms of alcohol. The dose of castor varies from ten grains to ten times that amount, according to the strength of the preparation employed. The variable quality of the drug restricts its use.

CATALPA.—BEANTREE.

Catalpa, E., F., G.

Catalpa bignonioides, *Walt.*, s. Bignonia catalpa, *Lin.*
Nat. Ord.—Bignoniaceæ.

Description.—The tree is indigenous to the southern portion of the United States, and cultivated further north. It attains a height of thirty to fifty feet, has spreading branches, large heart-shaped leaves, and compound racemes of showy flowers, which have the calyx two-lipped, the corolla bell-shaped, white, and in the throat dotted with purple and yellow. The fruit is capsular, nearly cylindrical, about twelve inches long, longitudinally striate and two-celled, and contains numerous very thin, long, and flat seeds which are inclosed in a delicate silky envelope, prolonged at both ends into finely fringed wings. The bark, fruit, and seeds have been employed. The bark is externally gray-brown, smooth, somewhat glossy, with numerous small circular warts; in the middle layer green, and in the thick, tangentially arranged bast layer white, becoming yellowish on drying; the inner surface is smooth. The bark of the trunk is about a quarter of an inch thick, one half consisting of the scaly cork, the other half of the bast layer. It has a strongly bitter taste.

Constituents.—The bark was analyzed by E. A. Rau (1870), who ascertained the presence of tannin in it. On dissolving the ethereal extract of the alcoholic extract in diluted alcohol, and boiling with oxide of lead, the liquid retained an amorphous bitter principle in solution, and hot alcohol dissolved from the lead precipitate a principle having an intensely nauseous, bitter taste, and crystallizing in micaceous scales, which were very soluble in ether, chloroform, and hot alcohol. Sugar and tasteless resin were also found.

Allied Plants.—BIGNONIA CAPREOLATA, *Lin.*, a native of the Southern United States, is a tall, climbing shrub, with orange-colored, bell-shaped, and somewhat two-lipped flowers, which are about two inches long. The root and stem have been used in place of sarsaparilla. A transverse section of the stem shows the pith in the shape of a cross. This plant, like the closely allied Tecoma radicans, *Juss.*, which bears large scarlet flowers, is known as *trumpet flowers.*

Several East Indian species of Bignonia are medicinally employed in their native country.

Medical Action and Uses.—This tree is more ornamental than it is useful in medicine. The bark, indeed, is said to be vermifuge, and the wood emetic, and the leaves emollient and anodyne; yet the emanations of the tree are reported to be poisonous. A decoction of the pods, and the dried seeds also, have been used with alleged advantage in chronic *bronchitis* and in nervous *asthma*, especially when associated with senega, of which latter statement there need be no serious doubt. The juice of the root is also stated to be an efficient local remedy for chronic scrofulous *ophthalmia.*

CATAPLASMATA.—CATAPLASMS.

Poultices, E.; *Cataplasmes*, Fr.; *Umschläge, Breiumschläge*, G.

These are topical applications, of a soft, pasty consistence, which are prepared from coarse or fine powders, mixed with water, various solutions, or fixed oils. In this country the ingredients are usually furnished by the pharmacist, but the poultice is prepared for use at the patient's house.

CATAPLASMA CARBONIS, *Br.*—CHARCOAL POULTICE.

Cataplasme au charbon, Fr.; *Kohlenumschlag*, G.

Preparation.—Take of Wood Charcoal in powder half an ounce; Crumb of Bread two ounces; Linseed Meal an ounce and a half; Boiling Water ten fluidounces. Macerate the bread in the water for ten minutes near the fire, then mix, and add the linseed meal gradually, stirring the ingredients, that a soft poultice may be formed. Mix with this half the charcoal, and sprinkle the remainder on the surface of the poultice. *Br.*

Medical Uses.—Charcoal poultice is used as an emollient and disinfecting application to *gangrenous* and *fetid sores.*

CATAPLASMA CONII, *Br.*—HEMLOCK POULTICE.

Cataplasme avec la ciguë, Fr.; *Schierling-Umschlag*, G.

Preparation.—Take of Hemlock Leaf in powder one ounce; Linseed Meal three ounces; Boiling Water ten fluidounces. Mix the hemlock and linseed meal, and add them to the water gradually, with constant stirring. *Br.*

Medical Uses.—Hemlock poultice is employed especially to relieve the pain of *cancerous* and other *sores.* Extract of conium may be substituted for fresh hemlock leaves in its preparation.

CATAPLASMA FERMENTI, *Br.*—YEAST POULTICE.

Cataplasme avec le levûre de bière, Fr.; *Hefenumschlag*, G.

Preparation.—Take of Beer Yeast six fluidounces; Wheaten Flour fourteen ounces; Water heated to 100° six fluidounces. Mix the yeast with the water, and stir in the flour. Place the mass near the fire till it rises. *Br.*

The rising of the mass takes place in consequence of fermentation, which speedily commences, and whereby carbonic acid gas is formed.

Medical Uses.—Yeast poultice, or fermenting poultice, is of great service to unhealthy *ulcers*, whether of a cancerous nature or not, in preventing fetor and hastening the removal of devitalized tissues. Its activity is indicated by the pain it sometimes causes.

CATAPLASMA LINI, *Br.*—LINSEED POULTICE.

Cataplasma emolliens s. communis.—*Flaxseed poultice*, E.; *Cataplasme de farine de lin*, *Cataplasme simple (commun)*, Fr.; *Leinsamen-Umschlag*, G.

Preparation.—Take of Linseed Meal four ounces; Olive Oil half a fluidounce; Boiling Water ten fluidounces. Mix the linseed meal gradually with the water, then add the oil with constant stirring. *Br.*

The linseed meal of the British Pharmacopœia is the *cake meal* of American commerce; that is, the press-cake left after the expression of linseed oil and reduced to powder; hence the addition of olive oil in the above formula. By mixing equal parts of ground flaxseed and cake meal, a mixture is obtained with about the same percentage of fat. Ground flaxseed is often used without admixture of other powders.

Medical Uses.—Linseed or flaxseed poultice is more frequently than any other employed in hospital practice, as an emollient and protective to *inflamed* and *painful parts.* Owing to its tendency to ferment, it is apt to occasion an eruption of vesicles or pustules, and more than any other poultice it renders the skin white, wrinkled, and sodden. To prevent these effects, its surface should be covered with fresh lard, sweet oil, linseed oil, or glycerin, or else one or the other of these articles should be mixed with the poultice.

CATAPLASMA SINAPIS, *Br.*—MUSTARD POULTICE.

Sinapismus, P. G.; *Cataplasma rubefaciens.—Sinapisme, Cataplasme de moutarde, Cataplasme rubéfiant*, Fr.; *Senfteig*, G.

Preparation.—Take of Mustard in powder two and a half ounces; Linseed Meal two and a half ounces; Boiling Water ten fluidounces. Mix the linseed meal gradually with the water, and add the mustard, with constant stirring. *Br.*

Take of Black Mustard Seeds powdered a desired quantity, mix it with an equal quantity of Common Water, and form a poultice of a somewhat soft consistence. It is prepared only when wanted for dispensing. *P. G.*

The British Pharmacopœia evidently intends the powder of *white* mustard seeds to be used, though it does not specially indicate it. The French Codex gives a formula similar to that of the German Pharmacopœia, and very properly cautions us against the use of *hot* water, and also of vinegar, which prevent the formation of oil of mustard or lessen its amount.

Medical Uses.—This poultice is convenient for maintaining a moderately stimulant action upon the skin, and at the same time protecting it. It is very useful in local muscular *rheumatism*, in thoracic and abdominal *inflammations*, in *colic*, and for maintaining a derivative action upon the feet in congestive affections of the *head*. The preparation and uses of the sinapism or mustard *plaster* are described under *Sinapis*.

CATAPLASMA SODÆ CHLORATÆ, *Br.*—CHLORINE POULTICE.

Cataplasme chloriné, Fr.; *Chlornatron-Umschlag*, G.

Preparation.—Take of Solution of Chlorinated Soda two fluidounces; Linseed Meal four ounces; Boiling Water eight fluidounces. Mix the linseed meal gradually with the water, and add the solution of chlorinated soda, with constant stirring. *Br.*

Medical Uses.—Chlorine poultices are useful in the same cases in which yeast poultices are appropriate; that is to say, for correcting the fetor of foul and sloughing *ulcers*, and for stimulating them to become more healthy.

CATARIA, *U. S.*—CATNEP.

Herba nepetæ s. catariæ.—Catmint, E.; *Cataire, Chataire, Herbe aux chats, Menthe de chats*, Fr.; *Katzenmünze, Katzenkraut*, G.

The leaves and tops of Nepeta cataria, *Lin.*, s. Cataria vulgaris, *Moench.* Bentley and Trimen, Med. Plants, 209.

Nat. Ord.—Labiatæ.

A perennial herbaceous plant 2 to 3 feet high, indigenous to many parts of Asia and Europe, and naturalized in the United States, where it grows near dwellings, in waste places, and along roadsides.

Description.—The stem is quadrangular, gray, hairy, and branched; leaves opposite, petiolate, 1 to 3 inches long, triangular ovate, cordate at base, pointed at apex, the margin strongly crenate-serrate, grayish-green, soft, hairy above and velvety beneath. The flowers are in terminal panicles, the lower stalked, the upper sessile, with a gray, hairy, obliquely 5-toothed calyx, and a whitish, purple-spotted carolla, which is hairy on the outside, has the three-lobed lower lip crenately toothed, and four stamens inserted in its tube. The stem and larger branches are rejected, the leaves and flowering tops only being collected in June and July. It has a peculiar, mint-like, rather disagreeable odor, and a bitterish, aromatic, and pungent taste.

Constituents.—The chemical constituents resemble those of other labiatæ. The plant contains a small quantity of oxygenated volatile oil, some tannin, a bitter principle which has not been isolated, and other medicinally unimportant constituents.

Medical Action and Uses.—Catnep is stimulant and slightly tonic, and, like the mints and other plants containing a volatile oil, it has been prescribed in various disorders attended with a feeble action of the nervous sysem and of the functions immediately depending upon it. Its most common use is for the relief of *flatulent colic* in infants, and also to promote *menstruation* when retarded or painful. Its local application excites a sense of warmth with partial anæsthesia, for which reason it is used to relieve *toothache* and other local pains. Cats are fond of it, hence the name Catnep (Cat-Nepeta). It is given in infusion.

CATECHU, *U. S.*—Catechu.

Cutch, Terra Japonica, Catechu nigrum.—Cachou, Fr.; *Katechu, Pegu-Catechu,* G.

An extract prepared principally from the wood of Acacia catechu, *Willd.* (Mimosa catechu, *Lin. fil.*) Woodville, Med. Bot. 157; Bentley and Trimen, Med. Plants, 95.

Nat. Ord.—Leguminosæ, Mimoseæ.

Origin.—A tree, about 30 to 40 feet high, with a pair of hooked brown prickles at the base of the numerous abruptly bipinnate leaves which are 6 inches and more long, and with pale yellow flowers arranged in dense cylindrical spikes about 3 inches long; the legume is brown, veined, flattened and pointed. The tree is indigenous to the East Indies and Ceylon, and is completely naturalized in Jamaica, where it is common in dry localities. It is met with also in the forests of tropical Eastern Africa.

Preparation.—The wood, which is heavy and very durable, consists of the whitish alburnum and of the dark-colored heart wood, which varies in color from red-brown to blackish-brown. This latter portion is cut into chips, which are boiled with water in earthen pots arranged over a rude fireplace, the decoction when sufficiently strong being decanted or strained into other vessels in which the evaporation is continued until the extract is of sufficient consistence to be poured into clay moulds, or into cups formed of leaves, or upon mats covered with the ashes of cowdung.

In Southern India the wood of *Acacia suma*, Kurz, is employed in the same manner, the bark of both species being removed and used for tanning.

The importation of catechu and gambir into the United States increased from 2,645,000 pounds during the fiscal year 1866–67, to 22,880,460 pounds in the year 1876–77.

Description.—Catechu is chiefly exported from Pegu and Calcutta, packed in mats, chests, or boxes. It forms several layers of dark-brown masses, in which remnants of the matting and of leaves are observed, and which are frequently soft near the centre. When dry it is hard and brittle, breaking into irregular, somewhat porous and glossy fragments, having but little odor, and a strongly astringent and sweetish taste. The catechu in balls and in quadrangular cakes, made in moulds as above described, is rarely met with in our commerce. A fourth variety, which is never exported, is made in Kumaon, in Northern India, by stopping the evaporation before the liquid becomes too thick; it bears a closer resemblance to gambir than to the ordinary catechu.

The *Areca catechu*, obtained from the so-called betel-nuts, the seeds of *Areca catechu*, Lin., does not form an article of commerce; it is said to be inferior to true catechu, and is known in India, in part at least, as *catta cambu*. (See page 228.)

Constituents.—The relation to one another of the principal constituents of catechu has been satisfactorily explained by C. Neubauer (1856). When catechu is treated with cold water, mainly *catechu-tannic acid* is found in the brown solution, which yields precipitates of a grayish color with gelatin, and of an olive-brown with ferric salts. The aqueous solution contains also some *catechin* and *quercetin*, the latter having been obtained by Löwe (1873), by treating the solution with ether. Most of the *catechin* or *catechuic acid* is, however, left undissolved by the treatment with cold water, and may be obtained pure by repeated crystallization and decolorizing with animal charcoal, or removing the adhering tannin by adding lead acetate until a dark-colored precipitate is no longer obtained. Catechin forms white silky needles, which are sparingly soluble in cold water, but more readily in cold alcohol and ether; it requires for solution less than 4 parts of boiling water, about 3 parts of boiling alcohol, and 8 parts of boiling ether. It has a sweetish taste, imparts a green color to ferric salts, and yields precipitates with most metallic salts, but not with tartar emetic, nor with gelatin; by long-continued boiling with water it is gradually converted into catechu-tannic acid. Its formula, according to Rochleder (1869), is $C_{13}H_{12}O_5$, representing a compound of *phloroglucin*, $C_6H_6O_3$, and *æscylic alcohol*, $C_7H_8O_3$, less H_2O. Subjected to dry distillation it yields *pyrocatechin*, and when fused with potassa is converted into phloroglucin and *protocatechuic acid*, $C_7H_6O_4$. Gautier (1878) gives to catechin the formula $C_{21}H_{18}O_3$, and found, among the products of decomposition by potassa, besides the two mentioned, also the hydrocarbon CH_4 and carbonic and formic acids. By the action of dilute sulphuric acid at 140° C., an amorphous orange-colored body, $C_{28}H_{22}O_7$, protocatechuic acid, and a polyatomic phenol, probably $C_{14}H_{16}O_7$, were obtained. H. K. Bowman (1869) determined the quantity of tannin in 3 samples of catechu, and found it to vary between 32.8 and 49.4 per cent.

Impurities.—Fragments of leaves, mats or cloth are usually found in the commercial article. An *artificial catechu*, proposed by Rave (1873), may be obtained by slightly roasting powdered mahogany and allied woods, and then boiling with water; it is said to be serviceable in dyeing.

Off. Prep.—Infusum catechu comp., Tinctura catechu, *U. S.*

CATECHU PALLIDUM, *Br.*—PALE CATECHU.

Gambir, *Gambier*, *Terra japonica*, E.; *Gambir cubique*, Fr.; *Gambir*, *Gambir-Catechu*, G.

An extract of the leaves and young shoots of Uncaria gambier, *Roxb.*, s. Nauclea gambir, *Hunter*. Trans. Linn. Soc., vol. ix. plate 22. Bentley and Trimen, Med. Plants, 139.

Nat. Ord.—Rubiaceæ, Naucleæ.

Origin.—This is a shrubby climber, having opposite leaves, and bearing globular heads of pinkish flowers upon axillary laterally compressed peduncles, which taper towards the apex, are articulated above, and after the fall of the whole inflorescence, curve backwards and form stout and hard hooks, by which the plant supports itself in climbing. It is indigenous to Ceylon, Sumatra and the countries about the Straits of Malacca, and is extensively cultivated near Singapore. *Uncaria acida*, Roxb., indigenous to Pulo Penang and neighboring islands, is nearly allied to the preceding species, and perhaps merely a variety of it; it appears also to be used in the preparation of gambir.

Preparation.—The fresh leaves and young shoots are boiled in water for one hour, after which the decoction is decanted, and the residue expressed with the hands. The liquid is now evaporated to the consistence of a thin syrup, poured into buckets, and stirred by working a stick of soft wood up and down in a sloping direction, when it gradually sets into a soft mass; this is placed in shallow square boxes, and when sufficiently firm, is cut into cubes, and dried in the shade.

Gambir is principally exported from Singapore, packed in boxes.

Description.—It is met with in cubes or in large irregular masses, having an external resemblance to catechu, but presenting upon the irregular fracture a dull grayish-brown appearance, with some streaks of a darker brown. The cubes are about an inch square on each side, externally light or deep brown, internally brownish-gray. Both varieties are friable, inodorous, of a bitterish astringent, finally sweet taste, and show under the microscope numerous small acicular crystals.

Constituents.—Gambir contains the same constituents as catechu, but less *tannin* than the latter; the crystalline structure observed under the microscope is due to *catechin.* Hlasiwetz (1867) detected *quercetin* in gambir. De Vrij (1865) avers the presence of *quinovic acid* in many species of Nauclea, and it is not impossible that it may also be found in gambir.

Off. Prep.—Infus. catechu, Pulv. catechu comp., Tinct. catechu, Trochisci catechu, *Br.*

Medical Action and Uses.—Catechu is astringent by virtue of the tannic acid it contains, and was originally used to constringe relaxed tissues, arrest fluxes, and for similar purposes. It is harsher but more energetic than kino in its action. It continues to be one of the most commonly employed of astringent medicines for checking *diarrhœa* produced by cold, or by irritating ingesta after their removal by purgation. It is best administered as an addition to the officinal chalk mixture. It is alleged to check the bronchial secretion in chronic *phthisis* and *bronchitis*, and to moderate uterine *hemorrhage* and *leucorrhœa.* It is of greater utility as a local astringent, applied to the nostrils in *epistaxis*, to the mouth in cases of spongy and bleeding *gums*, to the *vagina* in relaxation and leucorrhœa of this canal, and to the *throat* and *larynx* in cases of flaccidity of these parts. Lozenges containing it are very useful to correct *hoarseness* and roughness of the voice due to this cause. They sometimes are made with catechu, cascarilla, amber, orris, peppermint, etc., to conceal the odor of the breath caused by *fetid follicular secretions*, by *tobacco*, etc. The astringency of catechu renders it a useful ingredient of dentifrices. In gargles it relieves *sorethroat* unattended with active inflammation; in lotions it forms a valuable application to ulcerated *nipples* and other *ulcers* after the acute stage has passed; such lotions may contain catechu alone, or, in addition to it, borax, alum, sulphate of copper, etc. Gambir has the same medical properties, but its astringency is rather less. The *dose* of catechu is from one to thirty grains.

CAULOPHYLLUM.—Blue Cohosh.

Pappoose root, Squaw root, Blueberry root.

The rhizome of Caulophyllum (Leontice, *Lin.*) thalictroides, *Mich.*

Nat. Ord.—Berberidaceæ.

Origin.—A smooth and glaucous perennial with a simple stem, bearing near its apex a large sessile triternately compound leaf, with obovate 3 or 5 toothed or lobed leaflets; the greenish-yellow flowers, about 12 in number, form a terminal raceme, and produce capsules which are soon ruptured by the two globular seeds, these remaining inclosed in a blue fleshy integument. The plant is found in rich woodlands from Canada south to Carolina and Kentucky. It flowers in April and May.

Description.—The rhizome is nearly horizontal, somewhat branched and matted, several inches long, about $\frac{1}{4}$ inch thick, knotty from the numerous approximate stem-scars, externally brown-gray, internally whitish, the ligneous rays narrow and many. The numerous radical fibres are mostly on the lower side, 3 or 4 inches long, pale yellowish-brown externally, and white internally. Blue cohosh has a sweetish bitter afterwards somewhat acrid taste. As met with in commerce, it is sometimes mixed with a large proportion of the rhizome of hydrastis, which is easily recognized by its different shape, and its bright yellow color internally.

Constituents.—F. F. Mayer (1863) found blue cohosh to contain *saponin;* Ebert (1864) corroborated this statement, proved also the presence of two resins, starch, gum, and other common principles, and obtained $2\frac{1}{2}$ per cent. of ash. On concentrating the alcoholic tincture and pouring it into water, a precipitate of the resins is obtained, amounting to about 12 per cent. of the root; it has the peculiar taste of blue cohosh, and constitutes the so-called *caulophyllin.*

Medical Action and Uses.—Nothing has recently been added to our knowledge of its reputed virtues. It is said to be demulcent, anti-spasmodic. emmenagogue, and diuretic. It is more probably destitute of medicinal power,

CEANOTHUS.—Red Root.

New Jersey tea, E.; *Céanothe*, Fr.; *Seckelblumen-Wurzel*, G.

The root of Ceanothus Americanus, *Lin.* *Nat. Ord.*—Rhamnaceæ.

Origin.—This is a shrubby plant, indigenous to the greater part of North America, growing in pine barrens and dry woodlands. It is about 3 feet high, and has alternate ovate or oblong-ovate, serrate leaves, which are sometimes heart-shaped at the base, downy underneath, and three-veined. The small white flowers are in axillary panicles, and produce three lobed capsules containing three seeds.

Description.—The root is about a foot long, nearly cylindrical, an inch or more thick, with a knotty head and few branches, and covered with a firmly adhering rust-colored bark, which is about $\frac{1}{12}$ inch thick, with some longitudinal ridges, hard, breaks with a short granular fracture, and when cut with a knife, has a brown-red and waxy appearance. The wood is very tough, of a light red-brown color, and of a waxy lustre upon the recently cut surface. The branches have a rather lighter-colored bark and a whitish wood. The root is without odor, and has a bitterish astringent taste, which is strongest in the bark.

Constituents.—Red root has not been analyzed, but is known to contain tannin. Bowman (1869) estimated the tannin of the leaves to amount to 9.21 per cent.

Other Species.—Ceanothus ovalis, *Bigelow*, which has narrow oval leaves, is indigenous from Vermont to the Rocky Mountains.

Cean. cœruleus, *Lagasca*, s. C. azureus, *Desf.*, a native of Mexico, has been employed there as a febrifuge.

Medical Uses.—The leaves of this plant were used during the American war of Independence as a substitute for Chinese tea; and in the late civil war it was employed in the same manner, and pronounced "a good substitute for indifferent black tea." The root is astringent, and was applied locally by the Cherokee Indians in *gonorrhœa* and *cancer*, and given internally in *syphilis*. A decoction of the leaves and seeds has been used in *ulceration* of the mouth and throat, and internally in *dysentery*.

CELASTRUS.—STAFF TREE BARK.

False bittersweet, *Fevertwig*, E.; *Celastre*, Fr.; *Celaster*, G.

The bark of Celastrus scandens, *Lin.* *Nat. Ord.*—Celastraceæ.

Origin.—The staff tree is a native of Canada and the United States southward to North Carolina, growing in woods and thickets and twining about trees, ascending to a considerable height. The leaves are alternate, ovate-oblong, acuminate and serrate; the flowers are in small axillary racemes, greenish-white, and produce orange-colored three-valved capsules, containing from 3 to 6 seeds, which are covered with a scarlet-red arillus.

Description.—The root bark, which is usually preferred, is in irregular thin quills or double quills, is nearly smooth, externally brown or dark orange-brown; the outer layer, which is rather tough, separates concentrically and shows another layer of a bright orange-red color, which covers the white, fragile, likewise concentrically arranged liber. The internal surface is whitish and finely striate. The bark of the stem resembles the root bark, but is externally of an ash-gray or brown-gray color. It is without odor and possesses a bitterish sweet taste. The tough white wood is occasionally found adhering to the bark, as met with in commerce.

Constituents.—The bark has not been analyzed.

Medical Uses.—"The bark has considerable reputation in domestic practice as an emetic, discutient, and anti-syphilitic; it also appears to possess some narcotic powers." (Griffith). It is popularly supposed capable of "removing hepatic obstructions," whatever that may mean.

CEPHALANTHUS.—BUTTONBUSH.

Buttonwood, *Crane willow*, E.

The bark of Cephalanthus occidentalis, *Lin.*

Nat. Ord.—Rubiaceæ, Cinchoneæ.

Origin.—The buttonbush grows in wet places in Canada and the United States, attains a height of 10 to 15 feet, has ovate, acuminate, and entire leaves, which are opposite or in whorls of three, and the white flowers aggregated in dense globular terminal and axillary heads.

Description.—Buttonbush bark, as found in commerce, is in narrow curved pieces an inch or more in length. The outer surface is somewhat glossy, gray-brown, finely striate longitudinally, or, when older, covered with a scaly and fissured, ash-colored or brown-gray soft cork. The inner bark is white and smooth, after drying, light rust-brown, rather tough, and breaks with a fibrous fracture. The bark is inodorous, and has a slightly astringent and somewhat bitter taste.

Constituents.—Examined by E. M. Hattan (1874), the bark was found to contain tannin, a principle analogous to saponin, an uncrystallizable bitter principle, freely soluble in alcohol and water, two resins, and other common vegetable principles. A fluorescent body was obtained from the precipitates occasioned by acetate and subacetate of lead; it crystallizes in needles, is soluble in water, alcohol, and ether, yields a yellow precipitate with subacetate of lead, and has, in alkaline solutions, a yellow color, which in reflected light appears blue.

Medical Uses.—There is no evidence to prove that this plant possesses medicinal virtues sufficient to entitle it to consideration. It is reputed to have been useful in *paralysis*, *coughs*, and constitutional *syphilis*.

CERA ALBA, *U. S.*, *Br.*—WHITE WAX.

Cire blanche, Fr.; *Weisses Wachs*, G.

Yellow wax, bleached by exposure to moisture, air, and light.

CERA FLAVA, *U. S.*, *Br.*—YELLOW WAX.

Cera citrina.—Beeswax, E.; *Cire jaune*, Fr.; *Gelbes Wachs*, G.

The prepared honey-comb of the hive bee, or honey bee, Apis mellifica, *Lin.* *Class* Insecta. *Order* Hymenoptera.

Origin.—The insect has been domesticated from an early period, and several varieties are known; but the *Apis fasciata* of Egypt, *A. unicolor* of Madagascar, and *A. pallida* of South America, may perhaps be all distinct species. The bees live in societies called *swarms*, which are composed of one female or *queen bee*, several hundred males or *drones*, and ten thousand or more *working bees*, which are females with undeveloped ovaries. The wax is secreted in thin scales between the rings of the belly, and is used in the construction of the hexagonal cells, which form the comb, and are filled with honey. To obtain the wax, the honey is drained off, the comb expressed, melted in water, and after the impurities have subsided, the wax is allowed to cool or run into suitable moulds. By filtering the crude wax through paper at a sufficiently elevated temperature, a very handsome product is obtained. Beeswax is largely produced in the United States, particularly in some of the Western and Southern States, and is also imported from the West Indies to the amount of from 20,000 to 25,000 pounds annually.

Wax Bleaching.—Melted beeswax is solidified in thin ribbon-like sheets by passing it over wet revolving cylinders, or it is finely granulated, and then exposed to the light and air, being moistened from time to time and occasionally turned. It is then remelted and the process repeated until the desired degree of whiteness has been attained. Wax may also be deprived of its color by chlorine, but such a product is much inferior to the sunbleached wax.

Properties.—Beeswax is a solid body, having a more or less deep-yellow color, a slight lustre, a somewhat unctuous touch, a finely granular fracture, a peculiar aromatic odor and a slight taste. Its specific gravity is about .965 and its fusing point between 62° and 63° C. (about 145° F.). It is partly soluble in boiling alcohol, wholly in oil of turpentine, and in 20 parts of ether at a temperature of 15° C. (59° F.).

White wax is usually met with in yellowish-white thin circular cakes, which are slightly translucent, of a somewhat splintery fracture in the cold, have a specific gravity of about 0.97, and fuse near 64° C. (147° F.). Its slight odor suggests that of rancidity, its taste is insipid.

Constituents.—Yellow wax contains some aromatic and coloring matters, which vary somewhat in wax from different localities, and are destroyed by the bleaching process; they are partly dissolved by cold alcohol, together with a very small quantity of *cerolein*, which resembles a fat in appearance. Boiling 90 per cent. alcohol dissolves 10 to 20 per cent. of *cerin* or *cerotic acid* $C_{27}H_{54}O_2$, which exists likewise in Chinese wax, is crystalline, and fuses in its pure state at about 81° C. (177.8° F.). Schalfeief (1877) succeeded, by fractional precipitation with lead acetate, in separating it into several acids, one having the composition $C_{34}H_{68}O_2$. Repeated boiling of wax with alcohol leaves *myricin* behind, which is *myricylic palmitate* $C_{30}H_{61}.C_{16}H_{31}O_2$; when pure, it forms feathery crystals, has the fusing point at 72° C. (161.6° F.), is very sparingly soluble in alcohol, more freely in ether and oil of turpentine, and is with difficulty saponified by boiling with concentrated solution of potassa. The principle to which bleached wax owes its rancid odor has not been isolated.

Vegetable wax is obtained in different countries from various species of Myrica, Rhus, Corypha, etc. Some of them are glyceryl compounds of fatty acids and therefore true fats; but the exact composition of most of them has not been ascertained.

Adulterations and Substitutions.—The coarse adulterations with flour, white lead, and similar substances, are perhaps rarely practised at the present time, since they are so readily detected, by their insolubility in ether and oil of turpentine, and by subsiding or mixing with hot water on fusing the wax with it. The materials most frequently employed are resin, commercial stearin (the residue left on expressing lard oil), suet, and similar fats, and paraffin and the closely allied *ceresin* or *ozokerit* of Gallicia. The latter, which has also been termed *mineral* or *earth wax*, is found in nearly black masses, but is obtained in the process of purification of various shades of color varying between dark yellow and white. This and *paraffin* may be readily detected and their quantity estimated by their stability when heated with concentrated sulphuric acid, by which the beeswax is completely destroyed, while they are not affected and may be recovered nearly pure by fusing the residuary mass repeatedly with fresh portions of water. If the adulterated wax be previously exhausted with light petroleum benzin, which dissolves but little of the beeswax, the solution will contain the paraffin, together with any fat present, and the residue left on evaporation may be treated with sulphuric acid; this will destroy the fat and leave the paraffin. The determination of the specific gravity and fusing point has been recommended for detecting adulterations, but mixtures of the adulterants may be prepared which agree pretty well in these respects with the natural product. It must also be remembered that resins, like beeswax itself, are destroyed by the influence of hot sulphuric acid. But most resins and fatty acids are soluble without difficulty in cold strong alcohol, which takes up but minute quantities of beeswax, and this behavior affords a means of detecting such adulterations. Fats, however, are not dissolved by alcohol. With few exceptions, they are readily soluble in cold petroleum benzin, and their quantity may be estimated. To apply these tests, the wax should be cut into very thin pieces and digested for some time near its fusing point. After cooling, the liquid is decanted, and will then contain fatty acids and resin should alcohol have been used, or fats and paraffin if petroleum benzin should have been employed as the solvent. Advantage may also be taken of the behavior of Japan wax and other fats to form a milky emulsion on being boiled with an aqueous solution of borax, from which on cooling pure wax separates completely. When melted wax is allowed to congeal without being disturbed, it presents a level surface; but the surface of paraffin is concave, and A. W. Miller (1874) has observed this distinctly even in mixtures of pure wax and paraffin; the translucent appearance of the latter is even noticed on the edges of the mixture; while pure yellow wax is almost opaque. Another perhaps still more deceptive fraud has been practised in coating adulterated with a thin layer of pure wax of the same color; and completely artificial wax has been made (1876) by fusing together rosin and paraffin, or rosin, soap, and stearic acid; the solubility in cold strong alcohol, and in the former case the indestructibility of the undissolved portion by hot sulphuric acid, serve to detect these frauds. The admixture of fats may also be detected by the acrid odor of the vapors given off on throwing the suspected wax upon red-hot charcoal. See paper on white wax and its adulterations by Prof. Bedford, in *Proc. Amer. Phar. Assoc.*, 1877, p. 444.

Medical Action and Uses.—Wax is simply a protective. Its use in ancient times as a remedy for diarrhœa and dysentery was doubtless due to this property. Quite recently it has been similarly employed. Until the introduction of caoutchouc for preparing impermeable tissues, wax was generally used for this purpose, and in the treatment of *rheumatism*, *gout*, *neuralgia*, and other local diseases to protect the affected parts from cold, and favor cutaneous transpiration.

CERATA.—CERATES.

Cérats, *Céréolés*, Fr.; *Cerate*, *Wachssalben*, G.

The term cerate is applied to a class of unctuous preparations, which, in consistence, are about intermediate between ointments and plasters, sufficiently soft to be spread at the ordinary temperature, and at the same time firm enough to adhere to the skin without melting. They are composed of wax united with a fatty or oleoresinous substance, and to obtain them of proper consistence two parts of wax require about three parts of fixed oil, four parts of lard, or one part of soft turpentine. In preparing cerates the wax or resin should be melted first by the aid of a water-bath or otherwise carefully regulated heat. When thoroughly melted, the warm oil or lard should be added in quantities small enough not to congeal the melted portion; and, after all the ingredients have been liquefied and the vessel removed from the fire, the mass should be well stirred or beaten with a spatula to prevent the partial separation of the least fusible substances, and insure the perfect homogeneousness of the preparation. It is well to continue this manipulation until the temperature has been reduced to that of the room; but artificial refrigeration should not be applied until after the mass has thickened, and then only if vigorous stirring, or, better still, trituration is kept up. With this in view, the soft cerate may be transferred to a mortar previously warmed by hot water, or the whole process may be completed in a well-enamelled iron vessel with a rounded bottom, if a pestle fitting the curve of the latter be used. Straining is best avoided, and all the materials should therefore be free from dust and other foreign bodies. Powders, cantharides excepted, are gradually added while the cerate is merely soft enough to permit the whole to be uniformly mixed, and liquids should be previously warmed to 40° or 45° C. (about 110° F.). In dispensing cerates with extracts, the latter should be previously rubbed with water in a warm mortar to a uniform thin paste, which should then be mixed with the cerate added in small portions until the extract has been thoroughly incorporated; the remaining cerate may then be added in larger quantities.

Cerates should be kept in a cool place, where the temperature is not likely to rise much above 15° C. (59° F.); but even then those made with white wax, owing to its incipient rancidity, are liable to become rancid. This could have been avoided if the Pharmacopœia had directed unbleached wax, or, if white cerates be considered necessary, by the employment of benzoated lard. Some cerates, which are sufficiently firm, may be conveniently kept and dispensed in the form of square cakes, which are easily made by pouring the fused and nearly cool cerate into square moulds made of oiled or paraffin paper, and placed upon a flat slab. After the cerate has solidified, it is without difficulty removed from the paper, and cut into smaller pieces of any desired size or weight.

CERATUM, *U. S.*—CERATE.

Ceratum simplex, *U. S.* 1850; *Ceratum adipis*, *U. S.* 1860.—*Simple (lard) cerate*, E.; *Cérat simple*, F.; *Einfaches Cerat*, *Wachssalbe*, G.

Preparation.—Take of Lard eight troyounces; White Wax four troyounces. Melt them together, and stir the mixture constantly until cool. *U. S.*

The simple cerate of the French Codex is composed of 1 part of white wax to three parts of expressed oil of almonds; and the *Unguentum cereum*, Ph. Germ., of two parts of yellow wax to five parts of olive oil.

CERATUM CANTHARIDIS, *U. S.*—CANTHARIDES CERATE.

Emplastrum cantharidis, Br.; *Emplastrum cantharidum (vesicatorium) ordinarium*, P. G.; *Emplastrum epispasticum s. vesicatorium s. vesicans.—Blistering cerate or plaster*, E.; *Emplâtre de cantharides, Emplâtre vesicatoire*, Fr.; *Spanischfliegen-Pflaster, Blasenpflaster*, G.

Preparation.—Take of Cantharides in very fine powder twelve troyounces; Yellow Wax, Resin, each seven troyounces; Lard ten troyounces. To the wax, resin, and lard, previously melted together and strained through muslin, add the cantharides, and by means of a water-bath keep the mixture in a liquid state for half an hour, stirring occasionally; then remove it from the water-bath and stir it constantly until cool. *U.S.*

Take of Cantharides in powder twelve ounces; Yellow Wax, Prepared Suet, each seven and a half ounces; Prepared Lard six ounces; Resin three ounces. Liquefy the wax, suet, and the lard together by a water-bath, and add the resin, previously melted; then introduce the cantharides, mix the whole thoroughly, and continue to stir the mixture while it is allowed to cool. *Br.*

Cantharidin being freely soluble in fixed oils, the process of the U. S. Pharmacopœia always insures an effectual blistering cerate, provided the cantharides are of good quality. It is important that the heat be not raised above 100° C. (212° F.), since cantharidin would volatilize with the watery vapors extricated from the powder, and, while weakening the cerate, vesication of the operator's face and hands would be apt to occur. The solution of the cantharidin in the cerate may be greatly facilitated by dampening the powdered cantharides with oil of turpentine or chloroform a day or two before the cerate is made. Dragendorff's (1872) recommendation to increase the efficacy of the cerate by treating the powdered cantharides first with solution of potassa or soda, heating the mixture in a water-bath for half an hour, and supersaturating with muriatic acid, and its failure in the hands of Mr. Rother, is alluded to on page 339.

Off. Prep.—Blistering cerate is an ingredient of Emplast. picis cum cantharide and Unguentum cantharidis, *U. S.* The following two preparations are directed by the French Codex.

Camphorated cantharides plaster is made by diffusing upon the surface of the spread cerate a concentrated solution of camphor in ether or chloroform. As either solvent evaporates readily, a thin film of finely divided camphor is left behind.

Vesicating cloth or taffetas; Sparadrap (taffetas) vésicant.—Melt together 100 parts each of purified elemi and resin, 375 yellow wax, 225 basilicon ointment, and 40 of olive oil, add 420 parts of finely powdered cantharides, and spread the mass upon waxed cloth. Dubuisson proposed a substitute for this, made by forming a thick solution of one part of gelatin in sufficient water, adding four parts of hydro-alcoholic extract of cantharides, and applying three layers of the mixture upon waxed cloth, allowing each one to dry before the next is applied.

Various proprietary articles of a similar nature are in the market; but the above, in addition to blistering paper (see *Charta cantharidis*), will probably meet all necessities.

Medical Action and Uses.—Cantharides cerate forms the most usual blistering plaster. Its mode of action and remedial application have been sufficiently explained under CANTHARIS.

CERATUM CETACEI, *U. S.*—SPERMACETI CERATE.

Emplastrum spermatis ceti, *Ceratum labiale album.*—*Cérat de blanc de baleine*, *Onguent blanc*, Fr.; *Walrath-Cerat*, G.

Preparation.—Take of Spermaceti a troyounce; White Wax three troyounces; Olive Oil five troyounces. Melt together the spermaceti and wax; then add the oil previously heated, and stir the mixture constantly until cool. *U. S.*

Take of White Wax, Spermaceti, each two parts; Expressed Oil of Almonds three parts. Melt them at a gentle heat, and pour the mass into paper capsules, and when cold cut it into square cakes. *P. G.*

It should be white and free from rancidity. The latter preparation is firmer than the former, and is intended as a convenient application to chapped hands and lips, though for the latter purpose it is usually colored red by carmine or by previously steeping some alkanet root in the oil, and scenting it with some volatile oil.

The following two preparations are used for similar purposes:—

Camphor ice.—Melt together four ounces of white wax and twelve ounces of benzoated suet; when nearly cool add two ounces of powdered camphor and two drachms of oil of lavender. Mix and pour into suitable moulds (W. C. Bakes, 1867).

Medicated cacao butter.—Melt together four ounces of yellow wax and twenty-eight ounces of cacao butter; add one drachm each of balsam of Peru and benzoic acid. Mix and pour into moulds (Ferris Bringhurst, 1867).

Medical Action and Uses.—Spermaceti cerate forms a very bland dressing for *blisters*, superficial *abrasions*, and *ulcers* after their primary stage. It is less apt than simple ointment to grow rancid.

CERATUM EXTRACTI CANTHARIDIS, *U. S.*—CERATE OF EXTRACT OF CANTHARIDES.

Cérat d'extrait de cantharides, Fr.; *Cantharidenextract-Cerat*, G.

Preparation.— Take of Cantharides in fine powder five troyounces; Stronger Alcohol two pints and a half, or a sufficient quantity; Resin three troyounces; Yellow Wax six troyounces; Lard seven troyounces. Moisten the cantharides with stronger alcohol, pack it in a cylindrical percolator, and gradually pour on stronger alcohol until the liquid passes nearly colorless. Evaporate the filtered liquid by means of a water-bath to the consistence of a soft extract. Mix this with the resin, wax, and lard, previously melted together, and keep the whole at a temperature of 212° for fifteen minutes. Lastly, strain the mixture through muslin, and stir it constantly until cool. *U. S.*

This was proposed by W. R. Warner (1860). The cantharidin is completely extracted by the alcohol, and again dissolved from the resulting soft extract by the lard, the solution in the latter being facilitated by the prolonged digestion. A quantity of blackish extractive matter, insoluble in fats, separates, and is removed by straining. The finished cerate is of a yellow color.

Medical Action and Uses.—They are the same as those of cantharides cerate, for which it is intended as an elegant and efficient substitute.

CERATUM PLUMBI SUBACETATIS, *U. S.*—CERATE OF SUBACETATE OF LEAD.

Unguentum plumbi subacetatis compositum, Br.; *Unguentum plumbi*, P. G.; *Ceratum cum subacetate plumbico.—Goulard's cerate, Compound ointment of subacetate of lead*, E.; *Cérat de saturne, saturné, de Goulard*, Fr.; *Bleisalbe, Bleicerat*, G.

Preparation.—Take of Solution of Subacetate of Lead two fluidounces and a half; White Wax four troyounces; Olive Oil eight troyounces; Camphor thirty grains. Mix the wax, previously melted, with seven troyounces of the oil. Then remove the mixture from the fire, and, when it begins to thicken, gradually pour in the solution of subacetate of lead, stirring constantly with a wooden spatula until it becomes cool. Lastly, add the camphor dissolved in the remainder of the oil, and mix with the cerate.

Cerate of subacetate of lead may also be prepared by mixing intimately together: Cerate three hundred and fifty grains; Olive Oil fifty grains; Solution of Subacetate of Lead a fluidrachm and a half; Liniment of Camphor twelve grains. *U. S.*

Take of Solution of Subacetate of Lead six fluidounces; Camphor sixty grains; White Wax eight ounces; Oil of Almonds one pint (imperial). Melt the wax with sixteen ounces of the oil by the heat of a water-bath, remove the vessel, and, as soon as the mixture begins to thicken, gradually add the solution of subacetate of lead, and stir the mixture constantly while it cools; then add the camphor dissolved in the rest of the oil, and mix thoroughly. *Br.*

With the view of obtaining a white cerate, both Pharmacopœias order white wax, by which the tendency to rancidity is increased. The German Pharmacopœia very properly directs the use of the unaltered (yellow) wax, and thereby insures a preparation which retains its agreeable odor for a much longer time. The second process of the United States Pharmacopœia also yields an unobjectionable cerate, the rancidity of which will be prevented for some time if the simple cerate is made with benzoated lard.

Medical Action and Uses.—This cerate is astringent and protective, and is employed to promote the healing of suppurating surfaces, such as *excoriations, blisters, ulcers*, etc. It is objectionable from its tendency to become rancid, and therefore irritating; and it must be cautiously applied upon extensive raw surfaces lest it cause lead-poisoning.

CERATUM RESINÆ, *U. S.*—RESIN CERATE.

Unguentum resinæ, Br.; *Unguentum basilicum.—Ointment of resin, Basilicon ointment*, E.; *Cérat de résine anglais*, Fr.; *Harzcerat*, G.

Preparation.—Take of Resin ten troyounces; Yellow Wax four troyounces; Lard sixteen troyounces. Melt them together, strain the mixture through muslin, and stir it constantly until cool. *U. S.*

Take of Resin in coarse powder eight ounces; Yellow Wax four ounces; Simple Ointment sixteen ounces. Melt with a gentle heat, strain the mixture while hot through flannel, and stir constantly while it cools. *Br.*

The impurities always present in the resin necessitate the straining of this and the following cerate. By melting and straining the resin alone the purified resin may be kept on hand, and subsequent straining avoided. The formulas of the French and German Pharmacopœias differ considerably from the foregoing, the former ordering black pitch, the latter turpentine, among the ingredients.

Medical Action and Uses.—Resin ceràte, anciently known as Basilicon ointment, is one of the most extensively used and most useful of all the dressings for slowly healing and indolent *sores*, particularly when these have followed a local shock, such as is produced by a *burn* or *scald*.

CERATUM RESINÆ COMPOSITUM, *U. S.*—COMPOUND RESIN CERATE.

Deshler's salve, E.; *Cérat de résine composé*, Fr.

Preparation.—Take of Resin, Suet, Yellow Wax, each twelve troyounces; Turpentine six troyounces; Flaxseed Oil seven troyounces. Melt them together, strain the mixture through muslin, and stir it constantly until cool. *U. S.*

The cerate gradually becomes tough in consequence of the oxidation of the flaxseed oil.

Medical Action and Uses.—Rendered more stimulant than resin cerate by the turpentine it contains, it may be applied where that preparation appears to act too feebly.

CERATUM SABINÆ, *U. S.*—SAVINE CERATE.

Unguentum sabinæ, Br., P. G.—*Ointment of savin*, E.; *Cérat de sabine*, Fr.; *Sadebaumsalbe*, G.

Preparation.—Take of Fluid Extract of Savine three fluidounces; Resin Cerate twelve troyounces. Melt the resin cerate, add the fluid extract of savine, and, at a moderate heat, stir the mixture constantly until the alcohol has evaporated; then continue to stir until cool. *U. S.*

Take of Fresh Savin tops bruised eight ounces; Yellow Wax three ounces; Prepared Lard sixteen ounces. Melt the lard and the wax together on a water-bath, add the savin, and digest for twenty miuutes. Then remove the mixture, and express through calico. *Br.*

Of the two preparations we prefer the first, which was first suggested by Prof. Grahame (1858), and which contains all the soluble principles of savin. It is difficult to imagine that the brief digestion of the fresh savin ordered by the second formula should extract enough of the principles to render the cerate equally efficient. Both are, however, in point of elegance, improvements over the old method of incorporating the powder. The German Pharmacopœia employs an extract made with diluted alcohol, which is incorporated with nine times its weight of simple cerate.

Medical Action and Uses.—It is exclusively used as a stimulant of suppurating surfaces, whose discharge it tends to increase. Hence it is applied to prolong the secretion of *issues*, *setons*, and *blisters*, and has the advantage over preparations of cantharides that it does not occasion strangury. Its application produces a white pellicle of coagulable lymph, which should be from time to time removed, lest the part heal prematurely.

CERATUM SAPONIS, *U. S.*—SOAP CERATE.

Cérat de savon, Fr.; *Seifencerat*, G.

Preparation.—Take of Soap Plaster two troyounces; Yellow Wax two troyounces and a half; Olive Oil four troyounces. Melt together the plaster and wax, add the oil, and, after continuing the heat a few minutes, stir the mixture until cool. *U. S.*

The direction to continue the heat a few minutes is unnecessary, if the precaution is taken to add the warmed oil gradually, so as to avoid congealing any portion of the other ingredients.

Medical Action and Uses.—Soap cerate applied upon appropriate tissues affords mechanical support to joints, while it acts as a sedative of inflammation by promoting transpiration, and possibly by the direct operation of the lead in its composition. It is used to envelop *sprained*, *gouty*, *rheumatic*, and *scrofulous joints*, and as an application to *glandular swellings* and local hypertrophies.

CERATUM ZINCI CARBONATIS, *U. S.*—Cerate of Carbonate of Zinc.

Turner's cerate, E.; *Cérat de carbonate de zinc*, Fr.; *Zinkcerat*, G.

Preparation.—Take of Precipitated Carbonate of Zinc two troyounces; Ointment ten troyounces. Mix them thoroughly. *U. S.*

Turner's cerate was formerly made with levigated calamine; the present officinal formula very properly directs the use of pure carbonate of zinc in place of the impure article. The cerate has a pale yellow color, which is due to the yellow wax used in the simple ointment.

Medical Action and Uses.—This cerate is mildly astringent and drying, and is used to restrict the suppuration and promote the healing of *ulcers* and *wounds*, but especially of superficial lesions caused by *chafing*, irritating secretions, *burns*, *blisters*, etc.

CEREVISIÆ FERMENTUM, *Br.* See FERMENTUM.

Medical Uses.—As a topical remedy yeast has been spoken of under *Cataplasma fermenti*. Its internal uses are noticed under *Fermentum*.

CERII OXALAS, *U. S.*, *Br.*—Oxalate of Cerium.

Cerium oxalicum, *Oxalas cericus.*—*Oxalate de cérium*, Fr.; *Oxalsaures Ceroxydul*, *Ceriumoxalat*, G.

Formula $CeC_2O_4.3H_2O$. Molecular weight 234.

Origin.—The metal cerium was discovered in 1803 in a Swedish mineral, simultaneously by Klaproth, and by Berzelius and Hisinger. The last-named chemists called the mineral *cerit*, after the planet Ceres, then recently discovered, and the metal *cerium*. Mosander (1839 and 1840) observed, in the supposed pure oxide of cerium, the oxides of two other hitherto unknown metals, which received the names of *lanthanum* and *didymium*. The three metals exist together as silicates in the cerit and allanit, the latter mineral being found in Scandinavia and in the States of New York and Pennsylvania.

Preparation.—To obtain oxalate of cerium, F. F. Mayer (1860) recommends the following process: The powdered mineral is heated with concentrated sulphuric acid, to decompose the silicates, the dry mass ignited, then dissolved in dilute nitric acid, and treated with sulphuretted hydrogen to remove copper, etc. A little hydrochloric acid is added to prevent the precipitation of calcium salt, and the cerit metals precipitated as oxalates by oxalic acid. The precipitate is mixed with carbonate of magnesium, the mixture calcined to decompose the oxalates, the residue dissolved in a small portion of concentrated nitric acid, and the solution thrown into a large quantity of water containing about one-half per cent. of sulphuric acid. Lanthanum and didymium remain in solution, together with the magnesium and a little cerium, most of which is precipitated as yellow *ceric* sulphate; the latter is dissolved in sulphuric acid, and reduced to cerous sulphate by sodium hyposulphite, when the oxalate may be precipitated by oxalic acid.

Properties.—Oxalate of cerium is a white granular powder, insoluble in the simple solvents, but soluble in sulphuric and hydrochloric acids without effervescence (absence of carbonates), and this solution is not precipitated by sulphuretted hydrogen (absence of heavy metals). When calcined in contact with the air, the salt yields yellow ceric oxide, which has a brown tint if didymous oxide is present. Cerium oxalate dissolves in boiling potassa solution, and the clear liquid is not precipitated when heated with excess of ammonium chloride (absence of aluminium compounds); and when acidulated with acetic acid remains clear, but yields with calcium chloride a white precipitate of calcium oxalate.

Medical Action and Uses.—Oxalate of cerium was presumed to be a sedative of disordered nervous action because it seemed to be an efficient remedy for the *vomiting of pregnancy*, and less frequently for vomiting due to irritable conditions of the stomach itself. Some even attributed to it curative virtues in epilepsy and chorea; but experience has confirmed none of these statements except the first, and that only partially. It is worthy of being tried in cases of *vomiting* from uterine irritation, and may be prescribed in doses of one or two grains, three times a day. It should be given in pill or in powder.

CETACEUM, *U. S.*, *Br.*—SPERMACETI.

Spermaceti.—*Spermaceti*, Fr., G.; *Blanc de baleine*, *Cétine*, *Ambre blanc*, Fr.; *Walrath*, G.

Nearly pure cetin obtained from the head of the sperm whale, Physeter macrocephalus, *Linn.*

Class Mammalia. *Order* Cetacea.

Origin.—The sperm whale, or great-headed cachalot, is principally met with in the Pacific and Indian Oceans, and the seas of Australia. It is fifty to seventy feet long, with a head fully one-third of its entire length, and correspondingly thick. Anterior to the cranium the upper jaw contains a large cavity, containing an oily liquid, which is removed with buckets soon after the animal has been killed, and then congeals into a yellow mass. This is drained in suitable bags, and then strongly expressed to remove the oil; the pressed cake is purified by melting it in water, skimming off the impurities, boiling with weak potassa solution, and washing with water; it is finally allowed to congeal.

Description.—Spermaceti is in white, translucent, crystalline masses, somewhat unctuous to the touch, of a slight fatty odor and taste; spec. grav. 0.943, and fusing at about 45° C. (113° F.). It contains variable but small quantities of sperm oil, which may be removed by crystallizing it repeatedly from boiling alcohol, when it forms soft pearly scales, which, according to Stenhouse, fuse at 50.5° C. (123° F.), and constitute the *cetin* of Chevreul. It is soluble in chloroform, ether, fixed and volatile oils, and is readily saponified when boiled with alcoholic solution of potassa, yielding palmitate of potassium and cetylic alcohol or *ethal*. It is, therefore, cetylic palmitate = $C_{16}H_{33}.C_{16}H_{31}O_2$. Heintz separated also small quantities of myristic, laurinic, and stearic acids, and of the alcohols methal, lethal, and stethal. When boiled with nitric acid, spermaceti is slowly oxidized, *œnanthylic*, *succinic*, and other acids being found among the products.

Impurities and Adulterations.—Spermaceti is apt to become rancid on exposure, and to acquire a yellowish color from the decomposition of the sperm oil contained in it. Its former properties may be restored by boiling it with a weak solution of potassa, and afterwards with water. The admixture of fats deprives spermaceti of its pearly lustre.

Pharmaceutical Preparations.—When needed in the form of powder, spermaceti is triturated in a mortar, a little alcohol being added from time to time; or, better still, it is fused, and then well triturated until cold. The German Pharmacopœia recognizes the following:—

Cetaceum saccharatum s. præparatum. Prepared or saccharated spermaceti, *E.;* Blanc de baleine sacchar**é**, *Fr.;* Walrathzucker, *G.* Spermaceti 1 part, and white sugar 3 parts, are rubbed together to a very fine powder.

Spermaceti is contained in Ceratum cetacei, *U. S.;* Charta cantharidis (epispastica), *U. S., Br.;* Ung. aquæ rosæ, *U. S.;* Ung. cetacei, *Br.*

Medical Action and Uses.—Spermaceti is a lenitive like other fatty substances. In the form of a fine powder, and mixed with sugar it is a popular and useful remedy for commencing *sorethroats* and catarrhal inflammations of the *air passages.* *Alvine* and *urinary irritations* are also reputed to be benefited by its use. For these affections it is best administered in emulsion with the yolk of egg, or with almond oil.

CETRARIA, *U. S., Br.*—ICELAND MOSS.

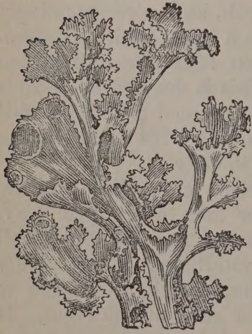
Lichen Islandicus, P. G.—*Lichen (Mousse) d'Islande,* Fr.; *Isländisches Moos, Isländische Flechte, Lungenmoos,* G.

The entire lichen, Cetraria islandica, *Acharius,* s. Lichen islandicus, *Lin.* Woodville, Med. Bot. plate 205. *Nat. Ord.*—Lichenes.

Origin.—The plant is indigenous to the northern hemisphere; in its southern limits it is found in mountainous regions, and further north in the plains. In North America it is met with from New England northward, in Europe as far south as Spain and Italy, and in Asia throughout Siberia; it is plentiful in Iceland, from which island its name is derived.

Description.—It is from two to four inches high, foliaceous, irregularly branched, with smooth, somewhat channelled, nearly linear, toothed and ciliate lobes; the upper surface is greenish-gray or olive-brown, lower surface whitish, with depressed spots; the apothecia or so-called fruits when present are situate near the margin, round or oval, chestnut-brown, and flattish with an elevated margin. When dry it is brittle and inodorous, but immersed in water it becomes soft, leathery, and cartilaginous, and has a slight odor; its taste is mucilaginous and bitter.

Fig. 31.



Cetraria islandica.

Impurities are usually found in the commercial article, and the drug frequently requires garbling. Adulterations are not likely to be intentional, but the lichen, as collected from different localities, is apt to vary somewhat in size and color, and in the shape of the divisions.

Constituents.—Iceland moss was last analyzed by Knop and Schnedermann (1845). The principal constituent is *lichenin* or *lichen-starch,* $C_{12}H_{20}O_{10}$, which is present to the amount of 70 per cent. It separates from its solution in hot water as a jelly, but by long-continued boiling with water is converted into a body resembling dextrin, and into glucose if boiled with dilute acids; the aqueous solution is colored blue by iodine. The bitter taste is due to about 2 per cent. of *cetraric acid* or *cetrarin,* $C_{18}H_{16}O_8$, which is contained in an uncombined state mainly in the outer layer of the lichen. It forms colorless fine needles, which are nearly insoluble in water, soluble in boiling alcohol, and yield with ammonia a yellow very bitter solution, which on exposure turns brown. The other constituents of Iceland moss are *lichen-stearic acid* $C_{14}H_{24}O_3$, *thallochlor*, a variety of chlorophyll, not soluble in hydrochloric acid, *fumaric* (formerly called *lichenic*) *acid*, sugar, etc., and 16.7 per cent. of cellulose. The production of alcohol from Iceland moss, as proposed by Sten. Stenberg (1870), depends upon the formation of glucose from lichenin noticed above.

Pharmaceutical Preparations.—Iceland moss is used in making Decoctum cetrariæ, *U. S.*, *Br.* The German Pharmacopœia has also the following:—

LICHEN ISLANDICUS AB AMARITIE LIBERATUS, Iceland moss free from bitterness. Fifteen parts of cut Iceland moss are macerated for three hours in ninety parts of tepid water, containing one part of potassium carbonate in solution, and afterwards well washed with cold water.

GELATINA LICHENIS ISLANDICI, Iceland moss jelly. Three parts of washed Iceland moss are boiled for half an hour with one hundred parts of water, and expressed, the decoction is strained, and after adding three parts of white sugar evaporated to ten parts.

GELATINA LICHENIS ISLANDICI SACCHARATA SICCA.—Sixteen parts of Iceland moss are deprived of bitterness, well washed and repeatedly boiled with water; the strained decoctions are mixed, and with six parts of sugar evaporated, then dried, weighed, and with an equal weight of sugar reduced to a gray-brown powder.

Medical Action and Uses.—Iceland moss is nutritious, demulcent, and tonic. The first two properties it owes to the starch in its composition, the last to its bitter principle, cetrarin. It increases the appetite, promotes digestion, and improves nutrition. It does not excite the circulation nor constipate; but in excessive doses may occasion nausea and diarrhœa. Its bitter principle is said to be perceptible in the milk of nursing women while using it.

This medicine has been employed almost exclusively as a remedy for chronic *pulmonary affections* attended with profuse expectoration and cough, and with more or less of the other symptoms belonging to consumption. It acts in these by its nutritious qualities in part, but more usefully by reducing the bronchial secretion, and thereby lessening both the waste of tissue and the fatigue of coughing. The amount of good which the medicine can effect will depend upon how far the *bronchitis*, which it chiefly influences, is simple. If this is accompanied by compression of the lung originating in pleurisy, or consolidation of the lung produced by pneumonia, or by tubercle, etc., the influence of the remedy must necessarily be subordinate, or even null. Chronic *diarrhœa* and *dysentery* are sometimes greatly benefited by it. It is usually administered in decoction; but an infusion is sometimes prepared by steeping three ounces of bruised cetraria in a pint and a half of boiling water for three hours, evaporating the liquid with gentle heat to the consumption of one-half, and adding sixty grains of extract of liquorice. Of this an ounce may be taken every three or four hours in chronic bronchitis with urgent cough. A decoction made with milk is less bitter, and may be employed as food.

CHAMÆLIRIUM.—STARWORT.

Blazing star, *Devil's bit*, *False Unicorn root*, E.

The rhizome of Chamælirium (Veratrum, *Lin.*) luteum, *Gray*, s. Cham. carolinianum, *Walt.*, s. Helonias lutea, *Ait.*, s. Hel. dioica, *Pursh.*

Nat. Ord.—Melanthaceæ.

Origin.—The plant is indigenous to Canada and the United States, where it grows in low grounds west to the Mississippi. The stem is about 18 inches high, the leaves are alternate spatulate below, lanceolate above, smooth, and the small whitish flowers are in a dense terminal raceme about 6 inches in length, which is rather slender on the barren plant. It flowers in May and June.

Description.—The oblique rhizome is about an inch long and $\frac{1}{4}$ inch in diameter, somewhat curved, of a dark gray-brown color, closely annulated from the leaf-scars, on the upper side with a few circular stem-scars, on the lower side with wiry rootlets, or their scars in lines parallel with the leaf-scars. The rhizome breaks with a nearly smooth and horny fracture, and shows on a transverse section, the fibro-vascular bundles crowded together near the centre, with a few scattered near the surface passing into the rootlets. The drug is destitute of odor, and has a strongly bitter taste. We have repeatedly found it as an admixture with the commercial rhizome of Aletris, from which it is easily distinguished.

Constituents.—Dr. F. V. Greene (1878) extracted from it the bitter principle, which he proposed to call *chamælirin*, and of which over 9 per cent. was obtained. It is prepared by evaporating the cold aqueous infusion with magnesia, and extracting the dry mass with absolute alcohol, concentrating, diluting with water, treating with animal charcoal, and evaporating. It is a yellowish neutral powder, freely soluble in water and alcohol, the solutions frothing like those of saponin, but insoluble in other simple solvents, soluble in and colored reddish by strong hydrochloric acid, and yellowish-brown by Fröhde's reagent. It has a very bitter taste, and is split by dilute acids into glucose and an insoluble body. The so-called *helonin* of the eclectics is the hydro-alcoholic extract of the rhizome.

Medical Uses.—This plant is reputed to be tonic and anthelmintic. The infusion is recommended in atonic dyspepsia, and for checking nausea and vomiting.

CHARTÆ.—MEDICATED PAPERS.

Papiers sparadrapiques, Fr.; *Medicamentirte Papiere*, G.

This class of preparations was introduced into the last editions of the United States and British Pharmacopœias; they resemble plasters spread upon non-absorbent paper, the process necessarily varying with the nature of the material. Similar preparations have been long in use on the continent of Europe; one which enjoys considerable popularity is

Charta antirheumatica, s. antarthritica, s. resinosa; antirheumatic paper, *E.;* Papier antirhumatique, antiarthritique, *Fr.;* Gichtpapier, *G.* The German Pharmacopœia directs it to be made by melting together 10 parts of resin, 6 parts each of black pitch and turpentine, and 4 parts of yellow wax, straining and spreading upon paper. The same preparation of the Belgian Pharmacopœia is a cerate containing $\frac{1}{10}$ per cent. of ethereal extract of mezereon.

The process of coating such papers is sufficiently described by the officinal directions. It is, however, sometimes convenient to spread certain cerates or plasters directly upon paper, which may be accomplished by fastening the latter upon a smooth table, by means of thin iron ledges, attached lengthwise to the margin, then pouring the melted material upon the paper and spreading it rapidly, using a warm smooth iron, which is long enough to rest upon both ledges; a very uniform and quite thin coating may thereby be obtained. If the material melts to a uniform mass, a flat brush may be employed, and care should be taken to apply it in one direction only. Should it be desirable to render the paper more impervious, it may be coated first with well boiled linseed oil, and then exposed to the air until perfectly dry, after which the material is applied in the manner described. In most cases, however, the intention is to impregnate the paper to some extent with the plaster-like material, which is most readily effected by placing two sheets of the paper upon smooth sheet iron, which is kept warm by means of a low fire or of a sand-bath; some of the melted mass is poured upon the upper sheet, and spread with some pressure by means of a pad, about three inches in diameter and formed of cotton or tow, which is first covered with thin tin-foil, and then with two or three layers of flannel. When the upper sheet has been thoroughly and uniformly impregnated, it is replaced by another, and this is repeated until the desired quantity of paper has been obtained. The lower sheet of paper is used merely to protect the others from becoming soiled.

The last described method is followed in making *wax paper*, *charta cerata*, thin well-sized paper being impregnated with white wax. It is very convenient for dispensing odorous substances, powders containing volatile oil, etc., for covering soft plasters and for various other purposes. *Paraffin paper*, prepared in the same way, is also often employed.

In this connection may be mentioned a variety of medicated papers which are used for fumigations and inhalations, and in the preparation of moxas; their basis is the *saltpetre paper*, *charta nitrata*, Ph. Germ., which is made by dissolving 1 part of nitrate of potassium in 4 parts of distilled water, and saturating with the solution sheets of white bibulous paper, which are afterwards dried. Ordinary saltpetre will answer if the paper is to be used for moxas; but for the preparation of *medicated cigarets*, nitrate of potassium free from chloride should be used. Such cigarets are either made in the same manner as ordinary cigars, except that stramonium, belladonna, hyoscyamus, or other leaves are substituted for tobacco; or the nitrated paper referred to above is impregnated with other solutions, or simply rolled into a thin tube, having the edges fastened with a trace of gelatin; the substance whose smoke is to be inhaled is then introduced, and the paper tube ignited at one end, when combustion without flame takes place. The following is a formula for *cigarettes antiasthmatiques*, which is much employed in France: A decoction is made of 5 grams each of the leaves of belladonna, stramonium, digitalis, and sage with 1000 grams of water, and strained. 75 grams of nitrate of potassium and 40 grams tincture of benzoin are added, and into this solution is then introduced, sheet by sheet, one quire of red-tinted absorbent paper, the whole remaining in contact for 24 hours, after which time the paper is dried and cut into rectangular pieces of 10 by 7 centimeters, which are formed into tubes by rolling them around a thin cylinder, about 1 or 1½ millimeters in diameter, and fastening the edge with gelatin.

For forming *moxas* of nitrated paper, it is rolled into pretty firm cylinders, having a diameter of about ¼ inch, which are afterwards cut into pieces of suitable lengths.

CHARTA CANTHARIDIS, *U. S.*—CANTHARIDES PAPER.

Charta epispastica, Br.; *Charta vesicatoria.—Blistering paper*, E.; *Papier épispastique*, *Papier à vésicatoire aux cantharides*, Fr.; *Spanischfliegen-Papier*, G.

Preparation.—Take of White Wax four troyounces; Spermaceti one troyounce and a half; Olive Oil two troyounces; Canada Turpentine, Cantharides in powder, each half a troyounce; Water five fluidounces. Mix all the substances in a tinned vessel, and boil gently for two hours, constantly stirring. Filter through a woollen strainer, without expressing, and keep the mixture in a liquid state by means of a shallow water-bath with an extended surface. Coat strips of paper upon one side only with the melted plaster by passing them successively over the surface of the liquid; and cut the strips when dry into rectangular pieces. *U. S.*

Take of White Wax four ounces; Spermaceti one and a half ounce; Olive Oil two fluidounces; Resin three-quarter ounce; Canada Balsam one-quarter ounce; Cantharides in powder one ounce; Distilled Water six fluidounces. Digest all the ingredients, excepting the Canada balsam, in a water-bath for two hours, stirring them constantly, then strain, and separate the plaster from the watery liquid. Mix the Canada balsam with the plaster melted in a shallow vessel, and pass strips of paper over the surface of the hot liquid, so that one surface of the paper shall receive a thin coating of plaster. It may be convenient to employ paper ruled so as to indicate divisions, each of which is one square inch. *Br.*

The first formula is that of the French codex, the second a slight modification of it.

Medical Action and Uses.—This preparation forms a neat and efficient blistering agent, and is very convenient when the vesicant action is to be accurately limited, as in blistering over nerves and veins, near the eye, etc. It is, however, comparatively less efficient than cantharides cerate when a full and prolonged vesicant operation is desired. Before applying it the skin should be cleansed with warm water.

CHARTA SINAPIS, *U. S.*, *Br. Add.*—MUSTARD PAPER.

Papier sinapisé, Fr.; *Senfpapier*, G.

Preparation.—Take of Black Mustard in powder ninety grains; Solution of Gutta-percha a sufficient quantity. Mix the mustard with as much of the solution as may be necessary to give it a semi-liquid consistence; then apply the whole of the mixture, by means of a suitable brush, to a piece of rather stiff paper, four inches square, so as completely to cover one side of it, and allow the surface to dry. Before being applied to the skin let the mustard paper be dipped for about fifteen seconds in warm water. *U. S.*

Take of black mustard seeds in powder one ounce; Solution of Gutta-percha two fluidounces, or a sufficiency. Mix the mustard with gutta-percha solution so as to form a semifluid mixture, and having poured this into a shallow flat-bottomed vessel, such as a dinner-plate, pass strips of cartridge paper over its surface so that one side of the paper shall receive a thin coating of the mixture. Then lay the paper on a table with the coated side upwards, and let it remain exposed to the air until the coating has hardened. Before being applied to the skin let the mustard paper be immersed for a few seconds in tepid water. *Br.*

By spreading the soft mixture upon paper a layer more uniform in thickness is obtained than by merely passing it over the surface of the former. When passed between cylinders suitably adjusted, the layer will be uniform and the surface smooth. The mustard, previous to powdering, should be deprived of most of its fixed oil by pressure. If the paper has been properly prepared, the mustard will adhere well without peeling off on bending.

Medical Action and Uses.—Mustard paper forms a very convenient means of obtaining the effects of a sinapism. Before being applied it should be immersed for a few seconds in warm (not hot) water.

CHELIDONIUM.—CELANDINE.

Herba chelidonii, P. G.—*Tetterwort*, E.; *Chélidoine*, *Herbe à l'hirondelle*, Fr.; *Schöllkraut*, G.

The herb of Chelidonium majus, *Lin.* *Nat. Ord.*—Papaveraceæ.

Origin.—A perennial herb, indigenous to Europe, and introduced on this continent. It grows in waste places, and flowers from May to September.

Description.—The stem is about two feet high, brittle, and branching; the leaves are alternate, petiolate, oblong or oval, lyrately pinnatifid or pinnate, the terminal segment obovate, the others ovate, cuttoothed or lobed, somewhat hairy and underneath glaucous. The flowers are in small axillary umbels on long peduncles, have a calyx of 2 sepals, 4 obovate yellow petals, about 20 stamens, and produce long linear one-celled capsules containing many crested seeds. All parts of the plant contain a bright orange-colored milk-juice, and have a bitter and acrid taste. The herb should be gathered when it begins to flower.

Constituents.—Probst (1838), and shortly afterwards Polex, isolated from celandine two alkaloids, *chelidonina* and *chelerythrina* or *pyrrhopina;* the latter Probst (1840) declared to be identical with sanguinarina, which was proven by Shiel (1855). Chelidonina, $C_{19}H_{17}N_3O_3$, is separated from chelerythrina by ether, in which it is insoluble; it crystallizes in colorless shining plates, has a bitter afterwards acrid taste, and yields with acids colorless salts, having an acid reaction, and a strongly bitter taste. Probst isolated also *chelidoxanthin*, which crystallizes in small yellow needles, has a bitter taste, is insoluble in ether, sparingly soluble in alcohol and freely soluble in hot water; it is not altered by acids or alkalies. The alkaloids are combined with malic and *chelidoninic acid*, which latter appears to be identical with succinic acid.

Pharmaceutical Preparations. EXTRACTUM CHELIDONII.—The expressed juice is freed from albumen by heating to 80° C. (176° F.), evaporated to a small bulk, mixed with an equal weight of alcohol, strained from the gummy precipitate, and the filtrate evaporated to the proper consistence. *P. G.* It has a dark-brown color.

Allied Plants. GLAUCIUM LUTEUM, *Scop.;* Horn poppy, *E.;* Pavot cornu, *Fr.*; Hornmohn, *G.*—A biennial plant, native of Europe, and to some extent naturalized in the United States. It grows mainly near the sea-coast, has clasping pinnatifid or sinuate toothed leaves, yellow flowers, and linear capsules which are beset with numerous short projections. It is less acrid than celandine; the juice, particularly of the root, is saffron-yellow, and contains, besides some sanguinarina, the white alkaloids *glaucina* and *glaucopicrina;* the former is in the herb, the latter in the root.

ARGEMONE MEXICANA, *Lin.;* Prickly poppy, *E.;* Argémone, *Fr.;* Stachelmohn, *G.*—An annual plant, indigenous to Mexico and the West Indies, and spontaneous in most tropical and subtropical countries. It has oblong, clasping, sinuate-lobed leaves, with prickly teeth, large yellow or white flowers, and ovate prickly capsules. Lepine (1861) obtained from the seeds by pressure 18 per cent. of an orange-yellow oil, having a mild taste. The statement by Charbonnier that the herb contains morphia requires confirmation.

Physiological Action and Medical Uses.—The yellow juice which exudes from this plant when wounded was formerly employed, according to the doctrine of signatures, as a remedy for jaundice; and it justified the superstition in so far that by violent purging it relieved cases of this disease depending upon obstruction of the gall-ducts with inspissated bile. In experiments upon animals, and in certain cases of poisoning in man, its effects were those of a violent local irritant, with a special narcotic action upon the nervous system. The fresh plant, as well as the juice, irritates the skin, and the latter is in popular use as a remedy for *warts*. In many rural districts of Europe the fresh juice is employed as a purgative in *jaundice*, abdominal *dropsy*, and inveterate *intermittent fever*, as well as in *scrofula* and chronic *diseases of the skin.* Like other drastic cathartics it is sometimes used as a vermifuge. When the fresh juice can be obtained it is given in doses of thirty or forty drops, or more, in sweetened water or in whey. An extract is used in doses of about ten grains, and an infusion is made with half an ounce of the plant in a pint of water.

CHELONE.—BALMONY.

Snakehead, Turtlehead, Shellflower, E.; *Chelone*, Fr., G.

The herb of Chelone glabra, *Lin.* *Nat. Ord.*—Scrophulariaceæ.

Origin.—The plant is perennial, native of Canada and the United States; grows in wet places, and flowers from July to September. The white corolla is inflated, two lipped, with the upper lip arched, and the mouth a little open; hence the botanical and some of the popular names.

Description.—The stem is 2 to 3 feet high, nearly simple and smooth; the leaves are opposite, nearly sessile, oblong-lanceolate, pointed, serrate, smooth, and shining above. The flowers are in a short, dense, terminal spike, and have the lower lip bearded in the throat and the four stamens with woolly filaments and woolly heart-shaped anthers. The plant is inodorous, and has a decidedly bitter taste.

Constituents.—The bitter principle appears to be soluble in alcohol and water, but has not been isolated.

Medical Action and Uses.—The extreme bitterness of the leaves of this plant probably led to its medicinal use by the American aborigines. It is not, however, tonic, but laxative or purgative according to the dose of it employed. Like other active cathartics it is reputed to "act upon the liver." It is sometimes used as a purgative in *jaundice*, and as an anthelmintic. The *dose* of the powder is a drachm. A decoction made with two ounces of the fresh herb in a pint of water may be given in the dose of two fluidounces.

CHENOPODIUM, *U. S.*—WORM-SEED.

Fructus chenopodii anthelmintici.—*Semences de chénopode anthelmintique*, Fr.; *Amerikanischer Wurmsamen*, G.

The fruit of Chenopodium anthelminticum, *Lin.*, s. Chen. ambrosioides var. anthelminticum, *Gray;* Ambrina anthelmintica, *Spach;* Orthosporum anthelminticum, *R. Br.* Bentley and Trimen, Med. Plants, 216.

Nat. Ord.—Chenopodiaceæ.

Origin.—The genus Chenopodium is characterized by alternate leaves and bractless flowers, with a 5-cleft calyx, 5 stamens, 2 or 3 styles, and bearing a one-seeded utricle as fruit. The plants are frequently covered with a white mealiness. The officinal species is never mealy, but viscid glandular. The stem is angular and branched; the leaves are short petiolate, oblong or ovate, narrowed at both ends, remotely toothed; the small greenish flowers are in dense and leafy spikes; the fruit is inclosed in the calyx. The variety differs from the typical form by having usually a perennial root, the leaves more deeply toothed, the lower being often deeply incised, and the dense racemes usually leafless. Both forms are indigenous to the West Indies, Central and South America, and have become completely naturalized in this country; the typical form having also established itself in some portions of Europe and Southern Africa. The variety is cultivated in Maryland with the view of obtaining the oil, and is quite frequent in waste places in the Southern and in some of the Middle States.

Description.—The fruit is about a line in diameter, depressed or irregular globular, glandular when viewed with a magnifier, of a dull greenish color, assuming a brownish tint on exposure; the thin, but not brittle integuments inclose a vertical seed, which is lenticular in shape, obtuse at the edge, brownish-black and glossy, and has the embryo strongly curved around the albumen. The fruit has a peculiar, aromatic, somewhat terebinthinate odor, and a bitterish and pungent taste. The fruit of Chen. ambrosioides cannot be distinguished from the officinal, except by its weaker and rather pleasanter odor.

Constituents.—American worm-seed has not been analyzed; its medicinal importance is due to volatile oil (see *Oleum chenopodii*), which is the only preparation for which the fruit is used.

Allied Species.—Several European Pharmacopœias recognize the herb of Chen. ambrosioides, *Lin.*, which is known as *Herba botryos mexicanæ; Mexican tea, E.;* Thé du Mexique, des Jésuites, *Fr.;* Mexikanisches Traubenkraut, *G.*

CHEN. BOTRYS, *Lin.;* Jerusalem oak, Feather geranium, *E.;* Chénopode à grappes, *Fr.;* Traubenkraut, *G.*—It is indigenous to Asia and Europe, and naturalized to some extent in North America. It is glandular pubescent, has oblong sinuate-pinnatifid leaves, and leafless cymose racemes of greenish flowers, and is strongly aromatic.

CHEN. BONUS-HENRICUS, *Lin.;* Good King Henry, *E.;* Bon Henry, *Fr.;* Guter Heinrich, *G.*—A European plant, somewhat naturalized here. It is slightly mealy, and has triangular halberd-shaped leaves, which have a mucilaginous saline taste.

CHEN. ALBUM, *Lin.;* Pigweed, Lamb's quarters, *E.;* Ansérine sauvage, *Fr.;* Weisser Gänsefuss, *G.*—A variable mealy annual, common in cultivated ground. The leaves vary between rhombic-ovate and lanceolate, and are angulate toothed, the upper ones often entire. The taste is mucilaginous and saline.

Medical Action and Uses.—All parts of the plant producing wormseed possess anthelmintic properties, and were long used by the southern negroes and others as a vermifuge for *lumbricoid worms;* the expressed juice and the seed being most commonly employed. These have been supplanted by the oil (Oleum chenopodii). The fresh expressed juice may be given in doses of a tablespoonful two or three times a day. A decoction made by boiling an ounce of the leaves in a pint of milk or water has also been used. The bruised or pulverized seeds may be given in an electuary, in doses of twenty or more grains three times a day. Carbonate of iron may be advantageously added to this preparation. After the anthelmintic has been used for several days, a purgative dose of castor oil should be administered.

CHIMAPHILA, *U. S.*—PIPSISSEWA.

Prince's pine, Wintergreen, E.; *Herbe de pyrole ombellée,* Fr.; *Doldenblüthiges Harnkraut, Wintergrün,* G.

The leaves of Chimaphila umbellata, *Nutt.*, s. Chim. corymbosa, *Pursh*, s. Pyrola umbellata, *Lin.* Bigelow, Med. Bot., ii. 21; Woodville, Med. Bot. v.; Bentley and Trimen, Med. Plants, 165.

Nat. Ord.—Ericaceæ, Pyroleæ.

Origin.—The genus is characterized by flowers having 5 petals, 10 stamens with the filaments enlarged in the middle, and the anthers conspicuously two-horned; the short style, with the disk-like and 5-lobed stigma, is nearly immersed in the top of the ovary; the capsule is 5-celled and many-seeded. The officinal species is a low shrub, 4 to 8 inches high, bearing the leaves near the summit of the stem, and a terminal peduncle with 5 or 6 wax-colored flowers in a corymbose umbel. It is indigenous to North America, Northern Asia, and Northern and Central Europe; is found in dry woods, and flowers in June and July.

Description.—The leaves are 1 to 2 inches long, on very short petioles, oblanceolate and sharply serrate above, with the base wedge-shaped and entire, leathery, upper side dark green and glossy, paler beneath. They are inodorous, and have a sweetish, afterwards astringent and bitterish taste.

The closely allied *Chim. maculata, Pursh*, spotted wintergreen or pipsissewa, with lanceolate or ovate lanceolate and toothed leaves, which are variegated with white on the upper surface, is indigenous to North America, and is used like the preceding.

Constituents.—Besides the widely diffused principles, sugar, gum, etc., S. Fairbank (1860) found tannin and obtained 5.24 per cent. (of the dry leaves?) of ashes. On distilling the stems with water, golden yellow crystals of *chimaphilin* are obtained in the neck of the retort, which are inodorous and tasteless, slightly soluble in water, freely soluble in alcohol, ether, chloroform, and the fixed and volatile oils. It may also be obtained from the tincture (of the leaves alone?), made with diluted alcohol, by agitating it with water. Zwenger and Himmelmann (1864) isolated from the leaves *arbutin*, which, together with tannin, was found by J. Oxley (1872) in several other ericaceous plants (see *Epigæa*, *Gaultheria*, and *Uva ursi*).

Off. Prep.—Decoctum chimaphilæ and Extract. chimaphil. fl., *U. S.*

Medical Action and Uses.—The fresh bruised leaves of pipsissewa applied to the skin cause redness and even vesication. Internally it is diuretic, tonic, and astringent, and, like uva ursi, darkens the urine in consequence of the tannin it contains. Indeed, in all its operations it closely resembles uva ursi. It was used by the natives and by the early settlers of this country for *rheumatism* and for *nephritic* disorders. The former disease in the joints was treated with fomentations or poultices of the leaves, while a hot decoction of them was administered internally to the production of sweating. In cases of scanty or suppressed secretion of *urine* it was often resorted to, as well as in *gravel*, and *hæmaturia* from various causes. The cure of many cases of dropsy was attributed to its use, and the evacuation of the fluid through the kidneys in other cases depending upon incurable organic lesions. Physicians of sound judgment have testified to its usefulness in *scrofula* of the glands and skin, both as an internal remedy and as an application to scrofulous ulcers. In the treatment of dropsy and of scrofula the generally superior efficacy of other medicines should not cause this one to be overlooked. Chimaphila has also been prescribed in the treatment of *intermittent fever*, chronic *diarrhœa*, *leucorrhœa*, and *gleet*. The best form of the medicine is the decoction or the fluid extract.

CHIRETTA, *U. S.*—CHIRETTA.

Chirata, Br.—*Chirette*, Fr.; *Chiretta*, G.

The entire plant Agathotes (Gentiana, *Roxb.*) chirayta, *Don;* Ophelia (Gentiana, *Wall.*) chirata, *Griseb.* Wallich, Plant. Asiat., iii. 252. Bentley and Trimen, Med. Plants, 183.

Nat. Ord.—Gentianaceæ.

Origin.—The plant, which is four to five feet high, is an annual, and indigenous to the mountainous portions of Northern India, where it grows at an elevation of from 5000 to 9000 feet, and is collected when the fruit begins to form.

Description.—It is met with in flattened bundles about three feet long, tied with a thin slip of bamboo, and has a purplish-brown color. The simple and tapering root is about three inches long. The stem is cylindrical, becoming slightly quadrangular above, much branched, smooth, and slightly thickened at the nodes. The leaves are opposite, closely sessile, ovate or ovate-lanceolate, entire at the margin, and five-nerved; in the outer layer of the bundles they are usually broken off, leaving the stems almost bare. The flowers are in loose axillary racemose cymes, in the upper branches often single, stalked, with a deeply four-lobed calyx and corolla, the latter upon each acute lobe with a pair of fringed scales; stamens four. The fruit is an ovate capsule tapering above into the two styles, and projecting but little from the persistent calyx and corolla. The seeds are very numerous, minute, and angular. The drug is inodorous, and has a purely and persistently bitter taste.

Constituents.—The older analyses failed to isolate the active principles of chiretta, and demonstrated only the presence of the common constituents of plants and the almost total absence of tannin. Henry Höhn (1869) succeeded in isolating two distinct bitter principles, *ophelic acid* $C_{13}H_{20}O_{10}$, and *chiratin* $C_{26}H_{48}O_{15}$, the former of which was obtained as a brown, very hygroscopic, amorphous mass, which is readily soluble in water, alcohol, and ether, has a slightly acidulous, afterwards intensely bitter taste, precipitates cuprous oxide from Trommer's solution, and produces with the lead acetates yellow precipitates; a crystalline salt could not be obtained. Chiratin forms a pale yellow powder, which, though hygroscopic, is not freely soluble in cold water, but dissolves readily in alcohol and ether, has a neutral reaction to test paper, and an intensely bitter taste. Its aqueous solution produces a flocculent white precipitate with tannin, and is not affected by Trommer's solution. When boiled with diluted hydrochloric acid it is split into ophelic acid and *chiratogenin* $C_{13}H_{24}O_3$, which is yellowish-brown, amorphous, bitter, nearly insoluble in water, soluble in alcohol, not precipitated by tannin, and not affected by Trommer's solution. It is not improbable that chiratogenin may exist in the drug. The presence of a crystalline wax-like substance and of some tannin was also observed. Dried at 100° C., the stems yielded 3.7 and the leaves 7.5 per cent. of ashes, which are mainly composed of potassa, lime, and magnesia, combined with carbonic and phosphoric acids.

Substitutes.—Several species of ophelia and allied genera are known in India as chiretta, and are distinguished from the officinal drug as *puharee* (hill), *dukhunee* (southern), *ooda* (purple), and *meetha* (sweet) chiretta; they appear to be indiscriminately collected and sent to Bombay, where, according to Dymock, the drug is garbled. Prof. Bentley (1874) met with such a substitution, probably *Ophelia angustifolia*, or *O. pulchella*, Don, which had the stem obscurely quadrangular below, and evidently four-sided and winged above, the leaves narrow and tapering to both ends, the leaf-scars not prominently marked, the flowers larger, the woody circle of the stem thicker, and the infusion less bitter than the true chiretta.

Off. Prep.—Infusum chiratæ, Tinctura chiratæ, *Br.*

Medical Action and Uses.—In Hindoostan this medicine is held to be *stomachic*, tonic, febrifuge, cholagogue, and deobstruent, as well as efficient in chronic *bronchitis*. In truth, it possesses virtues very similar to those of gentian and other simple bitters. The dose of chiretta is about twenty grains. An infusion may be made with half an ounce of chiretta to a pint of boiling water, or this preparation may be reduced by boiling for twenty minutes. *Dose*, one or two fluidounces three times a day. A tincture is also made.

CHLORAL, *U. S.*—HYDRATE OF CHLORAL.

Chloral hydras, Br. Add.; *Chloralum hydratum crystallisatum*, P. G.—*Chloral*, E.; *Hydrate de chloral*, Fr.; *Chloralhydrat*, G.

Formula $C_2HCl_3O.H_2O$. Molecular weight 165.5.

Formation and Preparation.—Chloral was discovered by Liebig (1832), and its production and composition were soon after determined by him and by Dumas. The results of these investigations prove that when dry chlorine is passed into absolute alcohol, aldehyd and hydrochloric acid are first formed: $C_2H_6O+Cl_2=C_2H_4O+2HCl$. By the continued action of dry chlorine gas, three atoms of hydrogen are abstracted from the aldehyd, with the formation of hydrochloric acid, and are replaced by three atoms of chlorine, producing chloral; the reaction is explained by the following equation: $C_2H_4O + 3Cl_2 = 3HCl + C_2HCl_3O$. Wurtz and Vogt regard the reaction as much more complicated. Other products of decomposition are formed in smaller quantities, and necessitate the subsequent purification of the chloral. The yield is very materially reduced if water be present, in which case a portion of the aldehyd at first produced is converted into acetic acid ($C_2H_4O + H_2O + Cl_2 = C_2H_4O_2 + 2HCl$), and this acid reacting with some alcohol forms acetic ether, which is not transformed into chloral by the action of chlorine. In preparing chloral, therefore, the materials reacting upon one another must be as nearly free from water as they can be obtained. Chlorine gas is generated in the usual manner, and passed first into a Woulf's bottle, where some of the moisture is condensed, then over chloride of calcium or through sulphuric acid, by which it is completely dried, and finally into the absolute alcohol, which is kept cool as long as the chlorine gas is rapidly absorbed; but after a few days requires to be warmed, the heat being slowly increased until at the end of the process it has reached 60° to 70° C. (140° to 158° F.). The whole process requires about two weeks (for 600 grams alcohol three days, Dumas); but if larger quantities of alcohol be operated upon, a longer time is required. In the experience of Dr. Squibb (1870), 92 pounds of alcohol required the continuous generation of chlorine gas for 28 days, using about $1\frac{1}{4}$ tons of mixture of manganese binoxide and common salt, and yielded about 160 pounds of crude chloral. Large quantities of hydrochloric acid gas containing some chloral escape during the latter part of the process, and if passed through a reversed condenser, the vapors of the latter will be condensed and returned to the vessel. Kraemer observed (1874) that the ethereal liquid which accumulates beneath the muriatic acid is a mixture of the *chlorides of ethylene* and *ethylidene.*

Crude chloral for its purification should be treated first with about its own weight of strong sulphuric acid, by which the hydrate and alcoholate of chloral are decomposed, and colorless chloral separates as an oily layer, which is at once rectified over some burned lime. To avoid combustion the lime must be completely covered by the liquid. Dr. Squibb prefers to distil the chloral directly from the sulphuric acid, to combine the distillate partly with water, rectifying it over a mixture of lime and calcium carbonate, and hydrating this second distillate completely by adding the necessary quantity of water, ascertained by calculation from the weight of the first distillate (82 parts require 10 parts of water); while still hot the mass is poured upon plates covered with a bell-glass, and allowed to crystallize.

Properties.—Chloral (anhydrous) is a colorless thin oily liquid, having the density 1.502, boiling at 94.4° C. (202° F.), and being gradually or sometimes rapidly converted into *insoluble chloral*, which is a white mass or powder of the same composition as chloral, and on distillation becomes again liquid and soluble in water. The change into the insoluble condition is prevented by the addition of a little chloroform (Markoe, 1870).

Chloral hydrate is met with in white crystalline masses, or in separate colorless crystals of a saccharoid aspect, attracts moisture in a damp atmosphere, but in a nearly dry atmosphere evaporates slowly without liquefying. It fuses between 56° and 58° C. (133° and 136° F.), congeals again at about 50° C. (122° F.), boils near 95° C. (203° F.), and evaporates without leaving any residue. It is soluble in four parts of chloroform, and in less than its own weight of water, alcohol, or ether. Chloral which has been insufficiently hydrated, contains the insoluble modification, and is, therefore, not completely soluble in water. It dissolves in fixed and volatile oils (Jehn, 1874), in petroleum benzin, benzol, and carbon bisulphide, and may be readily obtained in crystals from the hot solutions. It has a peculiar somewhat aromatic odor, the pungency of which is increased with the temperature. When pure its vapors are but slightly affected by the vapors of ammonia, except at a somewhat elevated temperature, when white clouds are produced. The solution of chloral hydrate in strong alcohol has a neutral reaction, but when dissolved in water it slightly reddens blue litmus paper; it is, however, not precipitated by nitrate of silver (absence of hydrochloric acid). Treated with soda or other alkaline hydrate, chloral is decomposed into chloroform and formiate; $C_2HCl_3O + KHO$ yields $CHCl_3 + KCHO_2$.

Tests.—The presence of chloral alcoholate is indicated by the combustion which takes place on heating a sample upon platinum foil over a flame. Smaller quantities are detected by the turbidity resulting from the production of iodoform, if a strong aqueous solution is warmed with a slight excess of potassa solution, iodine being then added as long as it is decolorized. On cooling microscopic crystals of iodoform will separate. The presence of various organic impurities is detected by warming the chloral hydrate with sulphuric acid, which will then acquire a brown color. If decomposition has set in, the aqueous solution of chloral hydrate on being acidulated with sulphuric acid, will readily decolorize a weak solution of potassium permanganate, and cause a white precipitate with nitrate of silver. The decomposition of chloral hydrate by alkalies affords a means of estimating its value; when perfectly pure, 100 grains of it dissolved in an ounce of water, and mixed with 30 grains of slaked lime and distilled, yield 72.2 grains (not less than 70 grains, *Br.*) of chloroform. Moist chloral hydrate yields less in proportion to the excess of moisture; chloral alcoholate produces only 60 per cent. of chloroform. V. Meyer and Heffter (1873) estimate the purity of chloral from the amount of formic acid produced, by warming the solution of chloral hydrate with an excess of normal solution of soda, and determining the excess of soda volumetrically by an acid. Pure sodium hydrate will decompose 4.1375 times its weight of pure chloral hydrate.

Regeneration of Decomposed Chloral Hydrate.—This is accomplished by treating it with strong sulphuric acid, and manipulating, as in the purification of crude chloral. If the decomposition is slight, recrystallization from hot petroleum benzin or carbon bisulphide will be sufficient.

Pharmaceutical Preparations. CHLORAL HYDRATE AND CAMPHOR.—In 1873, attention was drawn to the fact that if powdered camphor be triturated with an equal weight of chloral hydrate, a colorless liquid of syrupy consistence is obtained, which has since been used under the name of *camphorated chloral.* E. C. Saunders (1876) regards it as a simple solution, camphor being the solvent. It is soluble in alcohol, ether, glycerin, and fixed oils, but is decomposed by water, chloral hydrate being dissolved and camphor precipitated.

CHLORAL HYDRATE AS A SOLVENT.—R. F. Fairthorne (1874) observed that solutions of chloral hydrate in water or glycerin will dissolve morphia, veratria and other alkaloids, and suggested a class of preparations, which he named *chloral glycerites*, the basis of which is a solution of one drachm of chloral hydrate in a half fluidounce of glycerin.

Off. Prep.—Syrupus chloral, *Br. Add.*

Physiological Action. *On Animals.*—Chloral is hypnotic and anæsthetic. Many animals are very susceptible to its action. A grain and a half hypodermically administered to a rabbit has caused a lethargic sleep lasting nine or ten hours. In frogs, a grain has rapidly induced insensibility, coma, and death immediately preceded by spasm or convulsion. In general, the sleep produced in animals by chloral is not profound, but prolonged, resembling natural sleep. It lowers the temperature so considerably that of two animals to which equal poisonous doses have been given, if one be kept warm artificially, and the other is exposed to the air, the former will be saved but the latter will die. These are the effects when chloral is administered by the stomach or hypodermically;

but when it is injected into the veins, the effect will vary with the dose employed; the heart and lungs may simultaneously and suddenly cease to act, or the latter may be first arrested, or the action of both may be interfered with in various degrees. The heart's muscles appear to be paralyzed, and its cavities become more distended with blood at each pulsation. If the animal survives, the heart recovers slowly and irregularly its normal action. Meanwhile the blood accumulates in the bloodvessels as well as in the heart, and embarrasses still further respiration, and oppresses the cerebrospinal nervous centres. In all these organs, including the heart, and in the muscles also, the vessels are gorged with blood.

Observation of its effects upon animals appears to show that chloral in slowly poisonous doses interferes with or arrests the functions in the following order: 1. Those of the brain. 2. Those of the voluntary muscles. 3. Those of the respiratory apparatus. 4. Those of the heart. Throughout the series the blood grows more and more unfit to sustain life.

On Man.—Applied in its pure state to the sound skin it occasions a slight redness, but it acts as a powerful irritant upon the derm and upon wounds, even occasioning eschars, and excites pain in healthy mucous membranes. Its taste even in a watery solution is somewhat acrid and bitter, causing a sense of burning in the throat and sometimes in the stomach also, and producing more or less salivation. In enema it occasions more or less heat and irritation in the rectum; and its subcutaneous injection is not only painful, but is apt to be followed by sloughing.

Like opium, chloral allays pain and produces sleep, but less perfectly than opiates. It seldom produces the untoward effects of opium, such as nausea, dryness of the fauces, constipation, anorexia, dysury, headache, giddiness, or malaise; nor, except in very large doses, does it occasion anæsthesia. Indeed, the effects of occasional and appropriate doses closely resemble natural sleep, except that the face is flushed; the patient may sometimes even be temporarily awakened to take food or obey a call of nature without interfering permanently with the soporific action. As in natural sleep, respiration and circulation are retarded and the temperature is slightly lowered. Exceptions to these statements may be found in certain cases in which the sleep is restless or unrefreshing, or in which a state of delirious excitement exists, or in which there is subsequently experienced a degree of dulness, or headache, or sick stomach, or a partial loss of power in the limbs. But these effects are unusual, and may have been due to the use of an impure preparation.

Like chloroform, chloral sometimes produces poisonous and even fatal effects, without its being possible to explain them, by an excessive dose, or by any special condition of the patient. Death has resulted from the use of even ten grains of the drug. The phenomena of acute chloral poisoning usually denote failure of the heart's action. There are apt to be faintness, feeble pulse, fluttering heart, paralyzed and cold extremities, a sense of sinking, pallor, and partial lividity of the face; in a word, the phenomena of syncope. In other cases narcotism and asphyxia precede death, especially where the dose has been immoderate. In some cases the toxical effects come on suddenly in the midst of quiet sleep, the patient falling into collapse, with convulsions, presently ending in death. Or there may be no convulsion before death, but only hurried breathing and fluttering of the heart. Sometimes recovery takes place after enormous doses, such as 350 grains. A state of chronic disorder, which may be called chloralism, and is sometimes very persistent, comprises many of the following phenomena: mental hebetude and irritability, an emotional excitability and obstinate insomnia, loss of memory, with physical incapacity for exertion, and extreme prostration on attempting it; uncertainty of movement and a tendency to fall forward, or absolute inability to stand or walk, or perform various coördinated movements, as writing, articulation, etc.; partial paralysis of the œsophagus; impairment and even loss of vision; dyspnœa, especially on exertion; wandering pains and sometimes numbness of the limbs; a slow pulse, lowered temperature, and a low specific gravity of the urine; a dark, spotted, erythematous flush of the face, intensified by alcohol or by mental excitement; a bloodshot condition, and occasionally yellowness, of the conjunctivæ; caprice of appetite, nausea, and constipation, with pale and hard feces. Besides these effects is sometimes observed a condition which denotes an altered state of the blood, such as a spongy and ulcerated state of the mucous membrane of the mouth, livid and hemorrhagic spots upon the skin, purpurous effusions in the mucous membranes of the lungs, bowels, etc., general œdema, eczematous and scaly eruptions of the skin, alopecia, and shedding of the finger and toe nails. These latter effects correspond to the disorganization of the red corpuscles, which is observed in some cases of acute fatal poisoning by this substance.

Prof. Liebreich attributes a large proportion of these mischievous effects to the use of an impure preparation of chloral. He states that sometimes chloral, as it is sold, contains other compounds which give rise by their decomposition to acid and irritating substances of a complex character, which have a very injurious physiological action, and are liable to produce dangerous results. This eminent physician has called attention to a curious circumstance, viz., that after a dose of chloral alcohol produces much more than its ordinary effects in flushing the face. This effect seems to be due to the paretic action of chloral upon the arteries and capillaries as well as upon the heart.

When chloral was first introduced into medicine it was assumed to undergo in the blood a decomposition into formic acid and chloroform, to the latter of which its operation was ascribed, while the formic acid united with the alkalies of the blood. This view, which was purely hypothetical in its origin, has been disproved by demonstrating that chloral does not undergo decomposition in the blood at all, and may be found in this fluid after having been taken by the mouth; that its action is the same whether the blood be normally alkaline or abnormally acid; and that in the frog its characteristic effects take place, whether the circulating fluid be blood or a saline solution.

Medical Uses. *Insomnia.*—Chloral appears to be indicated when sleeplessness is dependent upon a vascularity due to exhaustion rather than to primary excitement of the brain; thus it has been found useful when loss of sleep follows severe and prolonged mental application, or excitement of feeling, or accompanies the general debility following acute diseases attended with delirium or severe pain; or is associated with acute *mania*, especially of the puerperal form. The somewhat analogous condition which exists in *delirium tremens* is very amenable to this medicine, especially in the forming stage of the affection known as "the horrors," and which so frequently follows surgical injuries in drunkards; it is useful also when great nervous excitement and restlessness are associated with extravagant phantasms.

Although far inferior for the relief of *pain*, chloral is a very useful substitute for opium and its preparations in many cases in which the pain is of moderate intensity, or when an idiosyncrasy exists which renders those medicines ineligible. Pains in nervous trunks and extremities, particularly those of neuralgia, whether of central or peripheral origin, of lead colic, cancer, and tumors compressing nerves, are more or less palliated by chloral. It has also been employed with advantage in cases of *angina pectoris* unconnected with obstructive disease, or degeneration, of the heart; but it should be used with extreme caution, if at all, whenever, from these or other causes, the action of the heart is irregular or tumultuous. Chloral is very efficient during *labor* in producing those effects for which chloroform and ether are commonly employed; that is to say, for allaying fruitless and excessive pains, and permitting rhythmical contractions of the uterus to occur; for promoting dilatation of the os uteri; for procuring repose to the mother during prolonged labor; and for quieting alarm and allaying nervous irritability. It should be given in doses of not less than thirty grains, repeated every half-hour until the desired effect is produced.

Among spasmodic affections, *tetanus*, especially of the subacute form, has proved very amenable to this remedy administered hypodermically, and also by the mouth or rectum. It is said that in the more acute and active forms of the disease its efficacy is less demonstrable; but in three acute cases out of four, occurring in the Pennsylvania Hospital, cure followed the use of chloral. The tetanic spasm produced by *strychnia poisoning* is equally under its control; it seems to reduce the force and frequency of the paroxysms; but a lethal dose of strychnia cannot be combated by an adequate dose of chloral, which would be equally dangerous to life. In some instances of *tonic spasm* its effects have been beneficial. It has been used to mitigate the fits of *epilepsy* by giving it before their regular hour of recurrence, when they are periodical. It may lessen the movements in *paralysis agitans*. *Puerperal convulsions* are, perhaps, more amenable to the influence of chloral than any other form of spasmodic disease, although it is far from being a certain remedy. To insure its favorable action it should be given in doses of not less than fifteen or twenty grains, repeated every fifteen minutes until its appropriate effects appear. In a case of *hydrophobia* the medicine was found to control the active symptoms completely, but the patient died by syncope (Gunning). In *chorea* the medicine displays a decided control over the spasmodic element of the disease, and must be regarded as a valuable adjuvant in the cure of cases depending upon definite blood disorder, nervous shock, or reflex irritation. In some uncomplicated cases it suffices for the cure, especially if given in full doses. In *whooping-cough* it is of service by mitigating the violence of the paroxysms, and preventing the loss of strength occasioned by their occurrence at night. It sometimes also appears to shorten the duration of the attack. In other varieties of *cough* it is a useful palliative, but is not to be compared with opium. The paroxysms of nervous *asthma* are sometimes very favorably modified by this medicine, but it is unsuited for the continuous treatment of so chronic a disease. It is one of the best remedies for obstinate *hiccup*. There is an alleged physiological antagonism between chloral and *Calabar bean;* but it is exhibited only when the doses of the two agents are duly proportioned, and the chloral is administered within a very few minutes after the bean.

The combined deodorizing, antiseptic, and stimulant qualities of chloral have caused various applications of it, especially as a *surgical dressing*. A solution of one part in one hundred of water has been found sufficiently strong. This is applied on lint to unhealthy surfaces, such as gangrenous, indolent, erysipelatous, diphtheritic, cancerous, mercurial, and carious *ulcers*, or as an injection for parts not so easily reached. It also corrects the fetor and lessens the discharge in *ozæna*, for which purpose a solution of one part in two or three hundred may be applied by means of the nasal douche. A solution of one part in a hundred corrects *fetor of the feet*. Stronger solutions, containing from twenty to forty grains of chloral to an ounce of water, have been used to prevent the decomposition of animal tissues immersed in them, which they are stated to do without injuring the color or the texture. They have also been successfully employed to inject dead bodies used for dissection. A solution of one part in twenty of water forms an excellent lotion in *pityriasis* of the scalp, and sometimes cures the disease, if it is recent. *Poisoning* by chloral should be treated by the same general method which is applicable to other forms of narcotism, including the use of coffee, galvanism, mechanical stimulants such as friction and flagellation, etc. Strychnia has been used as a physiological antidote to chloral. It would seem appropriate, so far as it tends to rouse the activity of the spinal cord, but it does not tend to diminish the action of chloral upon the brain. Clinical experience upon the subject is still deficient. It is of the utmost importance to combat the singular coldness which the poison tends to produce, by means of artificial heat, such as hot cloths, bottles, sand, etc., applied to the spine, heart, and extremities, and by small and repeated doses of alcohol.

Administration.—Chloral is too irritating for hypodermic use; and its injection into the veins may be mentioned only to be condemned. By the mouth the average dose for an adult is between ten and thirty grains, which may be repeated at intervals of one or two hours. In convulsive disorders much larger doses may be required. For children about one grain may be prescribed for each year of the child's age. The solution should be flavored with an agreeable syrup; peppermint water masks its taste effectually. Enemas of chloral may be prepared by dissolving from fifteen to sixty grains of the compound in a little water, rubbing up the solution with the yolk of egg, and mixing it with a sufficient quantity of milk.

CHLORAL BUTYLICUM.—BUTYLCHLORAL HYDRATE.

Hydrate de chloral butylique, Fr.; *Butylchloralhydrat*, G.
Formula $C_4H_5Cl_3O.H_2O$. Molecular weight 193.5.

Preparation.—It is prepared by passing chlorine gas into acetic aldehyd C_2H_4O, which should be placed in a refrigerating mixture to lessen the violence of the reaction. The apparatus is connected with a reversed condenser, which carries the condensable products back into the flask, while the uncondensable gases are allowed to escape. Gradually the temperature is permitted to rise, and when the hot liquid ceases to absorb the chlorine gas, this part of the operation is finished. The mass is now subjected to repeated fractional distillation until a product is obtained boiling uniformly between 163° and 165° C. (325.4° and 329° F.), which is butylchloral, and, by dissolving in water and crystallizing, the hydrate is obtained. That portion of the crude product distilling at a lower temperature requires treatment with sulphuric acid to decompose the hydrate contained in it, and subsequent fractional distillation.

Properties.—Butylchloral is a colorless oil, heavier than water, of a peculiar odor, somewhat like that of ordinary chloral. The hydrate crystallizes from water in thin white scales of a silky lustre, is freely soluble in alcohol, from which it crystallizes unaltered, soluble in cold water with difficulty, freely in hot water, and volatilizes with the vapors of boiling water. By soda and other alkalies it undergoes decomposition in a manner analogous to ethylchloral under the same conditions; yielding *bichlorallylen* $C_3H_2Cl_2$ formiate and chloride of sodium.

Composition.—When Krämer and Pinner first obtained this body (1870), they considered it to be *crotonchloral* $C_4H_3Cl_3O$, but have since (1875) ascertained that it is *trichlorbutylaldehyd*, which is butylaldehyd C_4H_8O, with 3H replaced by 3Cl. The hydrate contains a little over 9 per cent. of water.

Physiological Action. *On Animals.*—Administered to animals it produces a tendency to drowsiness, which is, however, usually preceded by some degree of excitement, and then motility and sensibility become successively impaired. Under its full operation anæsthetic sleep occurs, with muscular resolution, during which the respiratory movements and the pulse become less ample, and the temperature of the body falls, it may be as much as from one to three degrees C. If the experiment is suspended at this stage, the animal gradually recovers without injury. If, however, the dose is mortal, it destroys life by arresting the action of the heart. After death there is found vascular congestion of the meninges of the brain, and in a less degree of the membranes of the spinal cord.

On Man.—In the dose of from ten to thirty grains it occasions, in the course of from five to ten minutes, a sense of heaviness, confusion of ideas, and dulness of the senses; cutaneous sensibility is blunted, in the face first, and afterwards in the limbs, motility being at the same time more or less impaired. In from ten to thirty minutes sleep sets in; it is deep and tranquil, and while it lasts neither respiration, circulation, temperature, nor muscular tone is greatly affected. On the return of consciousness some dulness or lightness of the head may be experienced, but it soon passes off. The most striking peculiarity of these symptoms is the conservation of muscular tone. It was pointed out by Liebreich in his original communication respecting "croton-chloral hydrate." He describes two maniacs to whom it was administered as "remaining quietly sitting on their chairs in a deep sleep for two whole hours together." In medicinal doses it does not appear to derange the stomach, but its acrid taste, which persists in the throat, may excite nausea, and even vomiting. Very large doses may cause vomiting and diarrhœa; and the former effect has been induced by the hypodermic administration of the medicine.

The question as to the modus operandi of this preparation has been variously resolved by different investigators. Some will have it that in the blood it is resolved into chloroform and formic acid, of which the former is the real cause of the characteristic phenomena. But since these phenomena, and especially the conservation of muscular tonicity, are not those of chloroform, the theory may be discarded as inadequate. It is not worth while to pursue such investigations, which are as vain as those which have arisen respecting the soporific effect of opium, and which the satirist has answered as intelligibly as the scientist, by referring them to its "vis dormitiva."

Medical Uses.—The indications for the employment of this medicine were originally stated to be: 1. Its substitution for chloral hydrate in cases of heart disease; 2. Neuralgia of the trigemini; 3. When very large doses of hydrate of chloral are necessary to produce sleep. In the last case it is recommended to associate the two hypnotics. Experience has proved that it is of little use even in *neuralgia*, unless the pain affect the fifth pair. In that form of the affection, however, it is a most useful anodyne. If doses of from five to twenty grains are given at intervals of fifteen or thirty minutes, the pain is apt to be palliated, even before sleep is induced. In this manner it has proved very efficient in cases of *painful spasm* (tic douloureux) of the face. In ordinary facial neuralgia occurring in young persons, especially in anæmic women and girls, it is peculiarly efficient. It is also serviceable in *nervous headache*, and is a palliative of *dysmenorrhœa*. In some cases of *insomnia*, such for instance as are frequent in chronic phthisis, a dose at bed-time of from five to fifteen grains is useful; but its primary effect is apt to subside, and larger doses become necessary. Butyl-chloral is contraindicated by hyperæmia of the brain, and by an irritable condition of the gastro-intestinal mucous membrane, and by diseases which impair the vigor of the heart.

It may be given in doses of from three to ten grains; but the smaller dose is preferable, and may be repeated at intervals of an hour or less, until the due effect is obtained. Females are much more readily than men affected by small doses. Much larger doses than these have been recommended, as from eight to fifteen grains, and even from thirty to sixty grains; but they can rarely be necessary or safe. The extreme bitterness of the medicine requires it to be administered in a solution capable of masking its taste, such as glycerin and syrup flavored with essence of peppermint, or, still better, the syrup of liquorice root. It may also be administered in a mixture of the following description: butyl-chloral hydrate 5 to 10 parts; glycerin 20 parts; distilled water 130 parts; the mixture to be shaken before it is used. The dose of this preparation is half an ounce, followed in five minutes by a second, and in ten minutes by a third. It is well to begin with a small dose, so as to avoid hypnotism when the anæsthetic effect alone is desired; but to produce sleep from fifteen to forty-five grains, according to the patient's constitution, may be given at bedtime. Its hypodermic use is not to be recommended, on account of the abscesses it occasions. If poisonous effects result from an overdose, it is recommended to combat them with artificial respiration, electricity along the spine at the superficial portion of the pneumogastric nerves, while stimulants are applied to the extremities.

CHLOROFORMUM VENALE, *U. S.*—COMMERCIAL CHLOROFORM.

Chloroforme vénal, Fr.; *Käufliches Chloroform*, G.

CHLOROFORMUM PURIFICATUM, *U. S.*—PURIFIED CHLOROFORM.

Chloroformum, Br.; *Chloroformium*, P. G.; *Formylum trichloratum.*—*Chloroforme pur*, Fr.; *Reines Chloroform*, G.
Formula $CHCl_3$. Molecular weight 119.5.

Origin and Preparation.—Chloral is formed from alcohol and chlorine, and on decomposing chloral by an alkali, chloroform and a formiate of the alkali are produced; the conditions for these two reactions are present on bringing together alcohol and chlorinated lime, the chlorine of which converts the former into chloral, which is at once decomposed by the calcium hydrate, yielding chloroform and calcium formiate $Ca2CHO_2$ (see page 391). Omitting the formation of chloral, the reaction of chlorinated lime upon alcohol is explained by the equation: $16CaHClO_2 + 4C_2H_6O$ yields $2CHCl_3 + 3(Ca2CHO_2) + 5CaCl_2 + 8CaH_2O_2 + 8H_2O$. Calcium formiate is, however, not found in the residue of the distillation, but is decomposed by another portion of the chlorinated lime into calcium carbonate and chloride and water: $3(Ca2CHO_2) + 6CaHClO_2$ yields $6CaCO_3 + 3CaCl_2 + 6H_2O$. The theoretical quantity of chloroform obtainable according to these reactions would be 30 per cent. of the weight of available chlorine contained in the chlorinated lime; by working on the large scale, the yield of chloroform ranges between 22 and 24 per cent.

To prepare chloroform, 6 parts of the assayed chlorinated lime are mixed with about 24 parts of water, and the mixture strained into a still; one part of stronger alcohol is added and the whole heated to 40° C. (122° F.), when the heat is nearly wholly withdrawn. The reaction now proceeds rapidly, the temperature rises and the chloroform mixed with some alcohol distils over. The distillate is washed with water, the subsiding layer constitutes *crude chloroform.* The washings are preserved and employed in a subsequent operation. For papers on the manufacture of chloroform consult *Amer. Journ. Pharm.*, 1862, pp. 25, 42, and 1868, p. 289.

The British Pharmacopœia gives a process for preparing chloroform, in which less water (18 parts for the above quantities) is used, and slaked lime is put into the still with the chlorinated lime—an addition which has been recommended by Siemerling, Larocque, and others, but seems superfluous; otherwise the process scarcely differs from the one given, except that the water is mixed with the alcohol, and the solid ingredients are mixed with the liquid in the still.

Crude chloroform varies in specific gravity between 1.45 and 1.49, and imparts to strong sulphuric acid, after having been agitated with it, a brownish or brown color, the degree of coloration depending upon the amount of impurities present.

Chloroform may likewise be prepared by distilling wood spirit (methylic alcohol) or acetate of calcium with chlorinated lime. Chautart proposed to prepare chloroform from oil of turpentine; but Soubeiran proved that chlorinated lime diffused in water acts violently upon the oil, and that but little chloroform having a turpentine odor is obtained.

Purification.—Take of Commercial Chloroform one hundred troyounces; Sulphuric Acid twenty troyounces; Stronger Alcohol twelve fluidrachms; Carbonate of Sodium five troyounces; Lime in coarse powder half a troyounce; Water ten fluidounces. Add the acid to the chloroform, and shake them together occasionally during twenty-four hours. Separate the lighter liquid, and add to it the carbonate of sodium previously dissolved in the water; agitate the mixture thoroughly for half an hour, and set it aside; then separate the chloroform from the supernatant layer, and mix it with the alcohol. When the mixture has separated into two transparent layers, transfer the chloroform into a dry retort, add the lime, and distil, by means of a water-bath, into a well-cooled receiver, taking care that the temperature in the retort does not rise above 67.2° C. (153° F.), until one troyounce of residue is left. Keep the distilled liquid in well-stopped bottles. *U. S.*

The process of the British Pharmacopœia is essentially the same, except that it directs the agitation of the crude chloroform for five minutes with an equal volume of sulphuric acid, and omits the addition of the alcohol directed in the above formula, and obtains a product having the specific gravity 1.49, while that of the U. S. Pharmacopœia has a density of 1.48. On agitating crude chloroform with strong sulphuric acid the impurities contained in the former are destroyed, the chloroform separating as a colorless layer upon the acid. It may now be at once transferred to a retort containing some chloride of calcium and lime, or preferably is deprived of the adherent acid by washing with a solution of sodium carbonate, and subsequently distilled from the lime, by which operations the acid and water are completely removed. If the distillation is now effected at a temperature not exceeding 67° C. (153° F.), with the precaution of leaving a small quantity of liquid in the still, all impurities will be effectually separated which may have escaped the action of the acid, because they have a higher boiling point than chloroform.

Properties.—Pure chloroform is a limpid colorless liquid, not inflammable, of an agreeable ethereal odor and hot saccharine taste. Its density at 15° C. is 1.499 (*Hirsch*); but in this state it is very prone to change when in contact with air and diffused light; it keeps, however, entirely unaltered in direct sunlight if the air has been completely expelled from the vessel. Chloroform reduced by the addition of alcohol to 1.49 is readily decomposed by direct sunlight, more slowly when exposed to diffused daylight. If reduced to the density 1.480 to 1.484, it remains unaltered in diffused light for years, and for ten hours in direct sunlight, provided all moisture has been excluded; in the presence of some water, decomposition gradually commences. Chloroform below the density 1.475 is not affected by light. This behavior explains the necessity of keeping chloroform of 1.49 protected from the light, which is not required if the density is lowered to about 1.48 by the addition of 1 per cent. of alcohol. The products of decomposition have the suffocating odor of *phosgene gas*, $COCl_2$, redden and often bleach moistened blue litmus, and liberate iodine from potassium iodide; even an incipient decomposition is detected by evaporating spontaneously a drachm of chloroform with a drop of a neutral solution of litmus which will thereby acquire a red color. Partially decomposed chloroform may be restored to its original purity by agitating it with solution of sodium carbonate, and rectifying it afterwards over a little lime. Previous treatment with sulphuric acid will be necessary only, when it becomes colored on being agitated with the chloroform.

When chloroform is shaken in a perfectly clean glass-stoppered vial with an equal bulk of sulphuric acid, no color should be imparted to either liquid after remaining in contact for twenty-four hours. Should a coloration appear, the chloroform must be regarded as unfit for inhalation, and should be purified by the officinal formula. When it is agitated with an aqueous solution of nitrate of silver, a white precipitate of chloride of silver is not produced. The officinal chloroform placed in a dry flask begins to boil at 61° C. (142° F.). It is slightly soluble in water, to which it imparts its taste, and dissolves readily in alcohol, ether, the fixed and volatile oils, benzol and carbon bisulphide; it dissolves paraffin, gutta percha, caoutchouc, many resins, most alkaloids, iodine, bromine, etc.

Tests.—The purity of chloroform is ascertained by its complete volatility, its neutral reaction, its behavior to concentrated sulphuric acid, nitrate of silver, and iodide of potassium, and by its physical properties.

Detection of Chloroform.—Chloroform has sometimes been used for the adulteration of volatile oils; in these and in other liquids it may be detected by distilling them with some alcohol at a temperature of about 65° C. (149° F.). Hager (1868) recommended the treatment of this distillate with zinc and sulphuric acid, when the chloroform will be decomposed and hydrochloric acid recognized in the liquid by nitrate of silver. A. W. Hofmann (1870) recommended the addition of the alcoholic liquid to a mixture of anilin and alcoholic solution of soda, and warming, when the characteristic odor of isonitriles will be developed; 1 part of chloroform in 5000 to 6000 parts of alcohol may thus be detected, and it may be readily distinguished from *chlorethyliden* which closely resembles chloroform in physical properties. All compounds, however, which on treatment with an alkali produce chloroform, iodoform, or bromoform, give the same reaction.

Pharmaceutical Uses.—Chloroform is used as a solvent in the preparation of atropia and other alkaloids.

Off. Prep.—Linimentum chloroformi, Liquor gutta-perchæ, *U. S.*, *Br.*; Mistura chloroformi, *U. S.*; Spiritus chloroformi, *U. S.*, *Br.*; Tinctura chloroformi composita, *Br.*

Physiological Action. *On Animals.*—The characteristic effects of chloroform are the more promptly produced the more readily the anæsthetic is absorbed, and decline rapidly in proportion to the rapidity of its elimination. In animals whose power of cutaneous absorption is very great, such as frogs and snails, the effects are very prompt, decided, and prolonged. The last peculiarity is due to the slowness of their pulmonary exhalation. Of warm-blooded animals, birds are the most susceptible, and cats, rabbits, and rats are more so than dogs. And, in general, great facility in coming under the influence of the vapor implies a tendency to recover rapidly from its effects. These effects vary for the same animal, and for man, according to the amount of the vapor inhaled in a given time. Some experimenters have maintained that the blood in the arteries becomes dark during chloroform anæsthesia, while others declare that it acquires a lighter hue. In truth the color varies according to the freedom of the respiratory act. If the vapor is slowly introduced into the lungs so as to produce its effects gradually, there is no tendency to darkening of the arterial blood; but a rapid and excessive use of chloroform induces a dusky color of the integuments by occasioning a degree of asphyxia which is the more readily produced in consequence of the simultaneous insensibility of the nervous centres. Immediately on suspending the inhalation the natural color returns to the arterial blood, and even the venous blood for a time is less dark than natural. During the first stage of chloroform inhalation nervous symptoms are apt to develop, and sometimes spasms and convulsions, which are ascribed, not to the action of the absorbed vapor upon the nervous centres, but to the reflex irritation by that vapor of the branches of the superior laryngeal and pneumogastric nerves, which also interferes with the action of the heart and of the lungs. Hence the inhalation of chloroform vapor in large quantities acts by cutting off the supply of atmospheric air, by irritating the respiratory passages and thereby occasioning spasm of their walls, as well as reflex spasm of other muscles; and finally by absorption into the blood.

The experiments of Bernard led him to the conclusion that all anæsthesia is central in its source; that is to say, is due to the direct action of the anæsthetic upon the spinal cord alone, or upon the brain alone, or upon both at once, and that from these centres it controls the sensibility of the distal extremities of the nerves. If the brain alone receives the direct influence of chloroform the sensibility of the spinal marrow and of the nerves is not impaired; if the agent is limited in its operation to the spinal cord, it does not affect the brain, but it deprives the nerves of sensibility; and finally, if applied only to the extremities of the nerves, its influence is not propagated to the nervous centres.

The vascular condition of the nervous centres during chloroform inhalation differs at the different stages of that process. So long as the agitation lasts which usually precedes complete anæsthesia, the cerebral bloodvessels are congested, and the brain will project through an aperture made in the cranium of the animal experimented upon, but with the approach of the full anæsthetic state, this congestion subsides, the swollen convolutions shrink, and the excessive vascularity is replaced by unusual pallor of the tissues. In this particular the sleep produced by chloroform (and by ether) is identical with natural sleep, in which also there is a diminished vascularity of the brain. Compression of the carotids, in like manner, by lessening the amount of blood, and therefore the tissue change in the brain, induces first of all diminished sensibility in the brain and then loss of consciousness. The first or congestive stage of chloroform anæsthesia resembles that of the sleep produced by alcoholic intoxication and by excessive doses of opium; it is stupor or coma rather than sleep. Although the brain, during the full anæsthesia of chloroform, is anæmic, it does not follow that this condition suffices to explain the general loss of sensibility; for not only is this loss far greater than is ever observed in natural sleep, but the local application of chloroform occasions a partial anæsthesia, and there are surgical cases in which the perception of touch and of pain have been completely lost although consciousness, a cerebral function, remained quite unimpaired. These cases are exceptional, but they seem to show that in chloroform anæsthesia there must be a change produced in the conducting channels of sensibility as well as in the central perceptive organ which recognizes the existence of pain.

The order in which the several organs are successively affected is generally this: first the brain, the organ of consciousness, is benumbed, and simultaneously voluntary motion is impaired, while reflex motility may be momentarily increased in the voluntary muscles, and persist in the muscles of organic life; finally, the first-named muscles undergo complete relaxation, and the only remaining signs of life are given by the lungs and the heart.

In regard to the nature of the action by which chloroform impairs, or destroys for a time, sensibility, little more than conjecture can be advanced. According to Bernard, it consists in a partial and temporary coagulation of the contents of the nerve-cells, a view which he derives from the action produced in living muscle by injecting its bloodvessels with chloroform, or by suspending it in the vapor of this liquid. In the animal thus treated the muscle gradually returns to its normal condition. Similar effects are produced by a like treatment of the nerve trunks themselves. It is suggested that this partial and temporary hardening of the nerve tissue suspends the functions of the nerve, and that some analogical reason for adopting it may be found in the fact that infusoria lose all signs of life when dry, and regain them on being moistened; and in the case, also, of frogs to which salt has been administered, and which so abstracts the circulating fluids of the animal as to reduce it to a state of apparent death, in which, among other things, the crystalline lens grows opaque. The rapid, not to say instantaneous, return of a chloroformed animal to its normal condition, does not appear to harmonize with this theory.

In the view of Bernard, that anæsthesia is due to anæmia of the nervous centres, may be found the most plausible theory of chloroform narcosis, but it is by no means in harmony with the observations which go to demonstrate that the entire vascular system is paralyzed, and all the bloodvessels in the body dilated.

This paralysis and consequent dilatation of the bloodvessels are invoked by Schiff to explain the suspension of the heart's action, which, according to him, is due, not to an inhibitory influence of the chloroform directly operating through the nervous system, but to the fact that the increased capacity of the vascular system withdraws from the heart the blood which is the normal and necessary excitor of its movements. It is argued that this view is sustained by the effects which, under the circumstances, are produced by ligatures upon the limbs, by means of which the blood is retained in the trunk, and the heart is duly supplied. But it should not be overlooked that this expedient not only restores a due amount of blood to the heart, but also to the brain, and that to the latter influence is attributed the recovery from apparent death which has been observed in several instances, in man as well as in animals, when they have been so placed that the blood in the trunk gravitated towards the head.

On Man.—Chloroform is an irritant, producing redness of the skin when topically applied, and even vesication if its evaporation is prevented. In the stomach it occasions a diffusive sense of heat. Doses of half an ounce or more have produced general convulsions, insensibility, dilated pupils, trismus, foaming at the mouth, slow and stertorous respiration, and lividity of the face. The pulse is feeble and sometimes irregular. The stools may be bloody, and blood may be vomited. Death may result from pulmonary asphyxia alone, or from this together with gastritis. After death the brain has been found greatly congested, and the mucous membrane of the air-passages and of the alimentary canal in a similar condition. The bronchia are filled with mucus tinged with blood, or mixed with pus. The blood in the vessels is fluid.

The vapor of chloroform when inhaled slowly is apt to produce excitement, usually of an agreeable sort, with extravagant gayety and gesticulation. In fuller anæsthetic doses it occasions a sense of warmth and stimulation radiating from the chest to the extremities, followed by whirring noises in the ears, and a sense of numbness throughout the body, soon followed by a complete loss of consciousness. Sometimes consciousness is more or less preserved, while the sense of touch and that of pain are abolished. During the full anæsthetic sleep, the respiration is at first soporose and quickened, but soon becomes tranquil and slow; the pupil presents all degrees of dilatation; the pulse is at first fuller and more frequent, but subsequently nearly normal; the voluntary muscles are relaxed, but sometimes rigid or even cataleptic, and in females hysterical phenomena occasionally appear. The advantages of chloroform over other anæsthetics consist in its agreeable odor, the small quantity of it required, its non-inflammability, and the rapidity and completeness of its effects. Its one disadvantage is that it often destroys life. The number of deaths caused directly and exclusively by the administration of chloroform, independently of any error in the mode of the inhalation or in the quality of the agent, or any unfitness of the patient, may now be counted by hundreds. They are cases of homicide which may be called involuntary, but which even charity will not warrant us in calling accidental. A large proportion of them took place during operations which, under other circumstances, are considered trifling. It seems probable that many of these operations, such as that for strabismus, the extraction of teeth, the opening of abscesses, etc., were performed while the patient was in a sitting posture, and therefore most exposed to the dangers of syncope, which it has been shown is the chief cause of death in chloroform inhalation. No other solution is so plausible of the otherwise singular fact that the danger of chloroform is in an inverse proportion to the severity of the operation performed. Again, the almost complete safety of chloroform inhalation during natural labor lends itself to a similar explanation. The gravid uterus restricts the circulation of blood in the lower limbs, and increases it in the upper portion of the body; and this condition is mechanically exaggerated by the throes of labor, as well as by the mental stimulus of the parturient female. On the other hand, in the state of exhaustion and terror which accompanies most of the serious accidents of labor and of operative obstetrics, the conditions of safety are reversed, and chloroform becomes peculiarly dangerous. It is maintained by some of those who admit the dangers of chloroform, that they do not exist when this agent is employed in operations upon children. It is alleged that their immunity is owing to the absence of that dread of the possible consequences of the inhalation which older persons experience, and to the much greater rapidity with which they fall into the anæsthetic condition. These reasons may be valid in favor of using a safe anæsthetic in operations upon infants and children, but they do not appear to be sufficient to warrant the selection of chloroform for this purpose. In conclusion, it may be stated that the preference given to chloroform over other anæsthetics by European surgeons has been sensibly modified since the death of its introducer, Sir James Y. Simpson; and that professional opinion tends to the point occupied by Schiff, who "considers that chloroform should be banished from practice as an anæsthetic agent, except in cases in which extraordinary resistance to the action of ether shows itself, in which instances it might be allowed to mix a little chloroform with it in order to produce the commencement of anæsthesia, which should afterwards be continued with pure ether."

Uses. *In Surgery.*—What has been said above indicates the limits of the uses of chloroform in surgery which, in our judgment, experience has established. If the patient is robust and not exhausted; if the anæsthetic is administered to him in a recumbent position; and if its action is restrained within the limits of complete narcotism, its dangers are diminished; but they are not removed, and they cannot always be foreseen. The surgeon, therefore, who employs chloroform takes upon himself the risk, which no necessity imposes upon him, of destroying human life. That tens of thousands have escaped uninjured cannot exonerate him in any case of fatal issue, for he knew the danger and defied it.

During pregnancy chloroform has been used with advantage, both by the stomach and by inhalation, to arrest obstinate *vomiting;* but its tendency to relax the mouth of the uterus should restrict its use to cases in which other remedies have failed, and also to the production of only the first stage of narcotism. During *labor* chloroform is indicated by the presence or the imminence of convulsions; by excessive sensitiveness of the maternal soft parts; by irregular and inefficient pains; and by the necessity of manual or instrumental interference. In all operations for the success of which the contraction of the uterus is essential, the full anæsthetic action of chloroform is unsafe.

Various spasmodic diseases have been favorably influenced by chloroform inhalation. Of these spasmodic *asthma* is very speedily relieved, but the habit of using the medicine soon lessens its influence. *Tetanus*, traumatic as well as idiopathic, has been cured by it in many instances, and in the tetanoid spasms produced by *strychnia* poisoning its influence is salutary, and has often saved life. It has been used beneficially in *chorea* by subjecting the patient to its moderate operation for an hour or two every day; but in this disease its virtues do not counterbalance its dangers.

In *puerperal convulsions* the advantages of chloroform are very decided. Its inhalation should be commenced as soon as the indications of an impending paroxysm appear, such as restlessness, rigidity of the muscles, a staring expression, etc. *Infantile convulsions*, excited by a reflex irritation proceeding from the teeth, the digestive apparatus, etc., may be promptly allayed by chloroform inhalation, and its use for this purpose does not appear to have been injurious. All pains due to spasm are readily relieved by it, as in painter's and other forms of *colic*, including *biliary* and *nephritic*, *dysmenorrhœa*, *spasm of the bladder*, *rectum*, etc.

It affords prompt relief in paroxysms of *angina pectoris;* but when this affection is associated with heart disease, chloroform vapor must be very circumspectly employed.

As a local anodyne the applications of chloroform are as numerous as the seats and varieties of pain. It may be applied as an atomized vapor, on compresses, as an ingredient of liniments, etc. Its association with narcotics and anæsthetics in the last-mentioned form is most eligible, and particularly with tincture of aconite. As a topical anodyne and revulsive this mixture is particularly useful in superficial *neuralgia*, when applied directly over the neuralgic points upon small compresses protected by an impermeable covering, such as a coin, the bottom of a wineglass, etc. Cotton soaked with a solution of camphor in chloroform is one of the best applications for the pain of an *aching hollow tooth*, and rheumatic *toothache* is palliated by bathing the gum with chloroform. Among the many affections for which chloroform is topically useful are *headache*, *rheumatism*, *dysmenorrhœa*, and *painful parturition*, *swelled testicle*, the use of the *moxa*, and the *cautery*, *painful hemorrhoids*, etc.

Administration.—Chloroform vapor should be administered by means ot a napkin folded into a funnel-shape, and held closely over the nostrils and the mouth during inspiration; and in every case the patient should be in a recumbent position. To protect the skin of the face from irritation it should first be anointed. The quantity of chloroform used must vary with numerous conditions, but in surgery chiefly with the duration and painfulness of the operation. In slight operations and in labor profound narcotism is unnecessary, and in whatever degree this condition is required *it should be gradually induced*, especially after the excitement of the primary stage has subsided. A too rapid administration tends to produce symptoms of asphyxia. The best guide for continuing the inhalation is the condition of the pulse and the respiration; if these are normal and unembarrassed, the administration may be continued, provided the pulse warrants it by its strength and regularity. It is of the utmost importance that no more chloroform should be administered than is necessary to produce and preserve the requisite degree of anæsthesia. It has been proposed to administer chloroform as an anodyne and hypnotic by the hypodermic method. It is certainly efficient, but there are two dangers associated with it; the first is that of throwing the liquid into a vein; the second, and more ordinary one, is the production of local inflammation and abscess and even gangrene. The dose thus administered has varied from fifteen to sixty grains.

There is no medicinal antidote to chloroform. It destroys life more or less gradually by asphyxia, or more or less rapidly by syncope. For the former condition artificial respiration is the appropriate remedy. For the latter, the essential treatment consists in instantly placing the patient in such a position as will cause the blood to flow into the brain. In at least one case nitrite of amyl has appeared to save life in chloroform syncope.

CHONDRUS, *U. S.*—Irish Moss.

Carrageen, P. G.; *Caragahen*, *Fucus crispus.*—*Carragaheen*, *Mousse marine perlée*, Fr.; *Irländisches Moos*, *Perlmoos*, *Knorpeltang*, G.

The entire plant, Chondrus crispus, *Greville*, s. Sphærococcus (Fucus, *Lin.*) crispus, *Ag.*

Nat. Ord.—Algæ, Florideæ.

Origin.—This plant grows on rocks of the American and European shores of the Atlantic Ocean, and is collected in the spring on the coasts of New England and Ireland.

Description.—It is attached to the rocks by means of a small disk, has a frond about 6 to 12 inches long, which is cylindrical below, but soon becomes flat and is gradually dilated, acquiring a width of $\frac{1}{8}$ to $\frac{1}{4}$ inch, and repeatedly forked; the final divisions are often $\frac{1}{2}$ inch wide, wedge-shaped and ragged, or crisp at the rounded margin from newly forming segments. The sporocarps are imbedded near the end of the segments and project somewhat above the surface. In the fresh state it is cartilaginous, of a brownish or purple, or frequently yellow or green color. After washing in water and drying in the sun it turns whitish or yellowish, and becomes somewhat translucent and of a horny appearance. It has a slight seaweed-like odor, and a mucilaginous, somewhat saline, taste. 20 grains of it boiled with an ounce of water yield a solution which, on cooling, forms a jelly.

Constituents.—The principal constituent is mucilage, of which Herberger (1834) obtained nearly 90 per cent, 9.5 of which were soluble in cold water. Flückiger found the mucilage to contain 0.88 per cent. and the whole plant 1.012 per cent of nitrogen. The same author obtained over 15 per cent., Herberger only 8.8 per cent. of ashes, which the latter found to consist of chlorides, sulphates and phosphates of sodium, potassium, calcium, and magnesium. Grosse detected, also, traces of iodine and bromine.

Substitutes.—*Chondrus mamillosus*, Grev., having the sporocarps somewhat stalked, otherwise resembling the former, is collected with it; it has the same properties.

Medical Action and Uses.—Carrageen is slightly demulcent and nutritious. Its nutritious elements exist in an exceedingly minute proportion. It once had an extensive reputation in the treatment of chronic *bronchial* and *intestinal fluxes*, and in irritations of the *urinary passages*. The degree of its efficacy in these affections was probably due to its protective qualities, and possibly, also, to the influence of its iodic constituent upon nutrition, which has generally been admitted but not demonstrated.

CICHORIUM.—CHICORY.

Succory, E.; *Chicorée*, Fr.; *Cichorie*, G.

The root of Cichorium intybus, *Lin.* *Nat. Ord.*—Compositæ, Cichorineæ.

Origin.—Chicory is a perennial herb, which is indigenous to Europe and the Levant, and extensively naturalized in North America. The stem is about 3 feet high, with spreading branches. The leaves are oblong or lanceolate, the lowest lyrately runcinate, the upper ones sessile, clasping, toothed, or entire. The flower-heads are in axillary clusters of 2 or 3, have a double involucre, blue or whitish ligulate, and 5-toothed florets and striate akenes, with a chaffy pappus. It flowers from June to October. The root should be collected late in autumn or early in spring.

Description.—The root of the wild plant soon becomes woody, that of the cultivated plant remains fleshy and has a thicker bark. It is several-headed, 10 to 12 inches long, somewhat branched, longitudinally wrinkled, light brown externally and whitish internally. The bark is rather thin, white, radially striate from the darker colored milk-vessels, and by a brown cambium line separated from the finely porous yellow wood, marked by fine medullary rays and concentric annual layers. The root is inodorous, and has a mucilaginous and bitter taste. Over 3,600,000 lbs. of chicory are annually imported into the United States from Europe. It is not unfrequently sold as dandelion root, from which it is distinguished by its lighter color, its thinner bark, and its radiating milk-vessels. Much of it is used for the adulteration of coffee.

Constituents.—Chicory root contains, besides the ordinary constituents ot vegetables, inulin, and a bitter principle which has not been isolated. Nietzki (1876) separated from the flowers a crystalline colorless glucoside, which he found to be insoluble in ether, freely soluble in hot water and alcohol, and with a golden-yellow color in alkalies.

Allied Species.—Cichorium endivia, *Lin.*, Endive, *E.*, Scarole, *Fr.*, Endivie, *G.*, is a native of the Levant and cultivated for salad. The leaves are obovate and finely toothed, the upper ones lanceolate and entire. The blue flowers are axillary, one head being on a long and 3 or 4 on a short peduncle.

Medical Action and Uses.—Chicory is thought to increase the appetite, promote the digestion, and stimulate the liver, in a word, to operate very nearly as dandelion is supposed to act. Its excessive use is alleged to occasion venous congestion of the abdominal organs, the brain, and the organs of the senses. In this manner it is even accused of causing amaurosis. The fresh young plant is generally eaten, like endive, as a salad in the spring season, as a "purifier of the blood," *i. e.*, as a promoter of the secretions of the liver, bowels, and kidneys. Even from ancient times it has been recommended in cases for which dandelion is commonly used, including those of *feeble digestion* with flatulence, constipation, and light-colored stools, a condition supposed to denote torpor of the liver. It is alleged to have cured *intermittent* fevers that quinia failed to arrest, especially when engorgement of the liver and spleen was present, with general dropsy. It is also asserted to have been useful in chronic diseases of the *skin*, particularly those of gouty origin. Chicory root dried, roasted, and ground to a coarse powder has a close resemblance to ground coffee, and is extensively used for mixing with the latter or for fraudulently adulterating it. To those who are not aware that the proper flavor of coffee depends upon its aromatic volatile oil, and who measure its strength by its bitterness, the substitution of chicory can work no disappointment or injury. Very probably an infusion of chicory taken at meals as a substitute for coffee would be preferable to the latter on the score of health, and it is still more probable that pure water would be more wholesome than either; but such facts furnish no reason why the public should be deluded into believing that in drinking an infusion of chicory they are using a true substitute for coffee.

CICUTA.—WATER HEMLOCK.

Cowbane, E.; *Ciguë vireuse*, Fr.; *Wasserschierling*, G.

The herb of Cicuta virosa, *Lin.*; s. Cicutaria aquatica, *Lam.*

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—Water hemlock is a native of the northern section of the northern hemisphere, and is found in America from Canada northward. It grows in swamps and wet places; has a short, thick, rather ovate, hollow rhizome beset with circles of thin rootlets, and flowers from July to September.

Description.—The stem is about 3 feet high, hollow, often purplish. The leaves are on sheathing petioles, bright-green, and smooth, triangular-oblong in outline, twice or thrice pinnate, the leaflets opposite, narrow lanceolate, narrowed at both ends, sharply serrate, and the teeth with whitish points. The umbels are large, compound, the flowers small, white, and the fruit subglobose, laterally flattened, with thick corky ribs, and 6 oil tubes in each mericarp, the two on the face being very thin. The herb has a slight aromatic odor, and a somewhat aromatic and acrid taste.

Constituents.—Polex, Wittstein, and Buignet have observed the presence of a volatile alkaloid, *cicutina*, which, however, has not been completely isolated. The fruit yields about 1¼ per cent. of volatile oil which was proved by Trapp (1858) to be identical with oil of cumin. The *cicutoxin* of Trojanowski (1877) is a tenacious, non-drying, amorphous, resinous principle, residing in bright yellow drops contained in the resinous cortical zone of the rhizome.

Allied Plants.—Cicuta maculata, *Lin.*, *Spotted water-hemlock*, is a common perennial of North America, and is distinguished by its elongated, fleshy, tuberous roots, the purplish spotted stem, and the broader leaflets. Its properties are similar to those of the preceding species. J. E. Young (1855) obtained from the fruit a volatile alkaloid which he regarded as being identical with *conia.*

Sium latifolium, *Lin.*, *Waterparsnip*, is a European perennial, probably also indigenous to California; the nearly allied S. lineare, *Mich.*, which is a native of North America, has been often mistaken for it. Another poisonous species, S. angustifolium, *Lin.*, is indigenous to Europe and North America. The subterraneous portion of the California plant was examined by A. R. Porter (1876) who found in it an aromatic volatile oil, and attributed its poisonous properties to a resinous body. These results were in the main confirmed by N. Rogers (1876) who in addition obtained a nonpoisonous volatile alkaloid resembling Wittstein's *pastinacina;* but according to Porter, this is probably ammonia.

Œnanthe crocata, *Lin.*, *Waterdropwort* or *dead-tongue*, also known as water-hemlock, is a European perennial, with fleshy fusiform roots, containing a yellow juice, roundish-obovate, wedge-shaped, lobed or toothed leaflets and oval-oblong fruits, which are crowned with the long erect style, have thickened lateral ribs and 6 oil tubes in each mericarp. An acrid and emetic principle was observed by Gerding (1849) in *Œnanthe fistulosa.*

Physiological Action.—It is only since 1876 that the source and operation of the poisonous element of this species have been rendered clearer than before by the investigations of Boehm. Before that date it was well known that the root of the fresh plant is its most active part, although the stalks and leaves are scarcely less poisonous. Administered to dogs the root is found to cause salivation, vomiting, diarrhœa, and tetanoid convulsions followed by resolution, and in man essentially the same effects, but with the addition of syncope and strabismus. A child, six years old, having eaten some of the root of this plant suffered from burning pain in the stomach, lost sensation and consciousness, expelled his urine forcibly, and then was seized with violent tetanic convulsions, with grinding of the teeth, strabismus, and bleeding from the ears. Death occurred within half an hour. In various fatal cases it is reported that the gastro-intestinal mucous membrane was inflamed, and even ulcerated and gangrened; but it is probable that these appearances, if they existed, were due to the mechanical irritation of the ingested root. Certain it is that in a recent fatal case no lesions of the sort were found (Trojanowski). More important is the extreme engorgement of the lungs, and of the right side of the heart, and to a great extent of the brain also, which always occurs.

It was long since demonstrated that the oil with which this plant abounds is destitute of poisonous qualities, and that, on the other hand, they are fully developed in the alcoholic resinous extract. They appear to depend upon a principle which has been called cicutoxin (Trojanowski). It is so slowly absorbed from the digestive organs that full twenty minutes elapse after the administration of a fatal dose before its characteristic effects begin to appear. It does not produce any irritation of the fauces or of the stomach. When injected hypodermically it acts still more slowly than by the stomach. It is partially absorbed by the intact skin of frogs. Injected into the veins of animals its operation is almost instantaneous.

Injected subcutaneously in frogs, cicutoxin in the dose of from one to three milligrammes does not act instantaneously, but in from twenty minutes to an hour and a half tonic and clonic convulsions occur alternately, and if the animal dies it is in a state of complete resolution. Meanwhile the respiration is very hurried, the inspiratory so far exceeding the expiratory act, that the animal becomes distended with air. During the spasms the heart's action is suspended in diastole. In mammals poisoned by cicutoxin, the first symptom, occurring in about half an hour, is profuse salivation, with signs of distress, presently followed by a slight quivering or jerking of the muscles, which passes into violent spasm if the animal is irritated. Breathing grows very rapid, and signs of extreme distress are manifested, when suddenly violent tonic and clonic spasms supervene, with frothing at the mouth from the agitation of the saliva; the respiration is suspended by spasm of the respiratory muscles, the urine is violently expelled by a similar action of the abdominal muscles, and the heart acts so violently that its impulse may be heard at the distance of several feet. After a minute or two the spasms subside, and the animal lies exhausted, and breathes deeply, or walks staggering until overtaken by a fresh paroxysm, which still further restricts the function of the lungs, and death by asphyxia and in convulsion takes place. With smaller, non-lethal doses there may be no convulsion, but only wandering spasms of the muscles over all the body.

Medical Uses.—This plant, in consequence partly of its poisonous qualities, and partly because its efficacy is not established, is hardly ever used internally. It is said to be employed by the Kamschatdales as a topical anodyne in *rheumatism*, and others have applied it for the same purpose in *gout* and *neuralgia.*

CIMICIFUGA, *U. S.*—CIMICIFUGA.

Black snakeroot, *Black cohosh*, E.; *Racine d'actée à grappes*, Fr.; *Schwarze Schlangenwurzel*, G.

The rhizome and rootlets of Cimicifuga racemosa, *Ell.*, s. Cim. serpentaria, *Pursh*, s. Actæa racemosa, *Lin.*, s. Macrotys actæoides, *Raf.* Bentley and Trimen, Med. Plants, 8.

Nat. Ord.—Ranunculaceæ, Acteæ.

Origin.—A perennial herbaceous plant, growing in rich woodlands of the United States and Canada. The slender stem is 6 to 8 inches high, is leafless below and above, and bears near the middle several large, petiolate, thrice ternate leaves, with ovate-oblong, acute and deeply-toothed leaflets. The white flowers are in terminal racemes, 8 to 12 inches long, have small clawed two-horned petals, numerous stamens on slender filaments, and usually one pistil, producing a dry capsular fruit, containing many flat seeds. It flowers in June and July, and ripens its fruit in September, after which time the rhizome should be collected.

Description.—The rhizome is about two inches long, and one inch thick, horizontal, somewhat flattened, with distinct nodes and numerous stout branches, the remains of overground stems, which are upright or curved upwards, and increase the length of the underground portion to six inches or more. These branches are somewhat annulate by the prominent nodes, and are, according to their age, either hollow or have a cup-shaped, flat, or even convex termination. The rootlets originate mainly from the nodes, are 6 to 10 inches long, the older ones $\frac{1}{4}$ inch in diameter near their place of attachment, mostly thinner, when dry of a wiry appearance, obtusely quadrangular, and longitudinally wrinkled. The color of the fresh rhizome and root is dark-brown, becoming purplish-black after drying, the stem-remnants of a grayish tint. It has a slight but heavy odor, and a bitterish and acrid taste. As met with in commerce, the rootlets and often also the rhizomes are much broken.

The transverse section of the branches shows a large central usually dark-colored pith, which is surrounded by numerous almost linear wood bundles, the whole being covered by rather a thin bark. The rhizome itself has irregular-shaped wood bundles, and a thicker bark. The rootlets have a thick dark-colored bark, and a white woody meditullium, projecting with from 5 to 2 rays into the former;

the largest number of rays is at the base, and gradually diminishes towards the tip of the rootlets.

Constituents.—Tilghman (1834), J. S. Jones (1843), and G. H. Davis (1861) analyzed black snakeroot, finding starch, some tannin, gallic acid (?), resin, a little volatile oil, and other widely-diffused principles. T. E. Conard (1871) obtained a crystalline principle, which is insoluble in benzin, oil of turpentine, and bisulphide of carbon, slightly soluble in ether and water, and freely in chloroform, diluted and strong alcohol; its alcoholic solution has an intensely acrid and sharp taste. It was obtained from the fresh root by exhausting it with alcohol, precipitating the tincture with subacetate of lead, removing excess of lead by sulphuretted hydrogen, evaporating the alcohol, washing the residue with benzin and water, and crystallizing the undissolved portion from alcohol, after decolorizing with aluminium hydrate. It appears to be a neutral principle. It was isolated by L. F. Beach (1876) from the so-called *cimicifugin* or *macrotyn*, which is prepared by precipitating a concentrated tincture of cimicifuga with water.

Off. Prep.—Extractum cimicifugæ fluidum, *U.S.*

Medical Action and Uses.—It appears to be a sedative of the nervous and vascular systems, in that it occasions, in large doses, vertigo, dimness of vision, nervous tremors, depression of the pulse, and more or less nausea, with increased pulmonary and cutaneous secretion. It was originally employed in the treatment of chronic pulmonary diseases, particularly of *chronic bronchitis* with profuse purulent expectoration. In *chorea*, when independent of definite local disease, there is no doubt of the efficacy of cimicifuga administered so as to produce its specific effects. Probably it is most useful in rheumatic chorea, since it has proved to be an efficient remedy for acute *articular rheumatism*, when freely administered. It is also excellent in muscular rheumatism, and especially in *lumbago*. That it exerts a powerful impression upon the uterine system is rendered probable by the relief it affords to the symptoms of pelvic congestion which often are present during the decline of the *menstrual function*, and by its curing many cases of atonic *amenorrhœa* when its administration is duly prolonged. It is also alleged to be useful in the treatment of *seminal emissions*.

The average *dose* of cimicifuga is represented by twenty grains of its powder. This form is seldom used, a decoction, or the fluid extract, being preferred. The latter is officinal; the former may be prepared by boiling for a short time an ounce of the bruised root in a pint of water. One or two fluidounces may be given at a dose.

CINCHONA, *U. S.*—CINCHONA BARK.

Cortex cinchonæ s. chinæ.—*Peruvian bark*, E.; *Quinquina*, Fr.; *Chinarinde*, G.

The bark of all species of the genus Cinchona, containing at least 2 per cent. of the proper cinchona alkaloids, which yield crystallizable salts.

CINCHONA FLAVA, *U. S.*—YELLOW CINCHONA.

Cinchonæ flavæ cortex, Br.; *Cortex chinæ calisayæ*, P. G.; *Cinchona calisaya, Cortex chinæ regius, China regia.*—*Calisaya bark*, E.; *Quinquina calisaya, Quinquina jaune royal*, Fr.; *Calisayarinde, Königschina*, G.

The bark of Cinchona calisaya, *Weddell.* Hist. Nat. des Quinq., plates 3, 3 bis, and 28.

CINCHONA PALLIDA, *U. S.*—PALE CINCHONA.

Cinchonæ pallidæ cortex, Br.; *Cortex chinæ fuscus*, P. G.; *China fusca s. grisea s. pallida s. cinerea.*—*Pale Peruvian bark*, *Loxa bark*, *Crown bark*, E.; *Quinquina gris s. de Loxa*, Fr.; *Braune* (*Graue*) *Chinarinde*, *Loxarinde*, *Kronchina*, G.

The bark of Cinchona officinalis, *Hook.*, s. Condaminea, *Humb. and Bonpl.*, Plant. æquinoct. i. 33; and of Cinch. micrantha, *Ruiz and Pavon*, Flor. Peruv. ii. 52.

CINCHONA RUBRA, *U. S.*—RED CINCHONA.

Cinchonæ rubræ cortex, Br.; *Cortex chinæ ruber*, P. G.; *China rubra.*—*Red Peruvian bark*, *Red bark*, E.; *Quinquina rouge*, Fr.; *Rothe Chinarinde*, G.

The bark of Cinchona succirubra, *Pavon*, *MS. Nueva Quinologia.* Howard's Illustrations, plate 9.

Nat. Ord.—Rubiaceæ, Cinchoneæ.

Origin.—The genus Cinchona, as at present constituted, consists of about 36 species, all of which are indigenous to South America, from 10° north latitude to 19° or probably 22° south latitude. It follows the eastern slope of the central chain of the Andes, from the southern limits beginning in Bolivia, through Peru; and from about 2° south latitude in Ecuador it occupies also the eastern slope of the western chain of the Cordilleras until by two narrow belts it enters the highlands of New Granada, whence it spreads northeast and northward into Venezuela to the neighborhood of Caracas, and in proximity to the Caribbean Sea. The climate in which the most valuable species are found is, according to Karsten (1858), characterized by a rainy season, lasting for nine months, heavy rains falling principally during the night, and alternating with sunshine and fog through the day; during the remaining three months the temperature frequently sinks in the night to below the freezing point, but reaches in the daytime 25° C. (77° F.), producing dense fogs. The mean annual temperature of these regions is 12° to 13° C. (about 55° F.). The less valuable species are found in regions in which the moisture is less evenly distributed throughout the year, and in which the mean temperature is higher, rising, according to Martius (1863), to about 20° C. (68° F.).

The cinchonas are not met with in the valleys; the lowest altitude was observed by Karsten at the northern limits of the cinchona region, where the valueless *Cinch. barbacoensis* is at an elevation of 100 meters (330 feet). Caldas gives the highest limits at 3270 meters (10,700 feet), Karsten at 3500 meters (11,600 feet). The really valuable species, however, according to Weddell, grow at an altitude of 1600 to 2400 meters (5300 to 8000 feet); an exception is *C. succirubra*, which descends to about 700 meters (2300 feet). They are confined within about 11° to the north and south from Loxa, beyond which limits the barks are of little or no value. The most southern species is *Cinch. australis*, Wedd., the most northern ones *Cinch. tucujensis*, Krst., and *C. cordifolia*, Mutis. All grow in the primeval forests, either singly or with but few specimens together.

The cinchonas are evergreen trees or shrubs, most of the valuable species attaining a height of from 40 to 80 feet. Their laurel-like opposite leaves have deciduous stipules, are entire at the margin, and vary in shape between lanceolate and roundish obovate, occasionally with a heart-shaped base. The petiole and the leaves are often purplish or red while young or before falling, and most of the valuable species (Cinch. succirubra is an exception) are pitted (scrobilulate) on the lower side in the angles formed by the prominent midrib with the lateral veins. The fragrant flowers form terminal panicles, and have a tubular five-lobed corolla of a white rosy or purplish color. The small five-toothed calyx crowns the capsular fruit, which splits from the base upwards, and contains a number of flat and winged seeds. The nearly allied genus or subgenus of some authors, *Cascarilla*, is mainly distinguished by the fruit splitting downwards. Most of the species are variable in their foliage and in other characters, and are met with in several varieties or intermediate forms.

Cinch. calisaya, Wedd., discovered by Weddell (1847), a stately tree, is found in Bolivia and Peru, between 16° and 13° S. lat., at an altitude of 1500 to 1800 meters (5000 to 6000 feet). At a higher elevation it forms the shrubby variety *Josephiana*, and in Bolivia is seen the variety *boliviana*, which has the lower surface of the leaves purplish.

C. officinalis, Hook., the first species discovered by La Condamine (hence the name *Condaminea*), is a tree of about 15 meters (50 feet), and is found in Ecuador and Peru, principally near Loxa.

C. micrantha, R. & Pav., and *C. scrobiculata*, Humb. & Bonp., are trees 10 and 20 meters (33 and 65 feet) high, met with in Peru, between about 13° and 4° S. lat.

C. succirubra, Pav., 15 meters (50 feet) high, appears at present to be chiefly confined to the western declivity of Chimborazo, but is found south to Northern Peru.

The barks of the above species constitute the officinal cinchona barks. Several other species yield barks which are consumed in the manufacture of the cinchona alkaloids.

Collection and Commerce.—The great distance from populous districts at which the cinchonas are found renders it necessary to undertake expeditions of several months' duration. The *cascarilleros* (from *cascara*, the bark) are mostly Indians and half breeds, a number of whom unite in gangs, each one being under the direction of a magistral or mayor-domo, and in the employ of speculators or of companies. Supplied with provisions, they undertake the journey over the mountains during the dry season, and locate their camp near a stream, where they frequently plant maize and beans as an additional supply of food during their protracted stay. A rude shed or hut is constructed, in which the collected bark is dried, and the cascarilleros search for the trees, which they recognize either from the dry leaves and fruits on the ground, or at a distance by their foliage and flowers. The trunk of the tree and the large roots just beneath the ground are then stripped of their bark, after it has been loosened by previously beating it with a mallet, by which in some cases (calisaya) the corky layer is almost completely removed. The tree is then felled with an axe, and the climbing plants and adjacent trees which may support the cinchona are likewise cut, after which the peeling is completed, and the bark carried, often for considerable distances, to the camp, where it is completely dried. The bark of the branches is simply exposed to the sun, and rolled up into single or double tubes or quills; but the thick bark of the trunk, after some exposure, is often piled up in layers, crossing each other at right angles, and heavy weights are placed on the top. By this arrangement the curving or quilling of the pieces is prevented. In some places in New Granada the fresh bark is placed upon hurdles under a shed, and dried by means of fire made on the floor.

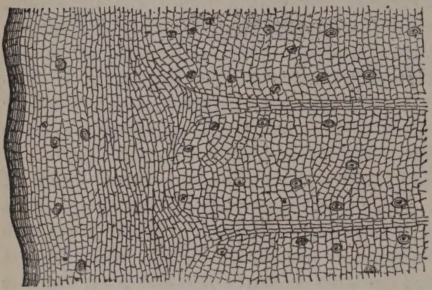
After a superficial examination for the purpose of rejecting the bad bark, the remainder is assorted according to its size, and made into bundles, which are sewn up in coarse canvas. These bundles, weighing about 150 pounds, are finally transported to the depots in the towns, where they are inclosed in fresh hides, which, on drying, contract and make a firm and compact package, the so-called *seroons*. Cinchona bark is also frequently shipped packed in bales and in wooden boxes. The principal ports of exportation of the officinal barks are, for calisaya bark Arica, and to some extent Islay in Peru; for the pale bark Payta in Peru, and for the red bark Guayaquil in Ecuador. Callao, on the coast of Peru, the shipping port of Lima, exports also considerable quantities of cinchona bark. The Colombian (New Granada) barks are exported from Santa Marta and Savanilla, formerly also from Carthagena, and some bark collected in Venezuela is shipped from Puerto Cabello. During the years 1874 to 1877 the average annual importation of all kinds of cinchona barks into the United States was 3,853,662 pounds.

Commercial Terms.—The word *quina* (pronounced gheena), in the language of the Peruvian Indians, signifies bark, and *quina-quina*, a medicinal bark, the term being originally applied to other barks. It is equivalent to the Spanish *cascarilla*, the diminutive of cascara, by which name the cinchona, with many other barks, is known in South America and in Spain. From the former word comes the French *quinquina*, and the German *china*, by which terms the cinchona barks are known in those countries. As the barks of different species are collected, they are in the first place distinguished as *quilled* or *flat*, according to the manner in which they were dried; and, secondly, by some striking peculiarity, principally the color. The color of the external layer necessarily varies with the age of the bark, and with the presence or absence of lichens and other cryptogamous plants. The fresh inner surface is always light colored, but becomes darker on drying; it is always distinct in color from the natural surface, and in the bark of branches is invariably lighter than in the trunk bark. The commercial terms used in this country are—at least for the unofficinal barks—almost altogether geographical ones, and refer to the town in which the depot was situated, or to the port from which it was shipped. Lima, Huamalies, Huanuco, Jaen, etc. barks are sent from Peru; Loxa and Guayaquil barks from Ecuador; and Bogota, Pitaya, Carthagena, etc. barks from Colombia (New Granada).

General Physical Description.—The shape of the commercial bark depends upon its treatment during the drying process, as described above. The quills are usually much broken and quite irregular in size; the flat barks are rather more uniform, though their original size, about eighteen inches in length and four inches in width, has mostly been considerably reduced through repacking and long transportation. These remarks apply also to the curved pieces of trunk bark. The corky layer of the branch bark, unless this is quite young, is usually more or less cracked. The surface of the bark of old wood is influenced in appearance by the presence or absence of the corky layer, which in some species is easily detached. The inner surface, if not torn, always presents a striate appearance, which is coarser or finer according to the relative thickness of the bast fibres and their arrangement; the immature barks of very young branches have a slimy appearance upon the inner surface. The size, arrangement, and relative number of the bast fibres impart to the transverse fracture its peculiar character, and the almost complete absence of these in younger barks causes them to break with a smooth fracture.

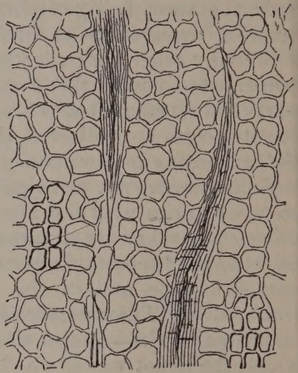
General Structural Characters.—The most important characteristics of cinchona barks are due to their bast or liber fibres, which are never branched, are rather short, with their ends obtusely pointed; of a rather quadrangular appearance upon the transverse section under the microscope, showing the secondary deposits of the cell-walls, by which the central cavity has been almost closed. They present some distinctions in their arrangement as seen upon the transverse section. In some species they are grouped together to the number of 4 to 6—rarely more; in others they form single or double radial rows, 4 to 10 in number; in others, notably in Calisaya, every bast cell nearly is entirely distinct from the others, and is separately imbedded in the bast parenchyma, forming with the others not very regular interrupted lines. The medullary rays are distinct, but usually narrow; together with the preceding they form the *liber* (endophlœum or inner bark). The liber is covered by the *primary layer* (middle bark, mesophlœum, cellular envelope and green layer of authors) or *outer bark*, which consists of parenchyma; in some of the species (C. calisaya, succirubra, scrobiculata, officinalis) a row of *laticiferous ducts* (or vessels, lacunæ of Pereira) is found just outside of the bast rays, and is observable even in old barks, unless the primary bark has been destroyed by secondary cork. Some species have in the primary bark cells with thickened walls, either scattered or in groups; some of these cells contain a brown mass of resinous aspect; others are filled with crystals of calcium oxalate; hence the terms *resin cells* and *crystal cells*. The epidermis is never present in the commercial bark; its place has been taken by a thinner or thicker *corky layer*, the primary cork (or epiphlœum). In some species bands of suberous tissue penetrate into the primary, and even into the bast layer of the bark, throwing off the outer tissues and remaining as the outer covering of the bark. These bands (Mohl's rhytidoma) are *secondary cork*, the periderm of Weddell and others. The distinction between these tissues is neglected by some authors, but the formation of secondary cork evidently tends to obliterate characteristics observed in young barks.

Fig. 32.



Calisaya Bark.
Transverse section, showing corky layer, laticiferous ducts in outer bark, and single bast fibres in inner bark.

Fig. 33.



Cinchona Bast Fibres.
Longitudinal section.

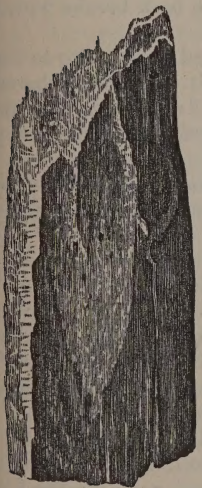
General Chemical Characteristics.—All cinchona barks contain astringent and alkaloidal principles, but they are present in very variable proportions. Grahe (1858) showed, that if about ten grains of the bark are heated in a test-tube, characteristic red vapors are evolved, which condense in an oily carmine-red liquid. Cinchona barks, which have been deprived of their alkaloids by treatment with dilute acids, do not show this reaction; but ligneous tissue, which has been impregnated with a solution of cinchona alkaloids, yields the sublimate. This reaction, in connection with the presence of cinchona bast fibres noticed above, may be regarded as pretty conclusive proof of the genuineness of cinchona barks. The value of this test has, however, been rendered doubtful by the observations of Flückiger (1871), according to which a white bark containing cinchona bast fibres and an alkaloid (*paytina*) yielded a brown tarry, instead of a red oily sublimate, which was obtained from a bark, named *copper-colored cinchona bark*, destitute of the cinchona bast fibres, but yielding to Hesse 1 per cent. of quinia. Both barks had doubtless been obtained from trees closely allied to the genus Cinchona.

Description of the Officinal Barks.—1. CALISAYA BARK is met with in quills and flat pieces. The quills are either single or double, and vary considerably in length, and between one-half an inch and two inches in diameter. The bark is from one-sixteenth to one-eighth of an inch thick, and covered with a grayish cork, in which longitudinal and transverse fissures are observed. They are about an inch apart, and form irregular meshes with raised edges, frequently inclosing shorter transverse and oblique cracks. The corky layer is readily removed, leaving the impressions of the meshes upon the cinnamon-colored primary bark, as slightly elevated lines corresponding to the deeper cracks. The inner surface is cinnamon-brown, darker than the primary layer, and finely striate from the bast fibres. Occasionally quills are observed, with the outer surface formed by a layer of secondary cork, which is brown, rather smooth, and has fine transverse fissures.

Flat calisaya is met with in pieces, occasionally fifteen inches long, three to five inches broad, and from one-quarter to nearly one-half inch thick. The external layer of secondary cork is very rarely present, except as small irregular dark-brown patches, which line the shallow longitudinal depressions, the so-called *conchas* of the cascarilleros, or *digital furrows* of Pereira and others. Otherwise the entire bark consists only of bast layer, is of a bright-rusty cinnamon-brown color, and has the inner surface closely and uniformly marked with fine, often wavy striæ.

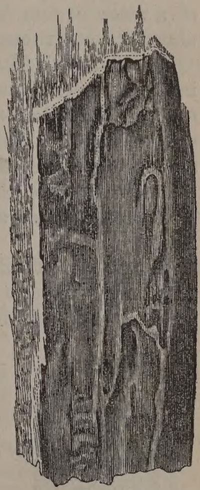
The structural characteristics (see page 411) of the bark are found in the one or two rows of large laticiferous ducts just outside the bast layer, which are present only in young bark. Secondary cork is soon formed, and penetrates obliquely into the bast, thereby throwing off the primary bark and laticiferous ducts, and after its removal leaving the conchas. In the young and old bark, the bast fibres are, with occasional exceptions, singly imbedded in the bast parenchyma, and show, radially, and still more tangentially, an imperfect arrangement in rows. The disposition of the bast fibres, their fineness, and brittleness permit them to be easily detached and to penetrate the skin on handling the flat bark; in the same way may likewise be explained the short fibrous transverse fracture of the bark.

Fig. 34.



Calisaya bark, showing digital furrow and short fibrous fracture.

Fig. 35.



Bark of Cinch. scrobiculata.

The flat calisaya bark of commerce is often found mixed with flat pieces of the bark obtained from the variety *boliviana* (see page 410). It is distinguished by being thinner, with the conchas more shallow and numerous, and by showing upon the longitudinal and transverse fracture large whitish spots. It agrees with the bark of the typical form in anatomical structure; but occasionally the secondary cork is found to penetrate the primary bark layer only, leaving the laticiferous ducts present, and it has the bast fibres arranged in but slightly interrupted radial lines; its transverse fracture is, therefore, long fibrous; hence it has been distinguished as *fibrous calisaya bark*. Otherwise the old bark of *Cinch. scrobiculata* agrees in its physical appearance closely with calisaya bark.

2. Pale Cinchona.—Loxa bark is found in commerce in quills which vary very much in size and appearance. The thinnest bark has a nearly smooth and but slightly wrinkled surface; the older and somewhat thicker bark is

marked by at first rather distant, finally more approximate, transverse, sometimes annular fissures, and with longitudinal wrinkles or slight wart-like corky ridges. Aside from the variously colored lichens, which are frequently present in patches, the external surface varies in color from dark brown-gray to blackish-brown, and the finely striated inner surface between pale-brown and reddish-brown. The bark breaks with a smooth fracture, which is somewhat fibrous in the inner layers, and of a light yellowish-brown color. The quills or double quills are usually much broken, though pieces a foot or more in length are sometimes met with.

In structure, Loxa bark is characterized by thin laticiferous ducts, which are found only in very young bark, and by the arrangement of the bast fibres in interrupted radial rows. The bark of *Cinch. micrantha* has no laticiferous ducts, and the bast fibres are either single or in scattered groups of two or three; the cork of the young bark is always of a brown-gray color, and has the transverse fissures less prominent.

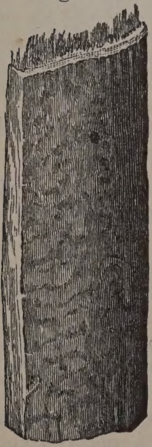
3. RED CINCHONA BARK is met with in quills and flat pieces. The former are often from one-half to one inch in diameter, with the bark about one-eighth inch or less thick. The outer surface of even very young bark shows a somewhat netted arrangement, which becomes plainer in older bark, the long meshes being formed by confluent corky warts. The suberous layer is of a brown-gray color, and of a darker gray-brown to rust-brown in older barks; the inner layers and inner surface are of a cinnamon-brown, in thicker quills of a more or less deep red-brown or brown-red color. The bark breaks with a short fibrous fracture.

The bark of old wood is termed flat, but is often in curved pieces, two to four inches in width and one-half inch or less in thickness. It shows the characteristics described, except that the bark throughout is of a deeper red color, the suberous layer thicker, very warty, sometimes longitudinally fissured and spongy, and the inner surface more closely striate.

Its structural characteristics are a row of laticiferous ducts and in the inner bast layer narrow medullary rays and radially arranged bast fibres in interrupted lines.

Unofficinal Cinchona Barks.—A large number of commercial varieties have appeared in the market, made up, frequently, of the barks of different species, and therefore difficult to characterize. This difficulty is greater with the small quills, but even the old bark of botanical varieties of the same species often present considerable differences in their physical and histological characters. We shall give brief descriptions of the most important varieties.

Fig. 36.



Bark of Cinchona pubescens.

PITAYA BARK is in flattish or curved pieces, about $\frac{1}{4}$ inch thick, covered with a nearly smooth, soft, brownish ochre-colored cork, marked with nearly circular scars; the bast layer is of a bright reddish-cinnamon-color and breaks with a short splintery fracture. The powder is of a brighter yellow tint than that of Calisaya bark. It is derived from *Cinch. pitayensis*, Wedd., and is valuable for the manufacture of quinia and quinidia.

CUSCO BARK comes, partly at least, from *Cinch. pubescens*, Vahl, and is in pieces similar to the preceding; but the corky layer is pale brown-yellow or whitish and warty, the bast layer cinnamon-colored, and the fracture smooth on the outside and coarse splintery in the inner layer. Some varieties yield the akaloid *aricina*. A red-colored variety of this species is called *China rubiginosa*.

CARTHAGENA BARK is in flat or usually curved pieces, occasionally in quills, with a pale ochre-yellow or whitish soft cork, often with somewhat glossy patches, internally of a dull-reddish or orange-cinnamon color, often interspersed with fine white dots of crystal cells; fracture long or short fibrous. It is derived from *Cinch. lancifolia*, Mut., the latter from *Cinch. cordifolia*, Mut. The *China rubiginosa* of European writers is partly referred to a variety of the former species, having a deeper red color. The bark is much used in the manufacture of quinia.

Lima or Huanuco bark is generally a mixture of the quilled branch barks of *Cinch. Peruviana*, How., *C. nitida*, Ruiz & Pavon, and *C. micrantha*, R. & P., and perhaps of other species; the bark of the last-mentioned is the most valuable of the three. The physical qualities must necessarily vary with the predominance of the different species. The same remark applies also to *Huamalies bark*, to which *Cinch. micrantha, glandulifera, purpurea*, R. & P., and other species contribute, and to the various *gray barks* of commerce.

The structural characteristics of cinchona barks, as described above, vary in the different species, and may be briefly stated as follows:—

1. Bast fibres single, occasionally in groups of two, or rarely more:

C. Calisaya.—No resin-cells, but laticiferous ducts in young bark. Secondary cork in old bark; bast fibres of medium thickness; medullary rays narrow.

C. glandulifera.—Very few resin-cells; laticiferous ducts in one or two rows; bast rays narrow; bast fibres of medium thickness; medullary rays large celled.

2. Bast fibres occasionally single, more frequently in groups of three or more:

C. micrantha.—Few or no resin-cells; no laticiferous ducts; medullary rays narrow; bast fibres of medium thickness, in groups of 2 and 3, and in older barks of 5 to 8.

C. purpurea.—Numerous resin-cells; laticiferous ducts in 1 or 2 rows; medullary rays narrow and broadly wedge-shaped; bast fibres of medium size, some larger, in groups of 3 to 5, intermixed with some incomplete fibres.

C. pubescens.—Resin-cells numerous; laticiferous ducts in 1 row; medullary rays rather broad; bast fibres variable, large, in groups of 2 and 3, intermixed with incomplete fibres.

3. Bast fibres in interrupted single, or occasionally double radial lines:

C. succirubra.—No resin-cells; laticiferous ducts in 1 row, in old bark often filled with cells; bast and medullary rays narrow; bast fibres medium, in lines of 2 to 5, and occasionally 8.

C. officinalis.—No resin-cells; laticiferous ducts thin, soon obliterated; medullary rays narrow; bast fibres medium, in somewhat irregular lines of 2 to 4.

C. pitayensis.—Few or no resin-cells; no laticiferous ducts; medullary rays with wedge-shaped opening; bast fibres uniform, thin, in mostly single lines.

C. cordifolia.—Few resin cells; no laticiferous ducts; medullary rays large celled; bast rays narrow, the nearly uniform fibres in single or rarely double lines of 2 to 4, with some incomplete fibres.

C. lancifolia.—Resin-cells numerous; laticiferous ducts none; medullary rays large celled; bast rays rather narrow, the fibres medium and thicker, in single and double lines of 2 to 4, intermixed with incomplete fibres.

C. nitida.—Few or no resin-cells; no laticiferous ducts; medullary rays narrow; bast fibres thin, with numerous others of medium or thick size, in single or some double lines of 2 to 4.

C. Peruviana.—Resin-cells present, small; laticiferous ducts small in 1 row; bast fibres small, varying, many incompletely filled, single or in double lines of 2 to 6.

4. Bast fibres in nearly uninterrupted radial lines:

C. scrobiculata.—Resin-cells numerous; laticiferous ducts in 1 or 2 rows; medullary rays large celled; bast fibres very numerous, in but little interrupted single or occasionally double lines.

The structural peculiarities of cinchona barks are, to some extent, influenced by the local conditions of growth, more particularly as regards exposure to or protection from the sunlight. This influence becomes more marked in the artificially protected (*mossed*) bark of the Eastern plantations, and still more in the second and third crops of (*renewed*) barks, in which the modifications of the parenchymatous tissue are very considerable, while the arrangement and characteristics of the bast fibres are likewise subject to striking changes.

So-called spurious cinchona barks are now rarely if ever met with in commerce. They were mostly obtained from trees belonging to the genera Ladenbergia, Nauclea, and Exostemma; some of these are quite similar to cinchona barks in appearance, while others have not the slightest resemblance to them. In those barks most nearly allied to the cinchona, a cinchona bast fibre is occasionally met with, but nearly all the bast fibres have large central cavities. Others (Nauclea) have the thin fibres nearly filled up, but regularly arranged in radial and tangential rows. Grahe's test, and, more reliable still, the microscope (see page 412), will at once prove their distinctiveness.

Cinchona Culture.—La Condamine (1738) noticed the reckless destruction of the cinchonas in South America, and after him most scientific men who have visited the cinchona region corroborated his statements. As early as 1792 the cultivation of cinchonas was suggested by Ruiz, and since 1837 Fritze, Blume, Miquel, and others advocated their transplantation to Java, while Royle (1839) pointed out certain districts in India as suitable for the cultivation of the plant. La Condamine's collection of living cinchonas and seeds was lost; Weddell (1848) procured considerable quantities of seeds, mostly of C. Calisaya, which germinated at the Jardin des Plantes in Paris, the seedlings being afterwards sent to Algeria and some to Java.

Weddell's *Histoire naturelle des Quinquinas* (1849) was the means of directing the attention of the Dutch Government more prominently to this subject. Pahud, the Colonial Minister of Holland, selected Carl Hasskarl, previously director of the botanical garden at Buitenzorg, Java, who left Holland Dec. 4, 1852, to procure seeds and plants from Peru. His first collection of 50 plants remained through an oversight in Panama, and was afterwards returned to Lima; but the seeds reached Holland, and yielded a number of seedlings, which were sent to Java. A collection of 400 plants of C. Calisaya was transported amid many difficulties to the seacoast, there packed in Wardian cases, and shipped August 21, 1854, from Callao to Batavia, where, notwithstanding every care, only 46 plants arrived Dec. 13 in a good or partly sickly condition. They were planted a short distance from Batavia, at an elevation of 4700 feet. In 1855 Junghuhn arrived there from Holland with 139 seedlings, nearly half of which perished; and when Hasskarl resigned in 1856, there were only 251 living cinchonas in the plantations. Junghuhn (died 1864) established plantations in more favorable localities; but ripe seeds were not obtained until 1858. Propagating from seeds and cuttings, there were, towards the close of 1863, nearly 1,160,000 cinchonas in the plantations, not quite one-half of which number had been planted in the open air. Only 1.1 per cent. of the plants belonged to the more valuable species. The remaining one was *Cinch. Pahudiana*, How., a rapidly growing species yielding a handsome looking bark, which, however, contained but 0.2–0.7 per cent. of quinia, 0.8 cinchonidia, and a total of 1.4–4.8 per cent. of alkaloids. Since De Vrij had undertaken frequent assays of the barks of the different species grown under different conditions, the cultivation of the less valuable ones was abandoned by K. W. van Gorkom, who succeeded Junghuhn, and by the close of 1876 nearly 2,000,000 of cinchonas, not counting C. Pahudiana, were planted in the open air in the government plantations, and of this number 1,142,715 were C. Calisaya (including C. Hasskarliana).

In the mean time Royle, Falconer, and others had again urged the introduction of the cinchonas into India, and, after several unsuccessful attempts to procure good plants and seeds through the British consuls on the west coast of South America, the British government decided in 1859 to organize an expedition under the direction of Clements Robert Markham, embracing all the districts of the most valuable species. Aided by John Weir, Markham explored the border land of Peru and Bolivia, April and May, 1860, and collected 529 plants, 497 of which belonged to different varieties of C. Calisaya, the remainder to C. ovata and C. micrantha. 63 of this number perished during the transportation to the coast; 456 being shipped from Islay in Wardian cases June 24. Owing to the jealousies of the population and the obstacles raised by the Bolivian government, he was unable to return to the districts for the purpose of collecting seeds, which do not ripen before August.

Richard Spruce undertook the collection of plants and seeds from the red-bark districts (C. succirubra), in Ecuador, in the forests of Chimborazo, where he arrived in June, and was joined, near the end of July, by Robert Cross, who collected a large number of cuttings and young plants, and with these and the seeds gathered by Spruce embarked at Guayaquil Jan. 2, 1861. Plants and seeds in the neighborhood of Huanuco were collected by G. J. Pritchett, who embarked from Lima in Sept. 1860, mainly with specimens of C. micrantha and nitida. The government having neglected to provide for their direct transportation to India, the shipments were made by way of Panama to England, and thence through the Red Sea to Bombay. The plants, and particularly those collected by Markham, suffered considerably from various delays and from the hot weather encountered during a part of the journey; but those in charge of Cross arrived mostly in good condition, as also did the seeds collected by the explorers mentioned, and those obtained on a second journey undertaken by Cross in 1861 to the neighborhood of Loxa.

The first cinchona plantation in India was established in the southwest, in the Neilgherry Mountains, near Ootacamund, at an elevation of 7000 feet. Under the care of William Graham McIvor (died 1876), who made many valuable observations on the cultivation of the different species, this was soon extended, so that in this district alone there were in 1866 over 1,500,000 cinchonas, besides those which had been distributed to or raised by private parties. While here *C. officinalis* appears to be the most valuable, *C. succirubra* and *Calisaya* succeed better in the Himalaya Mountains in Sikkim, where the cultivation was commenced in 1862. Plantations were also formed in Ceylon (1861), in Punjab (1864), and other portions of India. Since 1867 these barks have appeared in European commerce, but they are rarely seen in this country, except as cabinet specimens, owing to the discriminating duty of 10 per cent. upon them, while the South American cinchona bark is now imported free of duty. The packages of the Indian bark are always made up from the same species cultivated under the same circumstances, so that the *mossed* and *unmossed* barks are never mixed. This distinction is due to McIvor, who proved that, under an artificial covering of moss, the bark of certain species becomes thicker and richer in alkaloids, and also that trees which have been partly peeled will, under a covering of moss, rapidly *renew* the bark.

Attempts at the cultivation of cinchonas have been made in many countries and islands, and have been partly abandoned. Of more importance is the experiment made in Jamaica, where the plants were introduced late in 1861; the cultivation on a large scale however was not commenced until 1868, and, under the care of Robert Thomson, had in 1876 extended over 300 acres, the plantations being situated in the Blue Mountains, at an elevation of from 4000 to 6000 feet, with a variation of temperature between about 50° and 70° F. The officinal species, *C. Calisaya*, *succirubra*, and *officinalis*, are mainly cultivated here, as they appear to be also to some extent near Cordova, Mexico, where seeds were distributed in 1866; at least Hugo Finck exhibited, 1876, handsome specimens of these barks and sections of the trees.

Constituents. (1) ALKALOIDS.—Cinchona barks contain one or more of four alkaloids, which, according to their composition, form two groups, namely, *quinia* and *quinidia* = $C_{20}H_{24}N_2O_2$, and *cinchonia* and *cinchonidia* = $C_2H_{24}N_{20}O$. Gomes, of Lisbon (1812), obtained a crystalline body without recognizing its chemical relations; its basic properties were discovered by Houton-Labillardière (1820), and Pelletier and Caventou found in it two alkaloids, which they named quinia and cinchonia. Henry and Delondre (1833) obtained from a red-colored bark a distinct alkaloid, which they named *quinidia*, and which constituted, most likely, the greater portion of Van Heijningen's *beta quinia*, obtained (1849) from chinoidin; and of the *cinchotin* which Hlasiwetz (1850) found in the alcoholic mother-liquor of cinchonia. Quinidia is identical with the *conchinia* of Hesse (1869), but the latter considers Henry and Delondre's alkaloid to have been chiefly cinchonidia. F. L. Winckler (1847) separated from Maracaibo bark an alkaloid which he likewise called quinidia, but which Pasteur (1853) proved to be distinct from the former, and named *cinchonidia*. Pasteur's nomenclature has been adopted not only in France, but also in England and America; some German writers, however, still follow Winckler, and to some extent Hesse's nomenclature is employed in Germany.

Pasteur observed that by fusing the alkaloids of either group in the presence of acids, they are converted into the amorphous bases *quinicia* and *cinchonicia*, which have the composition of the alkaloids, from which they are obtained.

The bark of C. succirubra, cultivated in Sikkim, was found by Hesse (1872 and 1877) to contain also two other alkaloids, *quinamina* $C_{19}H_{24}N_2O_2$, and *paricina* $C_{16}H_{18}N_2O$. The latter is pale yellow, amorphous; when fresh soluble in ether, and is converted into a dark-green resinous mass by strong nitric acid. The same acid yields a dark-green solution with *aricina* $C_{23}H_{36}N_2O_4$, discovered in Arica bark by Pelletier and Coriol (1829). It is crystallizable, and its oxalate and acetate are sparingly soluble. Winckler (1842) regarded it as identical with an alkaloid, *cusconina*, obtained by Leverköhn (1830) from Cusco bark, and with the *cinchovatina* of Manzini (1842) from Jaën bark, and the production of a green color by nitric acid, due to the presence of impurities. But cusconina, though of the same composition as aricina, and in the same bark, differs from all cinchona alkaloids in the gelatinous form of many of its salts, including the sulphate, which is not soluble in sulphuric acid. The same bark contains also the yellow amorphous alkaloid *cusconidina*. The *pitoyina* of Peretti (1835) does not exist according to Hesse (1873); it had been obtained from so-called Pitoya bark, or *Cinchona bicolorata*, the bark of a species of Ladenbergia, characterized by the gray and fawn-colored patches of its external surface.

Quinamina (chinamin), together with its isomer *conquinamina*, is found in the bark of Cinch. succirubra, rosulenta, and other species; both are crystalline, dextrogyre; their solutions are not fluorescent, do not produce thalleioquin, are precipitated by chloride of platinum only when in concentrated solutions, and yield with chloride of gold, yellow precipitates changing to purple. Their hydriodates are slightly soluble in cold water, and crystallizable. Quinamina melts at 172° C. (341.8° F.), conquinamina at 123° C. (253.4° F.). The former is soluble in 32 parts of ether, and on boiling with dilute sulphuric acid is converted into amorphous *quinamidia*, isomeric with the former, and having a similar behavior to chloride of gold; its hydrochlorate crystallizes in prisms, and is sparingly soluble in water. On heating sulphate of quinamina to 100° C. (212° F.) it is converted into the isomeric *quinamicia*, which is white, amorphous, fusible in boiling water, and precipitated from acid solutions by sodium bicarbonate. When sulphate of quinamina, however, is heated to 120° C. (248° F.) *protoquinamicia* $C_{17}H_{20}N_2O$ is formed, which is insoluble in ether, and the sulphate of which is nearly insoluble in cold water. By treating quinamina or conquinamina with concentrated hydrochloric acid, H_2O is eliminated, and *apoquina-*

mina $C_{19}H_{22}N_2O$ is formed, which is white, amorphous, very soluble in ether; its hydrochlorate is amorphous, and freely soluble in water; the precipitate, with chloride of gold, does not turn purple.

The last-named alkaloid is isomeric with *homocinchonidia*, *homocinchonia*, and *homocinchonicia*, the first of which forms the bulk of Winckler's *cinchovatina* (*aricina*), from Cinch. ovata, has a left rotation, and forms a sulphate, crystallizing with $6H_2O$ in delicate needles of a gelatinous aspect, which fuse near 30° C. (86° F.). It resembles magnesia when anhydrous, and in this condition forms with chloroform a jelly-like mass. On melting the anhydrous monobasic sulphate of this alkaloid, homocinchonicia is formed. Homocinchonia is present in the bark of Cinch. rosulenta, which contains also *dihomocinchonia* $C_{38}H_{44}N_4O_2$; it has a right rotation and is amorphous, like its salts.

Diconchinia $C_{40}H_{46}N_4O_3$ is the principal constituent of *chinoidin* of barks containing much quinia and quinidia; it is amorphous, and does not yield quinicia, but resembles the two cinchona alkaloids in the fluorescence of the sulphuric acid solution, and in the behavior to chlorine and ammonia (green coloration). The chinoidin of barks yielding much cinchonia or cinchonidia contains amorphous *dicinchonia* $C_{40}H_{48}N_4O_2$, which is not easily freed from *diconchinia*.

The white cinchona bark of Payta contains, according to Hesse (1870), crystallizable *paytina* $C_{21}H_{24}N_2O + H_2O$, and amorphous *paytamina*, which resemble quinamina in the behavior to chloride of gold and solubility in ether, but differ in being levogyre and readily precipitated by chloride of platinum.

Hesse (1877) obtained from a young Bolivian calisaya bark a liquid alkaloid, having a penetrating odor suggesting that of quinolin; and from Java calisaya bark crystallizable *javanina*, which is very easily soluble in ether, and dissolves in dilute sulphuric acid with an intense yellow color.

The relation of the cinchona alkaloids to each other in regard to their ultimate composition will be observed from the following:—

$C_{23}H_{26}N_2O_4$: cusconina and aricina.

$C_{21}H_{24}N_2O$: paytina.

$C_{20}H_{24}N_2O_2$: quinia, quinidia, quinicia, and $2(C_{20}H_{24}N_2O_2)—H_2O$: diconchinia.

$C_{20}H_{24}N_2O$: cinchonia, cinchonidia, cinchonicia, and $2(C_{20}H_{24}N_2O)$: dicinchonia.

$C_{19}H_{24}N_2O_2$: quinamina, conquinamina, quinamidia, and quinamicia.

$C_{19}H_{22}N_2O$: apoquinamina, homocinchonia, homocinchonidia, and homocinchonicia.

$C_{17}H_{20}N_2O$: protoquinamia.

$C_{16}H_{18}N_2O$: paricina.

The characteristic properties of the four principal cinchona alkaloids may be compared as follows:—

	QUINIA.	QUINIDIA.	CINCHONIA.	CINCHONIDIA.
Rotatory power,	Levogyre,	Dextrogyre,	Dextrogyre,	Levogyre.
Soluble in water,	480 parts,	1500 parts,	3800 parts,	2580 parts.
Soluble in 80 per cent. alcohol,	30 "	45 " (absolute)	140 "	20 "
Soluble in ether,	21 "	30 "	400 "	76 "
Sulphuric acid solutions,	Are fluorescent, 1 in 200,000,		Not fluorescent.	
Chlorine water and ammonia,	Emerald-green thalleioquin,		White precipitates.	
Chlorine water, ferrocyanide potassium, and ammonia,	Dark-red solutions,		No coloration.	
Anhydrous sulphate soluble in chloroform,	1000 parts,	19.5 parts,	60 parts,	1000 parts.
Hydriodate,	More soluble than next,	Sol. in 1250 water, or 110 alcohol,	Readily soluble,	Soluble.
Iodosulphate,	Green in reflected, colorless in transmitted light; soluble in 1000 boiling water,	Similar to preceding, but different tint,	Purplish-black; in transmitted light yellow or reddish,	Purplish garnet-red; in transmitted light like preceding.

The iodosulphates are obtained by dissolving the sulphates in weak alcohol, acidulating with sulphuric acid, precipitating with tincture of iodine, and crystallizing the precipitate from alcohol.

In the preparation of the alkaloids, there finally remains a brown solution containing one or more amorphous alkaloids (see above), which are known collectively as *chinoidin, chinioidin*, or *quinoidin*. By precipitating with an alkali, washing and drying, it is obtained as a brown mass, which has a resin-like appearance, is brittle at ordinary temperature, breaks with a glossy conchoidal fracture, and dissolves readily in alcohol and dilute acids. Treated with hot water, the filtrate is not colored by potassa solution, and when evaporated leaves but a slight residue. It has but a slight taste, but its solutions are very bitter; on incineration it leaves a very small proportion of ashes.

Tinctura chinoidini, Ph. G., is made by dissolving 2 parts of chinoidin in 17 parts of alcohol and 1 of muriatic acid. Thus prepared it is miscible with water without producing any precipitate.

OTHER CONSTITUENTS.—The alkaloids are combined with one or more of the following acids: kinic, kinovic, and cinchotannic acids.

Kinic or *quinic acid* (Chinasäure), $C_7H_{12}O_6$, is found in cinchona barks and in many plants of the natural orders, Rubiaceæ, Vaccineæ, etc. In the preparation of quinia it is contained in the filtrate from the precipitated alkaloids. It appears to be present to the amount of 5 to 7 per cent., and when pure forms transparent colorless oblique rhombic prisms, which fuse at 162° C., are readily soluble in water, less in strong alcohol, and slightly in ether. On treating it, or one of its salts, with manganese peroxide and sulphuric acid, it yields, besides carbonic and formic acids, a golden-yellow crystalline sublimate of *kinone* or *quinone*, $C_6H_4O_2$.

Kinovic or *quinovic acid*, $C_{24}H_{38}O_4$, is met with in the East Indian barks, and forms a tasteless shining crystalline powder, which is insoluble in water and chloroform, slightly soluble in ether and cold alcohol, but soluble in alkalies and alkaline carbonates.

Kinovin or *quinovin*, $C_{30}H_{48}O_8$, is an amorphous mass, of a disagreeable bitter taste, sparingly soluble in cold water, somewhat soluble in ether, and freely soluble in alcohol. Its compounds with the alkalies, lime and magnesia, are soluble in water. Its solution in alcohol, treated with hydrochloric acid gas, yields kinovic acid and uncrystallizable mannitan (kinovin sugar), $C_6H_{12}O_5$. It has been found in different cinchona barks in quantities varying between 0.11 and 1.74 per cent., and is also contained in the barks of Esenbeckia febrifuga and Buena magnifolia (*China* s. *Quina nova*, hence its name).

Cinchotannic (or *quinotannic*) *acid* appears to be present in the best cinchona barks to the amount of 2 to 4 per cent. By treating the decoction with magnesia, precipitating the filtrate with lead acetate, decomposing with sulphuretted hydrogen, and repeating this process, it is obtained as a pale yellow mass of an acidulous and astringent taste, readily soluble in water, alcohol, and ether, and turning greenish with salts of iron. According to Rembold (1867), by boiling with dilute sulphuric acid it is split into sugar and

Cinchona red, $C_{28}H_{22}O_{14}$, which is nearly insoluble in water and ether, but dissolves readily in alkaline solutions and alcohol. It yields protocatechuic acid when treated with fusing potassa. Though contained in all cinchona barks, those having a red color contain it in largest proportion, thick red bark over 10 per cent.

The odor of cinchona barks is due to a minute quantity of a butyraceous *volatile oil*, which was first obtained by Fabroni. Trommsdorff obtained 2 grains from 20 pounds of pale bark. The other constituents, a small portion of wax, gum, sugar, etc., are of no importance, either medicinally or pharmaceutically.

Valuation of Cinchona Bark.—It has already been stated that the quality of bark is apt to vary; it is not only influenced by its age, but according to Karsten's observations, by the locality in which the trees naturally grow. That a certain protection is beneficial for the production of the alkaloids has been shown by experiments made in the East Indies. Howard (1871) demonstrated the presence of 9.75 per cent. of quinia (or a total of 11.40 per cent. of alkaloids in bark from *Cinch. officinalis* var. *lanceolata*), and Broughton (1870), a total of 13.5 with 9 per cent. of quinia. The variety *pubescens*, of the same species, yielded to Howard (1878) 12.90 per cent. of alkaloids, of which 6.94 was quinia, and 4.48 cinchonidia.

The Pharmacopœia requires only 2 per cent. of alkaloids (yielding crystallizable salts); but good flat Calisaya bark should contain from 4 to 5 per cent. of quinia, the other alkaloids being present in small proportions. Red bark yields about 4 per cent. of alkaloids, about half of which consists of quinia. The Indian red bark in quills, however, often yields from 9 to 11 per cent. of alkaloids, one-sixth to one-third of which is quinia (De Vrij, 1873). The Loxa bark being collected now only from branches or small trees, is variable and uncertain in its qualities. De Vrij obtained from the bark of C. officinalis, grown at Ootacamund, between 3.72 and 10.86 per cent. of alkaloids, one-fifth to two-thirds of which was quinia; the extraordinary yield of some of this bark has been referred to above.

The older processes devised for the valuation of cinchona were mainly based upon the ready solubility of quinia in ether. Of the more recent ones, that proposed by De Vrij (1873) gives pretty reliable results. 20 grams of powdered and sifted bark, dried at 100° C., are mixed with milk of lime containing 5 grams of slaked lime; the mixture is slowly dried, and then boiled with 200 c.c. of strong alcohol; when cool the liquid is passed through a small filter, the residue, mixed with 100 c.c. of alcohol, is then put upon the same filter and washed with another 100 c.c. of alcohol. The mixed filtrate is freed from calcium by a little sulphuric acid, the alcohol recovered by distillation, the residue, together with the alcohol and water used for washing the retort, is poured into a capsule, and the alcohol carefully evaporated. The cooled solution is filtered to separate quinovic acid and fat, the filter washed with some acidulated water, the filtrate reduced by evaporation to about 50 c.c., and while still warm precipitated by a slight excess of caustic soda. The precipitate is collected upon a filter, washed with the smallest possible amount of water, and the filter pressed between bibulous paper until the alkaloids can be readily removed. They are now transferred to a tared capsule, completely dried and weighed; the weight multiplied by 5 indicates the percentage of the mixed alkaloids.

These alkaloids are powdered, treated with 10 times their weight of ether, the undissolved portion is converted into neutral sulphates, and the solution treated with iodide of potassium to separate the *quinidia;* from the filtrate *cinchonidia* is separated by tartrate of potassium and sodium, and after again filtering, *cinchonia* is precipitated by soda.

To determine the *quinia*, the ethereal solution is evaporated, the residue dissolved in 10 times its weight of weak alcohol, sp. gr. 0.915, containing $\frac{1}{20}$ of its volume of dilute sulphuric acid, and the solution heated to about 50° C. (122° F.); tincture of iodine is added to produce iodosulphate of quinia, which is collected after cooling. The filtrate, if necessary, is slightly acidulated, warmed to expel the alcohol, and precipitated by potassa or soda, by which the *amorphous alkaloid* including quinamina is obtained.

Since none of the cinchona alkaloids are insoluble in ether, the process requires some modifications should a large amount of cinchonia be present; the mixed alkaloids left on evaporating the ethereal solution should then again be treated with a small quantity of ether.

The weights as above ascertained are multiplied with 0.718 for quinidia, 0.804 for cinchonidia, and 0.565 for quinia, or according to De Vrij, with 0.5509 for anhydrous quinia, to find the weights of the alkaloids named. Cinchonia and chinoidin are, by the above process, weighed directly as such. To determine from the mixed alkaloids merely the quinia, De Vrij has recently (1875) proposed iodosulphate of chinoidin as a test solution. Manufacturers of quinia generally prefer to ascertain by direct experiment the amount of sulphate of quinia obtainable.

The British Pharmacopœia gives the following test for the quality of the cinchona barks.

Boil one hundred grains of the bark, reduced to very fine powder, for a quarter of an hour in a fluidounce of distilled water acidulated with ten minims of hydrochloric acid, and allow it to macerate for twenty-four hours. Transfer the whole to a small percolator, and after the fluid has ceased to drop add at intervals about an ounce and a half of similarly acidulated water, or until the fluid which passes through is free from color. Add to the percolated fluid solution of subacetate of lead, until the whole of the coloring matter has been removed, taking care that the fluid remains acid in reaction. Filter and wash with a little distilled water. To the filtrate add about thirty-five grains of caustic potash, or as much as will cause the precipitate which is at first formed to be nearly redissolved, and afterwards six fluidrachms of pure ether. Then shake briskly, and having removed the ether, repeat the process, twice with three fluidrachms of ether, or until a drop of the ether employed leaves on evaporation scarcely any perceptible residue. Lastly, evaporate the mixed ethereal solutions in a capsule. The residue, which consists of nearly pure quinia, when dry, should weigh not less than two grains, and should be readily soluble in diluted sulphuric acid. The last requirement is for Calisaya bark. By the same process, red bark should yield not less than 1.5 grain, and pale bark not less than 1 grain of alkaloids.

Off. Prep.—1. Of Calisaya bark. Decoctum cinchonæ flavæ, *U. S.*, *Br.*; Extr. cinchonæ, *U. S.*; Extr. cinchonæ fluidum (cinch. flavæ liquidum), Infusum cinchonæ flavæ, Quiniæ sulphas, Tinctura cinchonæ (cinch. flavæ), *U. S.*, *Br.* 2. Of Pale bark. Mistura ferri aromatica, Tinctura cinchonæ composita, *Br.* 3. Of Red bark. Decoct. cinchonæ rubræ, Infus. cinchonæ rubræ, Tinct. cinchonæ comp., *U. S.*

Medical Action and Uses.—The action and uses of cinchona will be more conveniently studied in connection with its several preparations, and especially quinia, to which articles the reader is referred.

CINCHONIÆ SULPHAS, *U. S.*—SULPHATE OF CINCHONIA.

Cinchoninum sulfuricum, P. G.—*Sulfate de cinchonine*, Fr.; *Schwefelsaures Cinchonin*, G.

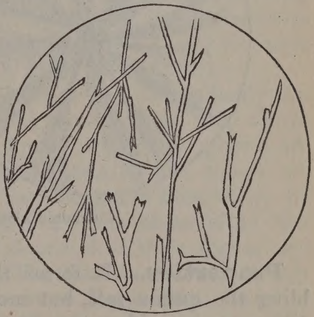
Formula $2(C_{20}H_{24}N_2O).H_2SO_4.2H_2O$. Molecular weight 750.

Preparation.—Take of the Mother Water, remaining after the crystallization of sulphate of quinia, in the process for preparing that salt, a convenient quantity; Solution of Soda, Alcohol, Diluted Sulphuric Acid, Animal Charcoal in fine powder, each a sufficient quantity. To the mother water add gradually, with constant stirring, solution of soda, until the liquid becomes alkaline. Collect on a filter the precipitate formed, wash it with water, and dry it. Then wash it with successive small portions of alcohol, to remove other alkaloids which may be present. Mix the residue with eight times its weight of water, and, having heated the mixture, add gradually diluted sulphuric acid, until it is neutralized and becomes clear. Then boil the liquid with animal charcoal, filter it while hot, and set it aside to crystallize. Lastly, drain the crystals, and dry them on bibulous paper. By evaporating the mother-liquid more crystals may be obtained. *U. S.*

Sulphate of cinchonia, requiring only 54 parts of water of 15° C. for solution, remains in the mother liquor from which sulphate of quinia has been crystallized. To obtain it pure the alkaloids of the mother waters are precipitated by soda, which, being cheaper, is preferable to potassa, collected upon a filter and washed with water to remove the sulphate of sodium formed. The dried residue is washed with cold alcohol, in which all the cinchona alkaloids are more soluble than cinchonia. The undissolved portion is converted into sulphate in the manner indicated in the formula, and deprived of coloring matter by treatment with animal charcoal, after which the salt is crystallized.

Properties.—Sulphate of cinchonia crystallizes in hard transparent, oblique prisms which have a glassy lustre, lose their (4.8 per cent.) water of crystallization at 100° C. (212° F.), fuse like wax at a somewhat higher temperature, then acquire a handsome red color, and finally burn, giving off a peculiar empyreumatic odor, and leaving no residue. It is apt to form supersaturated solutions with water, of which it requires 14 parts to dissolve it at the boiling, and 54 parts at the ordinary temperature. It requires 1.5 of boiling and 5.8 parts of cold 80 per cent. alcohol for solution, dissolves in 60 parts of chloroform, readily in dilute acids, and is almost insoluble in ether. Its solutions have a very bitter taste, and are destitute of fluorescence. The aqueous solution yields precipitates with tannin, bicarbonate of potassium, ammonia, chloride of gold, iodohydrargyrate of potassium, phosphomolybdic acid, and other reagents for alkaloids. Chlorine water added to its solution and afterwards ammonia does not produce a green coloration (quinia and quinidia), but a white precipitate of cinchonia. The solution yields a white precipitate with barium chloride (sulphate), which is insoluble in dilute hydrochloric acid. The crystals contain 82.14 per cent. of cinchonia, or two molecules of the alkaloid in combination with one of sulphuric acid and two (4.8 per cent.) of water of crystallization. When a drop of a saturated aqueous solution of this salt is mixed with a drop of solution of potassium sulphocyanide, crystals will be formed which, under the microscope, will appear long, radiating, and considerably branched, resembling antlers or equisetum.

Fig. 37.



Cinchonia sulphate with KSCy. Microscopic crystals.

Other salts of cinchonia are the following:—

Acid Sulphate of Cinchonia, $C_{20}H_{24}N_2O.H_2SO_4.4H_2O$, mol. weight 478, obtained by dissolving the disulphate in dilute sulphuric acid and crystallizing, forms oblique octahedral crystals, which dissolve in about half their weight of water, and in 90 parts of alcohol. They are insoluble in ether, and contain 64.4 per cent. of cinchonia.

Hydrochlorate of Cinchonia, $C_{20}H_{24}N_2O.HCl.2H_2O$, mol. weight 380.5, made by treating an excess of cinchonia with dilute hydrochloric acid, crystallizes in needles closely resembling sulphate of quinia, dissolves in 24 parts of water, in 1.3 parts of 80 per cent. alcohol, and is slightly soluble in ether. It has been occasionally used for adulterating, or fraudulently sold for sulphate of quinia, from which it is readily distinguished by the absence of fluorescence of its acidulated solution, by the white precipitate occasioned with silver nitrate, and by the sparing solubility in ether of the white precipitate with ammonia. It contains 81 per cent. of cinchonia.

Medical Action and Uses.—Sulphate of cinchonia is more poisonous to frogs and dogs than sulphate of quinia. The former in full doses does not so speedily produce buzzing in the ears and disordered vision, but, on the other hand, it is more apt to occasion a peculiar pain and sense of oppression in the frontal region of the head. It is also prone to excite præcordial pain, jerking of the tendons, muscular exhaustion, and faintness when freely used.

At present its therapeutical application may be regarded as identical in nature with that of quinia, at least in the treatment of *periodical fevers.* But the certainty of its curative effects is by no means so well established. It has the advantage over quinia of being less bitter, and much more soluble in water, as well as cheaper; but it has the disadvantage of being less reliable in its effects. The dose of cinchonia is variously stated to be from one-third to twice as large as that of quinia.

CINCHONIDIÆ SULPHAS.—SULPHATE OF CINCHONIDIA.

Sulfate de cinchonidine, Fr.; *Schwefelsaures Cinchonidin*, G.
Formula $2(C_{20}H_{24}N_2O).H_2SO_4.4H_2O$. Molecular weight 786.

Preparation.—In the manufacture of quinia from cinchona bark containing the above alkaloid, sulphate of cinchonidia remains in the mother liquors after the sulphate of quinia has crystallized, and is obtained by concentrating them, and purified by recrystallization. It is called sulphate of *chinidin* (quinidia) by several German manufacturers.

Fig. 38.

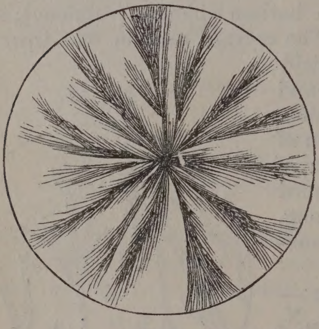
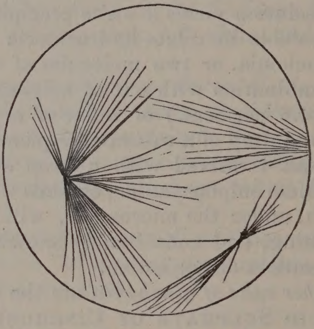


Fig. 39.



Cinchonidia Sulphate with KSCy. Microscopic crystals.

Properties.—It forms thin quadrangular prisms or silky needles, resembling the quinia salt, but more glossy. It dissolves in alcohol and in about 100 parts of cold water, but is scarcely soluble in ether. It is distinguished from the quinia salt by the absence of fluorescence of its solution, and by the non-production of thalleioquin with chlorine water and ammonia. Its solution in water is (unlike the cinchonia salt) precipitated by solutions of neutral tartrates. On mixing a drop of an aqueous solution of the salt with a drop of solution of potassium sulphocyanide, microscopic crystals are formed, which are either feathery and stellately arranged around a centre, or are spike-like and united in star-like or fan-shaped groups.

Medical Action and Uses.—They have not been determined by experiment or clinical observation.

CINNAMOMI CORTEX, *Br.*—CEYLON CINNAMON.

Cinnamomum, U. S.; *Cortex cinnamomi zeylanici*, P. G.; *Cinnamomum acutum s. verum.—Cinnamon bark*, E.; *Canelle de Ceylon*, Fr.; *Zeylonzimmt*, G.

The inner bark of Cinnamomum zeylanicum, *Nees*, s. Laurus cinnamomum, *Lin.* Wight, Icon. Plant. Ind. Orient., plate 123. Bentley and Trimen, Med. Plants, 224.

CINNAMOMI CHINENSIS CORTEX.—CHINESE CINNAMON.

Cinnamomum, U. S.; *Cortex cinnamomi cassiæ*, P. G.; *Cinnamomum chinense, Cassia cinnamomea.—Cassia bark, Cassia lignea*, E.; *Canelle de Chine*, Fr.; *Zimmtkassie, Chinesischer (Gemeiner) Zimmt*, G.

The inner bark of Cinnamomum aromaticum, *Nees*, s. Cinn. cassia, *Blum*, s. Laurus cassia, *Ait.*, s. Laur. cinnamomum, *Lour.*

Nat. Ord.—Lauraceæ.

Origin.—The tree first mentioned above is variable in size, but usually of small stature, and is met with in forest districts of Ceylon, reaching an elevation of 3000 feet. It has opposite coriaceous three to five-nerved leaves, which are bright green and glossy above, and glaucous beneath; the small flowers are in terminal panicles, producing a somewhat fleshy ovoid fruit, which at the base is surrounded by the enlarged perianth. Not less than seven or eight well-marked varieties are distinguished, some of which are regarded by some botanists as distinct species.

The second species is likewise a small tree, 20 to 30 feet high, and has oblong elliptical three-nerved leaves, which, when young, are downy, like the petioles and young branches. The panicles are smaller; the flower and fruit resemble the preceding. It is indigenous to Southern China and Cochin China.

Collection.—Ceylon cinnamon, the cultivation of which is gradually declining through the extension of coffee culture, is produced in the south-western part of that island in the vicinity of Colombo, where the plants are pruned so as to cause them to form stools from which four or five shoots are raised for eighteen months or two years, until the bark begins to turn brown by the production of a corky layer. The shoots, which are now about eight feet high and two inches or less thick, are cut off and deprived of their leaves and thin portions, which are sold as *cinnamon chips*. The bark is cut transversely at the distance of about a foot, after which two or more longitudinal incisions are made, and the strips of bark removed by inserting beneath it the peeling-knife called *mama*. The pieces are put one within the other, and the sticks thus formed tied together into bundles. After about 24 hours, the external layers of the bark are carefully removed by placing each piece upon a suitable stick of wood and scraping with a knife. The small quills are then placed in the larger ones, in such a manner as to form congeries of quills about 40 inches long. These sticks are kept one day in the shade, then dried in the sun, and finally made into bundles of about 30 pounds each. The plant has been introduced into Java, India, Senegal, Brazil, and the West Indies; but the cinnamon produced in these places is inferior in quality; that from Tellichery and Java coming nearest to Ceylon cinnamon.

It is not known whether Chinese cinnamon is collected from wild-grown or from cultivated trees. The commercial article has evidently been scraped, but with less care than the Ceylon cinnamon.

The U. S. Pharmacopœia recognizes the two kinds of cinnamon under the title of *cinnamomum.* About 15,000 to 20,000 pounds of Ceylon cinnamon, and from one to one and a-half million pounds of cassia bark are annually imported into the United States.

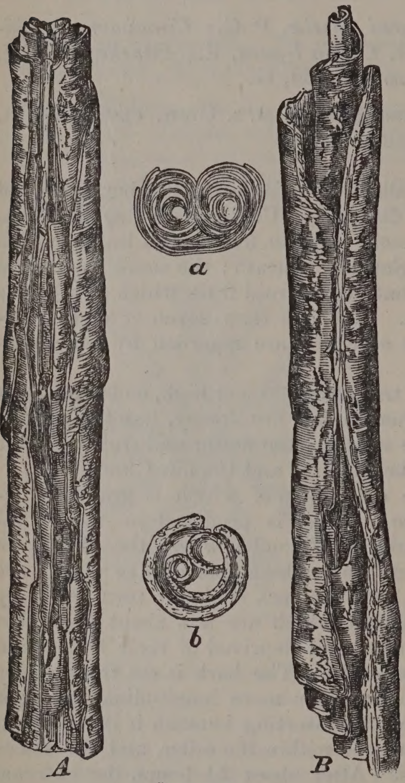
Description.—CEYLON CINNAMON is in sticks, about 40 inches long, and nearly $\frac{1}{2}$ inch thick, formed of 8 or 10 layers of very thin bark, which are together spirally rolled up from both edges. The bark itself has the thickness of stout writing paper, is brittle and splintery, and has the external surface of a dull light yellowish-brown, smooth, marked with faint wavy lines of bast bundles, and with a few scars or holes left by the leafstalks or branchlets. The inner surface is smooth and of a somewhat darker brown. The odor is fragrant, peculiar; the taste sweetish, aromatic, and pungent. Inferior kinds of cinnamon are usually somewhat thicker, darker in color, of less agreeable fragrance, and occasionally of a bitterish taste. Cayenne cinnamon has a reddish tinge, and is quite mucilaginous. Java cinnamon is often very similar to Ceylon cinnamon in appearance, though hardly equal to it in flavor; sometimes it is of a darker color, resembling Chinese cinnamon, but thinner and of better flavor.

CHINESE CINNAMON, cinnamon cassia, or cassia bark, comes loose or packed in bundles with bands of bamboo. The pieces vary considerably in length, and are either curved or half quilled, or in quills of $\frac{1}{4}$ to 1 inch in diameter. The bark is $\frac{1}{16}$ inch or less thick, and has a smooth, or finely wrinkled, reddish-brown outer surface, marked with some dark leaf-scars, occasionally with lighter colored lines, and very generally covered with larger or smaller patches of cork. It breaks with a short fracture, and when of good quality has a strong though less delicate cinnamon odor and taste.

A kind of Chinese or *Saigon cinnamon,* of late occasionally met with, is in more regular unscraped quills, yields a darker colored powder, but has a very sweet and warm cinnamon taste.

The term *Cassia lignea* is sometimes applied indiscriminately to Chinese cinnamon, or it is used only for the inferior varieties. Some writers have restricted it to a thicker bark, of a slight cinnamon odor, and a mucilaginous faint cinnamon taste. The origin of these barks is not positively known.

Fig. 40.



Cinnamon.

A a. From Ceylon. *B b.* From China.

Constituents.—The two kinds of cinnamon agree in the main in their chemical constituents, the most important of which is volatile oil (see Oleum Cinnamomi). They also contain a considerable amount of tannin, some sugar, mannit, starch, and mucilage. Flückiger and Hanbury noticed that the infusion made with cold water becomes turbid on the addition of iodine or iodide of potassium, and the decoction of both cinnamons discharges the color of a considerable quantity of iodine before it permanently assumes the blue color of iodide of starch. The body producing this reaction with iodine appears to be insoluble in alcohol and ether, but its nature has not been ascertained. A strong tincture of cinnamon gradually becomes gelatinous, and loses its astringent taste.

Off. Prep.—Acidum sulphuricum aromat., Aqua cinnamomi, *U. S.*, *Br.;* Decoctum hæmatoxyli, Infusum catechu, *Br.;* Infusum catechu comp., Pulvis aromaticus, *U. S.;* Pulv. catechu comp., Pulv. cinnamomi comp., Pulv. cretæ aromat., Pulv. kino comp., *Br.;* Spir. lavandulæ comp., Syr. rhei aromat., *U. S.;* Tinctura cardamomi comp., Tinct. catechu, Tinct. cinnamomi, Vinum opii, *U. S.*, *Br.;* Tinct. lavandulæ comp., *Br.*

Allied Products.—CASSIA BUDS, *Flores cassiæ*, s. *Clavelli cinnamomi*, are the small, pedicellate, unripe fruits of one or more species of cinnamomum; they bear some resemblance to cloves, but are smaller, and consist of the thick perianth, the six small lobes of which are folded over the depressed ovary. They have a cinnamon-like but less agreeable odor and taste, and contain a volatile oil and tannin. About 6000 pounds of it annually enter the United States.

The following barks, which resemble cinnamon in some respects, are similarly employed in their native countries, and are occasionally met with in commerce:—

CULILAWAN BARK is obtained from Cinn. Culilawan, *Nees*, indigenous to the Moluccas. It is in flat or curved pieces, $\frac{1}{10}$ to $\frac{1}{4}$ inch thick, grayish or brownish externally, dark cinnamon-brown internally, with the fracture corky and short fibrous. The odor resembles cinnamon with a mixture of cloves and sassafras; taste mucilaginous and aromatic.

CASSIA CARYOPHYLLATA, s. *Cortex caryophyllatus*, the clove bark (Nelkenzimmt, *G.*). From Dicypellium caryophyllatum, *Nees*, of Brazil. It usually comes in quills $\frac{3}{4}$ to $1\frac{1}{2}$ inch thick, and about 2 feet long, which are made up of from 6 to 10 pieces of bark rolled up together. The bark is about $\frac{1}{16}$ inch thick, smooth, or slightly wrinkled, chestnut-brown, often with a bluish tinge, fracture short, showing a whitish line near the outer margin; odor clove-like; taste mucilaginous, resembling cinnamon.

Medical Action and Uses.—The oil of cinnamon, like that of other aromatics, first stimulates and then exhausts and depresses the nervous system. Locally it is a rubefacient and stimulant. The water and the oil of cinnamon are used to impart an agreeable flavor to medicines, and the former is associated with astringents in the treatment of *diarrhœa.* Cinnamon was anciently believed to stimulate the uterus, and then and recently it has been used in conjunction with more powerful medicines, such as borax, ergot, cotton root, etc., to promote *parturition* and to check *uterine hemorrhage* after labor and during menstruation, as well as when it depended upon disease of the womb. Powdered cinnamon may be prescribed in doses of from ten to thirty grains. An infusion may be made with a drachm of the bruised bark to half a pint of boiling water, and administered in doses of a tablespoonful or two every half hour.

CLEMATIS.—VIRGIN'S BOWER.

Clematite, Fr.; *Waldrebe*, G.

The herb of different species of Clematis.

Nat. Ord.—Ranunculaceæ, Clematideæ.

Description.—The genus consists of perennial herbs or woody vines climbing by the aid of the bending petioles of their opposite pinnate leaves. The flowers have 4 to 6 colored sepals, minute or no petals, numerous stamens and many akenes, which are prolonged into a feathery or rarely naked tail, consisting of the permanent style. The following species have been used:—

Clem. erecta, *Lin.* Indigenous to Europe. The leaflets are 5 to 9 in number, oblong, narrowed below or usually cordate at the base, acute, entire, pale green beneath, 3 to 5 nerved. The white flowers are in cymose clusters. It was formerly known as *Herba flammulæ Jovis.*

Clem. vitalba, *Lin.* Indigenous to Europe. The leaflets are about 5 in number, ovate, heart-shaped at the base, acute, coarsely serrate or entire, 3 to 5 nerved, pubescent when young. The white flowers are in cymose clusters, and have the sepals clothed with felt-like hairs.

Clem. flammula, *Lin.* Indigenous to Southern Europe. The leaves are twice pinnate, the leaflets small, varying between lanceolate and oblong, entire, but two or three lobed.

Clem. virginiana, *Lin.* Common in Canada and the United States. Leaflets three, ovate, rounded or heart-shaped at base, lobed and cut dentate, with mucronate teeth. Flowers white in cymose panicles.

Clem. viorna, *Lin.*, *Leather flower.* Indigenous to the Southern States. Leaflets 3 to 7, ovate, acute, smooth. Flowers single, nodding, with dark purple leathery sepals.

Clem. cylindrica, *Sims.* Resembles the preceding, but has single bell-shaped bluish-purple flowers, with the sepals dilated and often crisped above.

Constituents.—The above species possess in the fresh state a very acrid taste, which is gradually lost. Braconnot observed that the acrid principle may be distilled with water, and is soluble in fixed oils.

Physiological Action.—All the numerous species of this genus possess essentially the same properties, which are those of an acrid irritant. The juice or the bruised plant applied to the skin is apt to cause blisters and even ulcers, and its emanations when it is crushed readily make the eyes water and inflame them. In Europe, beggars avail themselves of these properties to produce ulcers upon their limbs, for the purpose of exciting compassion. Hence, clematis is known as beggar's weed (l'herbe a gueux). These irritant properties are very feeble in the dried plant. The American appear to be less acrid than the European species.

Medical Uses.—The infusion of the flowers and leaves of clematis has been used internally in chronic *rheumatism*, *syphilis*, *scrofula*, *dropsy*, and *quartan ague.* An infusion of the fresh buds of C. vitalba (gr. xv to gr. xl in water f℥vi–viij), with the addition of anise or other carminative, when taken in three doses at intervals of an hour, is said to act as an efficient hydragogue cathartic. The dry leaves in weak infusion have been used with advantage as a diuretic in some cases of *dropsy* following intermittent fever. In Europe, the peasantry employ the fresh leaves as *vesicants*, and physicians have used them in the same manner to relieve local *pains*, also in chronic *rheumatism*, *gout*, and *paralysis.* Even in ancient times this plant was used in the substitutive treatment of chronic *skin diseases*, and much more recently an infusion of it in oil was employed to cure the *itch.* The affected parts, it is said, having been subjected to several frictions, became violently inflamed, but with the subsidence of the inflammation the itch was cured.

COCCULUS.—Cocculus Indicus.

Fishberries, E.; *Coque du Levant*, F.; *Kokkelskörner*, *Fischkörner*, G.

The fruit of Anamirta (Menispermum, *Lin.*) cocculus, *Wight and Arn.*, s. Anam. paniculata, *Colebr.*, s. Cocculus suberosus, *De C.* Bentley and Trimen, Med. Plants, 14.

Nat. Ord.—Menispermaceæ.

Origin.—This is a tall climbing shrub, with broad heart-shaped leaves and long drooping racemes of small greenish diœcious flowers. It is indigenous to India and some of the East Indian islands.

Description.—Cocculus indicus is globular, kidney-shaped, about $\frac{1}{4}$ inch in diameter, and less than $\frac{1}{2}$ inch in length, blackish-brown and wrinkled. The base and apex of the fruit are close together on one side of the fruit, separated from each other by a shallow sinus and connected by an obscure ridge running around the convex side. The endocarp or shell is whitish, thin, and, on the narrow concave side, folded inwards, forming a double projection into the interior of the fruit, and causing the embryo to assume a semilunar shape. The fruit is inodorous and almost tasteless, with the exception of the shrivelled oily embryo, which is disagreeably bitter. Cocculus differs in the characters described from all other fruits usually met with in drug stores. In 1867, 327 pounds of cocculus indicus were imported.

Constituents.—The poisonous principle, *picrotoxin* or *picrotoxic acid*, was discovered by Boullay (1819) and is contained in the kernel. To obtain it the fat is removed by pressure, the residue is exhausted with hot alcohol, and the alcoholic extract boiled with acidulated water, from which picrotoxin crystallizes in inodorous bitter needles. It is sparingly soluble in ether, cold water, and cold alcohol, crystallizes best from its solution in hot alcohol, dissolves freely in alkaline liquids, and precipitates cuprous oxide from solutions of copper, but is not a glucoside. Its composition is $C_{12}H_{14}O_5$. Köhler (1867) observed that it dissolves in sulphuric acid with a yellow color, which, with bichromate of potassium, becomes purplish-blue, then brown and green. It is not precipitated by the reagents for the alkaloids. Pelletier and Couerbe (1833) isolated from the integuments of the fruit the crystalline and tasteless alkaloid *menispermia*, $C_{18}H_{24}N_2O_2$, and *paramenispermia*, which has the same composition, but differs from the former in being insoluble in ether, sublimable, and in failing to neutralize acids. These bodies are associated with the amorphous brown *hypopicrotoxic acid*, which is insoluble in ether and water.

Physiological Action. *On Animals.*—Cocculus is familiarly used for catching fish by mixing the bruised fruit with dough and scattering it on the water. The animals, after whirling round, lie motionless upon the surface of the water. In dogs and other quadrupeds it occasions dulness, muscular tremor, convulsion, and tetanic spasms by turns, the body being strongly bent in opisthotonos. After death, no distinctive lesions are found. Picrotoxin appears to differ from strychnia in its effects, by producing alternate clonic and tonic spasms, and by occasioning vomiting. They agree, however, in exerting their power chiefly, if not exclusively, upon the spinal motor functions. It appears, however, that picrotoxin does not exalt the reflex irritability of the spinal cord as strychnia does. The minimum fatal dose for a rabbit weighing three pounds was found to be $\frac{1}{20}$ of a grain, and its lethal effects were preventable by chloral (Browne).

On Man.—There is no case on record in which cocculus or picrotoxin has produced such spasmodic phenomena as have just been described. Its chief effects in excessive doses appear to be slight giddiness and lightness of the head and partial loss of power in the lower limbs. In one case only have symptoms of active poisoning been described; among them were gastro-intestinal irritation, congestion of the brain, strabismus, sweating, exhaustion, and death. The absence of any spasmodic phenomena throws doubt upon the alleged nature of the attack.

Medical Uses.—The resemblance between the actions of picrotoxin and of strychnia led to the use of the former in *paralysis* of the extremities, and of the sphincters of the bladder and rectum, but the degree of its success does not appear to have been very great. Its virtues in curing *epilepsy* have been confidently set forth by Planat, who recognizes, as the sole exceptions to its curative power in this affection, inveterate cases, whether idiopathic or symptomatic. This physician reports no less than sixteen cases of the disease cured by a saturated tincture of cocculus, of which the primary dose was two drops twice a day, and then each successive day every dose was increased by one drop until thirty drops a day were given. It was then gradually reduced until the original dose was reached, when the medicine was suspended for a fortnight, after which it was renewed and again intermitted alternately during six months. If the results above related can be relied upon, then cocculus is a remedy for epilepsy of far higher curative power than any one before used in the same disease. The same physician claims an equally striking success in cases of infantile *eclampsia*, in *spasmodic contraction* of the limbs, and in *chorea*. But although these remarkable effects were announced in 1875, they do not appear to have been confirmed by other reporters. A case of labio-glosso-pharyngeal *paralysis* is stated to have been greatly benefited by the hypodermic injections of one milligramme doses of picrotoxin (Gubler). Cocculus indicus is employed in decoction or ointment to destroy *lice*, and in the latter form to cure *ringworm of the scalp*. The skin should, in the latter disease, be thoroughly cleansed with soap and water before applying the ointment. *Porrigo* has been cured by an ointment made with ten grains of picrotoxin to an ounce of lard. Cocculus indicus is said to prevent the secondary fermentation of liquors, and for this purpose it is sometimes added to malt liquors at the risk of poisoning those who drink them.

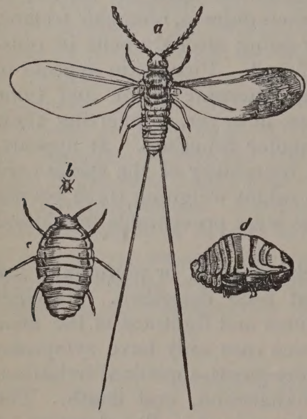
COCCUS, *U. S.*, *Br.*—Cochineal.

Coccionella, P. G.—*Cochenille*, Fr., G.

The female insect, Coccus cacti, *Lin.* Class Insecta; Order Hemiptera.

Origin and Collection.—The cochineal insect is indigenous to Mexico and Central America, and has been introduced into and is cultivated in some of the West Indian islands, the Canaries, Algiers, and Southern Spain. It feeds on different species of cactus, particularly on Opuntia cochinillifera, *Mill.*, O. ficus indica, *Haw.*, O. Hernandezii, *D. C.*, and others. The male insect is very small, has the rostrum or snout in the breast, two large wings and the red body terminated by two long bristles. The female is nearly twice as large, is furnished with a rostrum, and has a bluish-red body flattened below, convex above, wingless, and without terminal bristles; they attach themselves firmly to the plant, where they couple, after which they increase considerably in size and lay several thousand eggs; the insect then dies, and the body dries up, still inclosing the eggs, from which the young soon escape. During the rainy season in Mexico, the insects are kept under cover, upon cactus branches, and when the weather begins to be favorable, they are *sown* upon the plants, and the young ones allowed to develop until the females become fecundated and enlarged, when they are brushed off from the branches, killed by dipping them into hot water, and afterwards dried in the sun or near a fire. Some females are left upon the plants, and in this way three harvests are made before the rainy season again sets in.

Fig. 41.



Coccus Cacti.—*a*. Male insect; *c*, female insect, magnified; *b* and *d*, the same, natural size, before and after impregnation.

Description.—Commercial cochineal is about one-eighth inch long, nearly hemispherical, somewhat oblong and angular in outline, flat or concave on the lower side, transversely wrinkled, readily pulverizable, of a faint odor and slightly bitterish taste. Immersed in water, it imparts to it a red color, and swells up so that the ringed structure of the insect can be readily examined. There are two varieties met with in commerce, the *silver-gray* and the more esteemed *black*. The former is of a purplish-gray, the latter of a purplish-black color; it differs from the former only in the absence from the furrows between the rings of the white wool, which imparts to the other kind the gray color. An inferior kind, called *granilla* or *grana sylvestra*, consists mainly of very small insects, but is rarely seen in commerce. The United States import annually about 1,250,000 pounds of cochineal.

Adulterations.—Adulterated cochineal is not uncommon. The adulteration is effected by moistening the gray variety with gum-water and then rolling it in black lead or ivory black mixed with some powdered cochineal to imitate the purplish-black color of the more valuable variety. Or an inferior quality of cochineal, moistened as before stated, is superficially colored by a mixture of barium sulphate or lead carbonate and ivory black. Frauds are readily detected by macerating some of the insects in water, when the powder is soaked off and the insect may be examined.

A similar product is the *kermes*, *chermes*, or *alkermes*, which consists of the fully-developed females of Coccus ilicis, *Fabr.*, indigenous to the basin of the Mediterranean and living upon Quercus coccifera, *Lin.* By moistening with vinegar and drying in the sun, they acquire a brown-red color. They are of the size of a pea, nearly globular, almost smooth, yield a carmine-colored powder, and produce with tinsalt, like cochineal, a fine scarlet red.

Constituents.—Besides fat, a small amount of volatile acid, mucilaginous and glutinous compounds, cochineal contains *carminic acid*, $C_{17}H_{18}O_{10}$, which Belhomme believes to be also met with in the blossoms of Monarda didyma. It is readily soluble in water and alcohol, little in ether, and insoluble in the fixed and volatile oils. Its alcoholic solution is precipitated by alkalies, but the crimson color of its aqueous solution is succeeded by a purplish-red and precipitated on the addition of alkaline earth. Most metallic salts yield colored precipitates with it; the deposit with alumina hydrate is called *lake*. When decoctions of cochineal containing a little alum, cream of tartar or salt of sorrel are set aside, they will deposit *carmine*, which in commerce is often found adulterated with starch and other substances; pure carmine should be entirely soluble in ammonia water.

Off. Prep.—Tinct. cardamomi comp., *U. S.*, *Br.;* Tinct. cinchonæ comp., Tinct. cocci, *Br.*

Medical Action and Uses.—It is very doubtful if cochineal possesses any medicinal virtues. It has, indeed, been reputed to be stimulant, antispasmodic, and diuretic, and cases are not wanting, especially of *whooping-cough* and *neuralgia*, to prove its curative virtues. But such testimony is quite unsupported by general observation. The beautiful carmine color which it imparts to various medicinal preparations is its only substantial title to a place in the Pharmacopœia.

COCHLEARIA.—SCURVY-GRASS.

Herbe au scorbut, Fr.; *Löffelkraut*, G.

Cochlearia officinalis, *Lin.* *Nat. Ord.*—Cruciferæ, Siliculosæ.

Description.—This biennial or annual herb is a native of Northern and Central Europe, where it grows in saline soil, and is occasionally cultivated. The root is of the thickness of a quill, long, and white. The numerous radical leaves are on long petioles, roundish, heart-shaped, or almost reniform, very obtuse, and nearly entire; those of the stem are ovate, obtuse, with few angular teeth, the lower ones petiolate, the upper ones clasping. The flowers are white, in terminal racemes, followed by globular ovate, ascending pods, which are slightly flattened laterally, pointed by the persistent style, and contain 3 to 5 red-brown seeds in each cell. All parts have a pungent, acrid, and bitterish taste.

Constituents.—Winckler obtained tannin and a bitter principle, which with myrosin of white mustard, yielded oil of mustard. O. Geiseler (1859) corroborated the statement that the volatile oil does not pre-exist, but is formed only on maceration with cold water; he found its sp. grav. to be 0.942, and its composition $=(C_3H_5)_2OS$. According to A. W. Hofmann, however, it is butyl-mustard oil, $CSN.C_4H_9$, or sulphocyanide of butyl; boils near 160° C. (320° F.) and yields with ammonia a crystalline compound, fusing at 135° C. (275° F.). An oil obtained synthetically from butylamin had the composition of oil of scurvy-grass, but a different odor, and yielded an ammonia compound, fusing at 90° C. (192° F.).

Medical Action and Uses.—Common scurvy-grass is stimulant, diuretic, and antiscorbutic in virtue chiefly of its acrid essential oil. Its bitter principle also contributes to its medicinal qualities. When chewed it excites the secretion of saliva, and, when swallowed, a sense of warmth in the stomach; it also tends to relax the bowels. It is everywhere eaten as a salad, generally mixed with water-cresses, and has great popular repute as a purifier of the blood. It is justly celebrated for its efficacy in *scurvy;* and is either eaten fresh, which is preferable, or its expressed juice is administered. It has also been used with reputed advantage in *scrofula, chronic intermittent fever,* and *dropsy* depending upon the latter disease. Externally the bruised herb has been applied in poultices to stimulate scrofulous and other atonic *ulcers;* and the juice diluted with water has been used as a mouth-wash for *spongy gums* and ulcers of the mouth.

COLCHICI RADIX, *U. S.*—COLCHICUM ROOT.

Colchici cormus, Br.; *Bulbus s. Tuber colchici.*—*Colchicum corm, Meadow saffron root,* E.; *Bulbe de colchique, de safran bâtard,* Fr.; *Zeitlosenknollen,* G.

The tuber of Colchicum autumnale, *Lin.;* Woodville, Med. Bot., plate 177. Bentley and Trimen, Med. Plants, 287.

COLCHICI SEMEN, *U. S.*—COLCHICUM SEED.

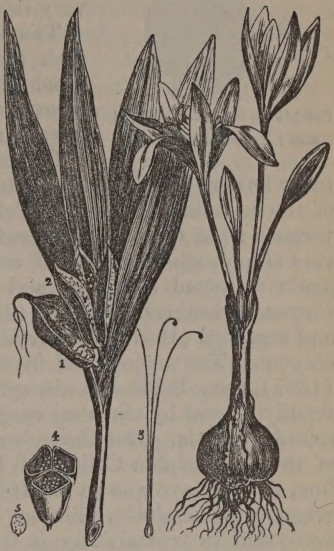
Colchici semina, Br.; *Semen colchici,* P. G.—*Semences de colchique,* Fr.; *Zeitlosensamen,* G.

The seeds of Colchicum autumnale, *Lin.* *Nat. Ord.*—Melanthaceæ.

Origin.—The plant is indigenous to Europe, in the southern and central part of which it is frequently found in pastures and meadows, flowering in September or October, and ripening its seeds in June following. In the autumn the subterraneous portion consists of the fully developed tuber (corm of many writers), bearing at its apex the scar left by the fruit stem of the preceding summer. A tuft of root fibres is attached to a lateral projection of the base, above which there is a shallow groove running to the apex of the tuber. In the lower part is a short conical axis with three or four rudimentary leaves, and bearing upon the apex one or more flowers, with the lower part of their long corolla tubes resting in the groove. The whole is surrounded by a few brown leaves forming a sheath above. After flowering the tuber gradually diminishes in size, until by the following summer it is completely absorbed and decayed. In the mean time the short conical axis is gradually developed into a stem rising above ground and enlarged at the base to an ovoid fleshy tuber, as yet without the lateral groove, but showing in the lower axil the bud, which by the following autumn will be developed into a short conical flowering axis, while in the mean time the lateral groove on the fruit-bearing tuber will have been formed. The development and duration of the tuber embrace, accordingly, a period of two years, in the first half of which the tuber produces flowers and fruit and afterwards serves for developing and nourishing its successor.

The flowers resemble those of Crocus, have a whitish tube about 5 inches long, and a six-parted pale lilac or rose-colored border. The ovary remains underground during the winter, and is afterwards formed into an obtusely-triangular, oblong-ovate and inflated capsule, which is three-celled, bears the numerous seeds in the centre, and is surrounded by 4 or 5 linear lanceolate leaves. The tubers are collected in July and August before the appearance of the flowers; but Schroff (1856), and afterwards Maclagan, concluded from physiological experiments the proper time for the collection to be the period of flowering and immediately afterwards.

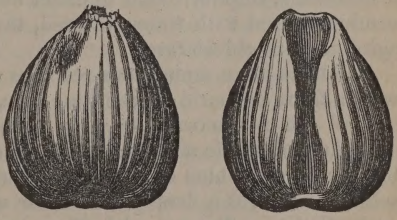
Fig. 42.



Colchicum autumnale. — 1. Capsule closed; 2, the same open; 4, transverse section; 3, the styles.

Description. 1. The Tuber.—It preserves its properties best if dried entire by exposure to the sun and air, and is then of an ovoid shape, 1 to $1\frac{1}{2}$ inches long, and nearly as thick at the thickest portion, convex on one side, flattened, and with a grove on the other. After the removal of the brown membraneous teguments, the surface is of a brownish or ash color, longitudinally wrinkled, and internally white. In our commerce it is usually met with in transverse slices about $\frac{1}{8}$ inch in thickness, somewhat reniform in shape, and notched on one side, of a white mealy appearance, and breaking with a short and mealy fracture. In the fresh state it has a radish-like odor, which is completely lost on drying. The taste is sweetish, then bitter, and somewhat acrid. Colchicum tubers exhibiting a blackish color upon the recent fracture should be rejected.

Fig. 43.

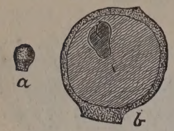


Tuber of Colchicum.

The oriental *hermodactyls* resemble this tuber, but have a smooth surface, and vary in color between whitish and blackish, and in taste between insipid and bitter. They have been referred to Colch. variegatum, *Lin.*, which is found in Southern Europe and Asia Minor, but are probably obtained from different species, indigenous to Asia. Orphanides (1875) enumerates not less than forty-three distinct species.

2. The Seeds.—They are about a line in diameter, nearly spherical, slightly pointed at the hilum by a crest-like appendage, of a dull-brown color, somewhat glutinous when fresh, and with a powdery surface when older. They are entirely inodorous, and have a bitter, acrid taste. The finely punctate testa

Fig. 44.



Colchicum Seed.—*a*, natural size; *b*, section magnified.

adheres closely to the thick horny albumen, which renders the seeds very difficult to powder, and incloses a very small embryo nearly opposite the hilum.

The powdering is effected by grinding them in a mill with hardened plates, and if done in a mortar they should be well dried, or else previously soaked in the menstruum to be used for exhaustion, and while still moist, crushed beneath the pestle in small quantities.

Constituents.—The important constituent of the tuber flowers and seeds of colchicum is *colchicia*, according to Hübler (1864), of the formula $C_{17}H_{19}NO_5$. Pelletier and Caventou (1820) supposed it to be veratria; but Geiger and Hesse (1833) proved it to be distinct. Owing to a case of poisoning by wine of colchicum, which occurred in Berlin in 1855, it again attracted attention, and was examined (1857) by Aschoff, Bley, John Carter, and others. Oberlin (1856) denied the alkaloidal nature of this body, and regarded (1857) the crystalline *colchiceïn* as the poisonous principle of colchicum. The majority of investigators, including Ludwig (1862) and Diehl (1867), regarded it as a nitrogenated non-alkaloidal bitter principle, which is readily altered by chemical reagents, though it is not a glucoside, as was asserted by Walz. But Carter's colchicia (a specimen of which is in the cabinet of the Philadelphia College of Pharmacy) is unmistakably though feebly alkaline, as we have shown in 1867; it affords also precipitates with the usual reagents for alkaloids. Similar results were obtained by Eberbach (1874), who succeeded in crystallizing it from chloroform in silky needles. Rosenwasser (1877) obtained crystals from benzol, which became amorphous after exposure to the air for several months. Colchicia is usually prepared by exhausting with alcohol, evaporating, diluting with water, filtering, precipitating coloring matter with subacetate of lead, removing excess of lead by sodium phosphate and precipitating colchicia with tannin; the washed tannate is digested with lead oxide, and dried when alcohol dissolves the colchicia. Eberbach's process is a modification of that of Geiger and Hesse; he exhausts with alcohol containing $\frac{1}{4}$ per cent. sulphuric acid; to the tincture calcium hydrate is added, and to the filtrate if necessary, sulphuric acid to exact neutralization; the alcohol is distilled off, the residue diluted with water, filtered, the filtrate treated with ammonia, and then agitated with chloroform.

Colchicia is an amorphous resinous mass, yielding a pale yellowish powder, with a faint aromatic saffron-like odor, and bitter taste, freely soluble in water, alcohol and chloroform, less so in ether. It is characterized by yielding with concentrated nitric acid (sulphuric acid with some potassium nitrate) an intense blue or purplish-blue color; passing into green and yellow. Its cold aqueous solution acquires a deep-yellow color with muriatic and other mineral acids and with alkalies. Treated with diluted sulphuric acid it is converted into the isomeric colchiceïn, which shows the same reactions, and similar behavior to solvents, and differs mainly by the readiness with which it crystallizes and yields mostly amorphous compounds with bases. 1 pound of dry tubers collected in October yields about 6.5 grains; the amount then decreases, and is in May 0.75 grain, and for the young tuber 6.5 grains. 1 pound of seeds yields 15 to 19 grains. 2 pounds of fresh (= $4\frac{1}{2}$ oz. dry) colchicum flowers yielded 7 grains; but if collected without the underground portion of the tubes, only 2 grains. The flowers, if properly gathered, furnish therefore quite an active medicine.

The remaining constituents of the tuber are medicinally unimportant; they comprise starch (about 10 per cent.), gum, sugar, tannin, and fatty resinous and coloring matter. The constituents of the seeds are similar; their fixed oil amounts to between 6 and 7 per cent.

Off. Prep.—1. Tuber. Extract. colchici, *Br.;* Extr. colchici rad. fluid., *U. S.;* Extr. colchici aceticum, Vinum colchici radicis, *U. S.*, *Br.*

2. Seed. Extr. colchici seminis fluid., *U. S.;* Tinc. colchici (colchici sem.), *U. S., Br.;* Vinum colchici seminis, *U. S.*

Physiological Action.—Colchicum and its alkaloids, when given to certain animals by the mouth or veins, or hypodermically, produce essentially the same symptoms. They consist of violent and even bloody vomiting and purging, great nervous exhaustion, and signs of extreme suffering. After death intense vascular congestion is found in the gastro-intestinal mucous membrane, and in the kidneys; the blood is dark and thick, not only in the veins, but even in the heart and arteries, in consequence, no doubt, of the great loss by vomiting and purging of its watery element. According to Rossbach the most characteristic effect of cholchicia is a complete paralysis of the central and peripheral terminations of the nerves. This effect involves sensibility, motility, and reflex excitability. It is remarkable that the action of the alkaloid is very slowly developed, and that even in experiments causing death, the fatal effect is delayed for several hours. Upon man the operation of colchicum and its preparations does not differ essentially from that just described. Its topical action is shown by the redness, prickling, and diminished sensibility of the skin, produced by the application of the fresh cormus. Its constitutional operation may be produced in this manner. Applied to the tongue it occasions an acrid, bitter, and astringent taste, irritation of the fauces, with salivation, and a sense of tension and pain, followed by insensibility and rigidity of the organ, and sometimes profuse ptyalism. Medicinal doses, insufficient to produce any gastro-intestinal irritation, diminish the frequency of the pulse, and probably increase the proportion of solids in the urine. The latter statement is not sustained by uniform evidence; but there has been too little care to distinguish between cases into which no disturbing element entered, and those in which the emeto-cathartic operation of the drug took place, and in which, therefore, the urinary secretion was necessarily diminished. It is very certain that there is nothing in its eliminative action by the kidneys or by the bowels to explain its curative virtues.

When moderate doses of colchicum have been repeated for several days, or a large dose has been taken, some heat is felt in the epigastrium, with eructations, and perhaps nausea. If continued, the appetite fails, the tongue becomes coated, and there is some colic, with gurgling and diarrhœa. In doses of from one to four drachms within twenty-four hours it also occasions bilious vomiting, with colic and straining, heat in the anus, and bloody and mucous stools. It is said that the abdomen is not tender under pressure, and cases of colchicum poisoning indicate that the statement is true.

Poisonous doses of colchicum, apart from the symptom just alluded to, occasion all the signs of violent gastro-intestinal irritation, a true cholera morbus, with griping, vomiting, diarrhœa, prostration, and painful spasms of the limbs and trunks, followed by resolution and collapse, in which death occurs without delirium or coma. It probably is due at last to cardiac syncope. After death the most notable changes consist of lividity of the skin in depending parts, engorgement of the veins, with dark pitchy blood in the lungs, brain, and trunk, and sometimes a dark-colored injection of the gastro-intestinal mucous membrane, and submucous ecchymoses. It is alleged that colchicum, or its alkaloid, is sometimes used in the manufacture of beer to simulate the bitterness of the hops which is deficient. A case is recorded in which several persons who each had drunk about a glass of English beer were seized with vomiting and purging, heat of head, etc., and that the beer, on examination, was found to contain colchicia.

It may be concluded that colchicum acts chiefly upon the digestive organs and upon the nervous system, and probably favors the elimination of the effete matters through the bowels, the kidneys, and in a slight degree through the skin.

Medical Uses.—The chief use of colchicum is in the treatment of *gout*, for which disease it was anciently employed, and only fell into neglect through the prevalence of absurd medical theories, which condemned it because their authors could not comprehend its operation. Only within the first quarter of the present century was it revived, after the discovery that the virtues of an unquestionably efficient quack remedy for the cure of gout were due to colchicum. As a general rule it acts much more favorably upon acute than chronic gout, and upon first attacks than upon those frequently repeated; it does not agree with old persons as well as with the young or the middle-aged; and usually, although by no means uniformly, its favorable operation is attended with an increased secretion of bile and urine, free alvine discharges without diarrhœa, and a moist state of the skin. Its curative effects are not to be secured by allowing it to excite vomiting or purging, but are retarded and rendered incomplete by such evacuations. In all cases these evils should be avoided by commencing the administration with small doses of the drug. A repetition of the gouty attacks renders larger doses necessary, and in course of time they are apt to resist the medicine completely. Before commencing the administration of colchicum in this disease, it is usually profitable to remove the contents of the alimentary canal by means of a purgative. A draught containing sulphate of magnesia, with magnesia or its carbonate, in an aromatic water, is the most appropriate form of prescribing it.

Much has been written of the virtues of colchicum in *rheumatism*, and some reputable physicians have estimated them highly; but a close inquiry leaves no doubt that whatever good may have been achieved was due either to the violent purgative operation of the medicine, or to the agents with which it was associated. The same remark applies with equal force to the use of the medicine in *cholera*, *tetanus*, *neuralgia*, diseases of the *skin*, etc.; but it is possible that it may exert a salutary diuretic action in *dropsy* depending upon congestion or infarction of the kidneys. Its importance in this affection compared with that of digitalis, is almost null.

The *dose* of the dried cormus of colchicum may be stated at from two to eight grains; and, according to some persons, this form of the medicine is the most efficient. But the wines or the extracts are usually preferred.

COLLINSONIA.—Horsebalm.

Rich-weed, *Stoneroot*, *Knobroot*, *Heal-all*, E.; *Guérit-tout*, *Baume de cheval*, Fr.; *Collinsonie*, G.

Collinsonia Canadensis, *Lin.* *Nat. Ord.*—Labiatæ.

Description.—A perennial herb about 3 feet high, growing in rich woodlands in North America from South Carolina northward. It has a nearly horizontal and irregularly branched rhizome, having, together with the branches, a length and width of three or more inches, and on the upper side a very knotty and tuberculated appearance from the numerous short projecting branches and the many shallow concave stem-scars; the lower surface is much less knotty, and bears many thin, nearly simple rootlets or their remnants. It is externally of a grayish- or yellowish-brown color, has a very thin bark of a slight nauseous taste, and a very hard whitish wood.

The stem is quadrangular and hairy above; the leaves are opposite, petiolate, 3 to 8 inches long, thin, nearly smooth, ovate, pointed, sometimes rather heart-shaped at the base, coarsely serrate, and somewhat dotted beneath. The flowers are in loose racemes, of a greenish-yellow color, the lower lip of the corolla fringed and with two exserted stamens. The herb has when rubbed a strong and usually disagreeable odor; but occasionally it is more pleasant and anise-like. Its taste is pungent. Like other labiatæ, it contains a volatile oil, but it has not been chemically examined.

Medical Action and Uses.—From the fact that this plant contains a volatile oil which it loses in drying, and that it has been popularly regarded as a remedy for various states requiring stimulus, it must be held to possess stimulant virtues. Their special direction appears to be towards the urinary organs, since it is esteemed most in *dropsy*, *gravel*, and *vesical catarrh;* and towards the skin, since it is employed as a diaphoretic in *rheumatism* and *fevers*. Doubtless the latter object is best secured by a warm, and the former by a cold, infusion of the plant. The essential oil has been used separately, and probably contains all the curative virtues of the herb. The fresh bruised herb has been employed as an anodyne for *colic* and other *local pains*, and especially in hot fomentations. Next to the essential oil, an infusion of the bruised plant is to be preferred.

COLLODIUM, *U. S.*, *Br.*—COLLODION.

Collodion, Fr.; *Collodium*, G.

Preparation.—Take of Pyroxylon two hundred grains; Stronger Ether twelve fluidounces and a half; Stronger Alcohol three fluidounces and a half. Mix the ether and alcohol in a suitable bottle, and, having added the pyroxylon to the mixture, agitate occasionally until it is dissolved. *U. S.*

The British Pharmacopœia directs the dissolution of 1 ounce of pyroxylin in a mixture of 36 fluidounces of ether and 12 fluidounces of rectified spirit. The proportions of the German Pharmacopœia are 1 part of gun-cotton to 18 parts of ether and 3 parts of alcohol. Both Pharmacopœias order the solution to be poured off from any sediment, which, on the contrary, is reincorporated by agitation before the collodion is used, according to the United States Pharmacopœia.

Properties.—If the pyroxylon, or more correctly *colloxylon*, has been properly made, there is no difficulty in preparing collodion by simply agitating it occasionally with the liquid.

It forms a neutral, nearly clear, or slightly opalescent liquid having a syrupy consistence and ethereal odor. On evaporation it forms a colorless, glossy, and contractile film, which is more or less white and opaque if applied with the insoluble sediment as directed above.

Pharmaceutical Uses.—Collodion and flexible collodion may be used as an eucellent vehicle for the local application of medicinal substances soluble in ether, such as aconitia, atropia, tannin, ferric chloride, carbolic acid, the oleoresins of capsicum, pepper, etc., camphor, corrosive sublimate, red iodide of mercury, etc.

Medical Uses.—These are treated of under *Flexible Collodion.*

COLLODIUM CUM CANTHARIDE, *U. S.*—COLLODION WITH CANTHARIDES.

Collodium cantharidatum, P. G.; *Collodium cantharidale s. vesicans.*—*Cantharidal collodion*, E.; *Collodion vésicant* (*cantharidé*), Fr.; *Blasenziehendes Collodium*, G.

Preparation.—Take of Cantharides in fine powder eight troyounces; Pyroxylon one hundred grains; Canada Turpentine three hundred and twenty grains; Castor Oil one hundred and sixty grains; Stronger Ether a pint and a half; Stronger Alcohol a sufficient quantity. Introduce the cantharides into a cylindrical percolator, and, having pressed it firmly, gradually pour on the ether.

When fifteen fluidounces have passed set aside the liquid in a close vessel, and continue the percolation with stronger alcohol until half a pint more of liquid is obtained. Set this in a warm place for spontaneous evaporation, and, when it is reduced to a fluidounce, mix it with the reserved liquid. Then add the pyroxylon, the Canada turpentine, and the castor oil to the mixture, and agitate occasionally until they are dissolved. Lastly, keep the solution in a well-stopped bottle. *U. S.*

The powdered cantharides are first treated with ether, by which most of the cantharidin is taken up, and afterwards with alcohol to displace the remainder of the ether. The first 15 fluidounces being reserved, the tincture last obtained is evaporated spontaneously to one fluidounce, when but little ether remains; it is then mixed with the first portion, and the preparation completed by adding the other ingredients and dissolving them in the ether. Procter's suggestion (1852) is to exhaust completely with ether, to recover the latter by distillation, and to dissolve the residue in collodion. For reasons stated under Cantharides, the exhaustion is better accomplished by acetic ether.

An improved formula, as far as the manipulation is concerned, was recommended by C. L. Mitchell (1872), who suggests the percolation of 4 troyounces of the powder, first with 12 fluidounces of ether, and then with sufficient alcohol to obtain 16 fluidounces, in which 180 grains of pyroxylon are dissolved; but this is only one-half the officinal strength, and when used requires to be repeatedly applied.

The German Pharmacopœia directs this collodion to be made from *Æther cantharidatus*, which is prepared by macerating 4 parts of coarsely powdered cantharides with 6 parts of ether and filtering; the filtrate should weigh four parts. The process evidently involves a loss of one-third of the active matter.

Properties.—Cantharidal collodion has the same physical properties as flexible collodion except that it is of a brownish-green color, which becomes yellowish on exposure to light; it is, therefore, best kept in amber-colored vials.

Medical Uses.—See the following article.

COLLODIUM FLEXILE, *U. S.*, *Br.*—FLEXIBLE COLLODION.

Collodium elasticum, P. G.—*Collodion élastique*, Fr.; *Elastisches Collodium*, G.

Preparation.—Take of Collodion a pint; Canada Turpentine three hundred and twenty grains; Castor Oil one hundred and sixty grains. Mix them, and keep the mixture in a well-stopped bottle. *U. S.*

This is identical with the formula of the British Pharmacopœia; the German Pharmacopœia directs the dissolving of one part of castor oil in 50 parts of collodion.

Properties.—This preparation has the same appearance as collodion, but on evaporation it forms an elastic and scarcely contractile film.

Medical Action and Uses.—When collodion is laid upon the skin the evaporation of its ether causes its dissolved elements to solidify and contract. As it then becomes very adhesive, all the parts to which it is applied are constringed during the process, and therefore are measurably rendered anæmic, so that congestion, inflammation, and pain are prevented or reduced. The film formed by collodion in drying is impermeable to air and water, and therefore protects the parts underneath it, while its transparency permits them to be seen. The adhesive, protective, and contractile powers of collodion have been variously applied. In *wounds* of the scalp it serves to attach to the shaven skin slips of parchment, between whose opposite edges sutures are inserted to draw them together. In other simple incised wounds it is applied while the edges of the wound are kept accurately adapted, the skin being first made perfectly dry. Collodion is often serviceable as a coating to *ulcers* which will not heal in consequence of the moisture of the locality or its liability to mechanical irritation. Of the former sort are ulcers of the neck of the *uterus;* of the latter, various ulcers of the *skin.* The application should be made first at some distance around the sore, and gradually advance to its centre, which ought to be left open for the escape of the secretions. Its protective and constringing properties are usefully employed in the treatment of *carbuncles.* As in the case just mentioned, the application should be made widely around the swelling, whose central portion should be left free. The same qualities render it available in preventing and in treating *bed-sores* and *sore nipples.* Its protective action has been employed to prevent *abrasions* and other wounds from becoming infected during surgical and obstetrical operations, and in *dissections.* Its constringing operation enables it to control *hemorrhage* from leech-bites and other small wounds, to diminish the inflammation produced by the *stings of insects*, the local phenomena of *erysipelas*, *burns*, and *smallpox*, in the latter of which it is thought to prevent pitting. For the last three purposes it is necessary to modify the action of the collodion so as to render it less rigid when hardened. A mixture of one part of castor oil with fifteen of collodion is said to have this effect; or the officinal flexible collodion may be used. With a similar object collodion has been applied with more or less success to the treatment of a variety of limited cutaneous eruptions, such as *intertrigo*, *acne*, *eczema*, and *herpes zoster.* In the last-named affection it certainly lessens the pain. In several of these disorders a preparation of collodion has been used containing vegetable and mineral astringents. Collodion may be employed to reduce the swelling of gonorrhœal *orchitis*, the skin of the swollen testicle being tensely drawn before the liquid is applied. It has also been used with advantage in the treatment of *varicocele.* In *retracted nipple* a zone of this liquid, applied so as to encircle the nipple at the distance of a quarter of an inch, will sometimes cause it to protrude. Its constringing action and its mechanical support render it sometimes efficient in preventing protrusion of the bowel in umbilical *hernia*, and even in some cases of inguinal hernia; and the same is true of its use in cases of *spina bifida*, *vascular nævi*, and *cephalæmatoma* after puncture. It has been used with alleged success to prevent nocturnal *urination* in children, by closing the orifice of the urethra by means of it at bedtime. But this is a clumsy expedient. In applying the *actual cautery* its action may be limited by including the skin about to be burned within a broad and thick circle of collodion.

Various substances of a caustic nature, such as cantharides, croton oil, iodine, corrosive sublimate, iodide of zinc, chromic acid, etc., and certain astringents, such as tannin, the salts of iron and copper, etc., have been associated with collodion for local application. Cantharidal and flexible collodions are officinal.

Before applying collodion the skin should be perfectly dried, and, the liquid having been laid on with a soft brush, the first layer should be allowed to harden before a second is applied. For protective purposes a thin film will suffice; for constriction a thicker coating is required. In dressing wounds a piece of patent lint or of linen cambric saturated with the liquid should be laid upon the part after the edges of the wound are accurately coaptated. If a firm dressing without constriction is desired, flexible collodion is to be preferred.

COLOCYNTHIS, *U. S.*—COLOCYNTH.

Fructus colocynthidis, P. G.; *Poma colocynthidis.*—*Coloquinte*, Fr.; *Koloquinten*, G.

The fruit, deprived of its rind, of Citrullus (Cucumis, *Lin.*) colocynthis, *Royle.* Woodville, Med. Bot., plate 175.

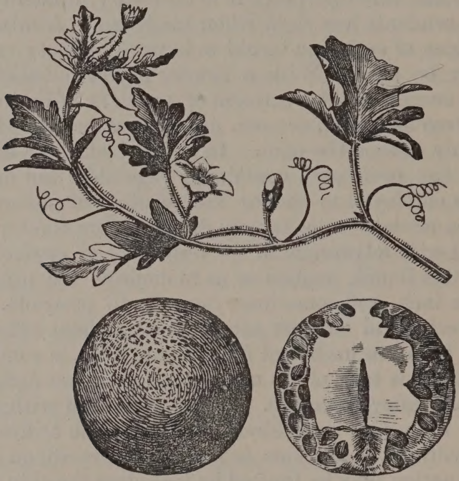
COLOCYNTHIDIS PULPA, *Br.*

Colocynth pulp, E.; *Pulpe de coloquinte*, Fr.; *Koloquintenmark*, G.

The decorticated fruit, freed from the seeds, of Citrullus colocynthis, *Royle.*

Origin.—The colocynth plant has a perennial root, an herbaceous, angular, hispid stem, with many-lobed hairy leaves, short branching tendrils and solitary axillary unisexual flowers, with a yellow corolla. It is said to be indigenous to Japan, and is met with abundantly from the sandy lands of Coromandel northwestward to the Caspian Sea, and westward throughout Western Asia to Greece, and throughout Northern Africa as far south as Nubia and Senegambia. It is cultivated and naturalized in Spain.

Fig. 45.



Colocynth, plant and fruit.

Description.—The fruit, called gourd or pepo, resembles an orange in size and appearance, is globular, two to three inches in diameter, and covered with a smooth and thin but firm parchment-like rind of a light yellow color. The rind is usually removed, sometimes from the fresh, but more frequently from the dried fruit. In the former case the pulp is considerably shrunk, so as to closely envelop the seeds; in the latter case the fruit has retained its original size and shape, but shows upon the surface of the white spongy pulp the smooth cuts with a sharp knife. It is destitute of odor, but has an intensely bitter taste, is very light, and divided into three easily separable cells by the parietal placentæ, which project to near the centre, are then branched, turned back towards the rind, and here curved inward again, so that by the development of each placenta three slightly united wedges are formed, each one being again divided into two parts. The naturally one-celled fruit has therefore the appearance of being six-celled, and the seeds being borne on the incurved ends of the placentæ in two rows, there are four rows of seeds in each wedge, or twelve rows in the fruit. The seeds are flat ovate, with a rounded edge, brownish or yellowish, and contain an oily embryo, with two thick cotyledons. Good colocynth yields about 72 per cent. seeds, and from 28 to 33 per cent. of pulp, the latter alone being employed in medicine.

Colocynth reaches commerce from Syria, Egypt, Morocco, and Spain. The Syrian variety is often peeled while fresh, and when dry, of a very shrivelled and unsightly appearance, but is rarely met with in our commerce. 27,555 pounds of colocynth were imported into this country in 1867.

Some other cucurbitaceous fruits have a very bitter taste, and are reputed to be purgative, like Cucumis trigonus, *Roxb.*, and Cuc. Hardwickii, *Royle*, of East India, and Cuc. prophetarum, *Lin.*, of Arabia.

Constituents.—Colocynth has been analyzed by Braconnot, Vauquelin, Herberger, Meissner, Bastick, and others; but Walz (1858) appears to have obtained the bitter principle *colocynthin* in a pure state, by exhausting the alcoholic extract with cold water, precipitating the filtrate with acetate and subacetate of lead, removing excess of lead with sulphuretted hydrogen, precipitating with tannin, diffusing the precipitate in alcohol, and decomposing with plumbic hydrate. Any lead taken up by the liquid is removed by hydrogen sulphide, the clear liquid evaporated, and the residue washed with ether. The undissolved portion is colocynthin $C_{56}H_{84}O_{23}$(?), an amorphous yellow mass, which appears to become crystalline on the slow evaporation of its alcoholic solution. It is soluble in water, and precipitated by ether from its alcoholic solution. On boiling with dilute acids it splits into sugar and resinous *colocyntheïn.* The portion of the alcoholic extract remaining undissolved by cold water contains a tasteless crystalline principle, *colocynthitin*, which is soluble in ether, alcohol, and hot water. The medicinally unimportant constituents are pectinaceous, mucilaginous, and gummy matter, fixed oil, and salts.

Pharmaceutical Uses.—FRUCTUS COLOCYNTHIDIS PRÆPARATI, s. *Trochisci alhandal*, P. G.; it is prepared by triturating five parts of colocynth pulp and one part of powdered gum arabic with sufficient water to form a paste, which is dried and reduced to a fine powder, having a yellowish color.

TINCTURA COLOCYNTHIDIS, P. G.—Tincture of colocynth is made by macerating for eight days one part of colocynth pulp with ten parts of alcohol, sp. gr. 0.91, expressing and filtering.

For medicinal purposes an *impure colocynthin* has been proposed, to be made be treating the alcoholic tincture with animal charcoal, or by mixing the powdered colocynth with and packing it upon some animal charcoal, and then displacing with alcohol; on evaporating, a garnet-colored mass is obtained, soluble in water and alcohol and insoluble in ether. It has been used in doses of a quarter to half a grain.

Off. Prep.—Extract. colocynthidis, *U. S.;* Extr. colocynth. comp., Pilula colocynth. comp., Pil. colocynth. et hyoscyami, *Br.*

Physiological Action.—Unless in very large doses, colocynth acts feebly upon horses, sheep, and swine. It purges dogs and rabbits violently, causing exhaustion, with inflammation of the bowels. In man, small doses of it appear to quicken intestinal peristalsis and augment the mucous and biliary secretions. The stools are generally mucous and watery, and are attended with colic. In excessive doses it operates as a violent emeto-cathartic, causing vomiting and serous or bloody stools, severe burning and colicky pains, and muscular spasms, such as are apt to occur in all severe gastro-intestinal irritation. It has been known to cause death with these symptoms, or with the addition of peritonitis. Solutions of colocynth applied to the skin of the abdomen have occasioned purging, and the more readily when the cuticle was removed.

Medical Uses.—Colocynth is used as a purgative when it is intended to produce a copious secretion and rapid evacuation from the bowels, and, at the same time, a derivative operation upon their mucous integument. Thus, it is employed simply as an *evacuant* when fecal or other accumulations obstruct the intestine, and in this manner, also, it becomes a *vermifuge*. In a similar manner partly, it is used to promote indirectly the absorption and discharge of *dropsical effusions*, these collections being absorbed in proportion as the bloodvessels lose their watery contents through the bowels. It is one of the drastic cathartics which were anciently employed to cure *melancholia*, and which for this purpose are probably undervalued at the present day. In many cases of the affection the scybalous dejections, muddy skin and eye, foul tongue, tender liver, and loaded urine, are speedily modified by active purgation, and with their abatement the mental torpor is removed. In *coma*, *apoplexy*, and recent *paralysis* of a congestive origin, colocynth will often prove a valuable revulsive. On the other hand, its irritation of the bowel, by extending to the bladder, urethra, or uterus, sometimes serves to cure *vesical paralysis*, *chronic urethritis*, and *amenorrhœa* depending upon torpor of the uterine system. Colocynth has been used as a *diuretic* in dropsy, but the proof of its efficacy is insufficient.

Neither colocynth nor its simple extract is, at the present day, often administered alone, but usually in combination with rhubarb, aloes, scammony, and mercurials. As a laxative, the *dose* may be stated at from two to five grains; and as a drastic purgative, from five to ten grains three or four times a day. The tincture (Ph. G.) is an efficient preparation.

COLUTEA.—BLADDER SENNA.

Baguenaudier, *Séné indigène*, Fr.; *Falsche Senna*, G.

The leaves of Colutea arborescens, *Lin.*

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The bladder senna is a South European shrub, about 10 feet high, with small racemes of yellow flowers and greenish inflated legumes containing many roundish blackish-brown seeds.

Description.—The leaflets are in 4 or 5 pairs, oval or elliptic, obtuse or emarginate at the apex, regular at the base, thin, smooth, and dark green above, pale green beneath, and clothed with appressed hairs. They have a feeble odor and a nauseous and bitter taste.

They have occasionally been used for adulterating senna leaves.

Constituents.—Bladder senna has not been analyzed.

Medical Action and Uses.—The leaves and the seeds of this plant are purgative, and the latter were formerly regarded as emetic also. It has been used chiefly as a domestic purgative in some parts of Europe, in an infusion prepared with an ounce of the leaves to a pint of water with the addition of liquorice root and anise seed, and taken in divided doses, in the morning, fasting. The dried leaves smoked in a pipe are said to act powerfully as an errhine. It is employed in the same cases as senna.

COMPTONIA.—SWEET FERN.

Ferngale, *meadowfern*, E.

The leaves and tops of Comptonia (Myrica, *Blum*) asplenifolia, *Ait.*, s. Myrica comptonia, *D. C.*

Nat. Ord.—Myricaceæ.

Origin.—Sweet fern is a branching shrub, about 3 feet high, growing in sandy or sterile places in Canada and the United States southward to Virginia, and flowering in April.

Description.—The leaves are scattered, linear-lanceolate, pinnatifid with alternate, roundish, obtuse lobes, resinous-dotted, thin, and two to four inches long. They have a peculiar resinous, aromatic odor, and an aromatic and astringent taste.

Constituents.—H. K. Bowman (1869) determined the amount of tannin contained in the leaves to be 8.20 per cent. R. T. Chiles (1873) found in sweet fern a principle analogous to saponin, resin, volatile oil, gallic acid(?), fat, and other common vegetable principles.

Medical Action and Uses.—Sweet fern is stimulant and astringent; it probably owes the former property to its essential oil, which is also the cause of its grateful fragrance, and the latter to tannic acid. A decoction of it is sometimes used to relieve *colic* and check *diarrhœa.*

CONDURANGO OR CUNDURANGO.

Origin and Description.—The drug which first attracted attention under the above name is known in Peru as *cundurango blanco*, and comes from a hitherto undescribed apocynaceous climber, for which Dr. Ruschenberger proposes the name *Pseusmagennetus equatoriensis*, and which grows in localities from 3000 to 5000 feet above the level of the sea. The shrub is from 10 to 30 feet high, and has a smooth ash-gray bark, which is more or less mottled with greenish or blackish lichens. The bark is prepared for market by pounding the stem with a mallet to detach it, and then drying it in the sun, generally on skins, during eight or ten days. It forms quills and semi-cylindrical pieces, which are often much broken; has a yellowish-white liber, and in transverse section presents numerous minute yellowish points, which in longitudinal section are considerably elongated. When dry it is without odor; its taste is bitter and aromatic.

Constituents.—Dr. Antisell (1871) ascertained the bark to contain, besides 8 per cent. of moisture, 12 of mineral salts, and 80 of vegetable matter; the latter consisting of 0.7 fat, 2.7 yellow resin, 0.5 starch, gum, and glucose, and 12.6 tannin, coloring matters, and extractive, the remainder being cellulose.

Other Condurangos.—Dr. Jos. G. Ayers, U. S. N., (1871) ascertained that there are at least ten different shrubby vines which are designated by this name, and of the majority of which he was unable to collect the flowers and fruit. The origin of the following, however, has been determined:—

Echites hirsuta, *R. and Pav.*, yields *cundurango de paloma* from Zaruma. The bark has a soft, pale yellow or white corky layer, which is a line or more thick.

Echites acuminata, *R. and Pav.*, yields *cundurango de plátano.* The bark is thin, and pale gray on the outside.

Gonolobus tetragonus, *D. C.*, yields *cundurango de palóma* from Malacatos. It is of a dark-gray or brown color, and on the dry stem is slightly wrinkled longitudinally.

The above facts have been taken from the valuable *Report on the Origin and Therapeutic Properties of Cundurango*, by W. S. W. Ruschenberger, M.D., U. S. N., Washington, 1873.

Medical Action and Uses.—This plant, which exhibits no active properties whatever, was in 1871–2 proclaimed to be a cure for *cancer*, and for a short time it attracted professional notice. It speedily, however, was proved to possess no medicinal virtues, either in cancer or in any other disease, and has quite lost its ephemeral reputation.

CONFECTIONES.—CONFECTIONS.

(*Conservæ* and *Electuaria*).—*Electuaries*, E.; *Conserves*, *Electuaires*, *Saccharolés mous*, Fr.; *Conserven*, *Latwergen*, G.

These preparations are now but little employed medicinally compared with the extensive use made of them during the past century, when many medicinal substances were preserved and exhibited in the form of soft solids sweetened by sugar or honey. A distinction was then and in some countries is still made between *conserves* and *electuaries*, which in the British and U. S. Pharmacopœias are now comprised under the title of confections.

CONSERVES were made by covering fresh drugs with a layer of sugar, afterwards by beating fresh vegetable substances with sufficient sugar until the whole was converted into a uniform soft mass. As indicated by the name, the primary object in view was to preserve the medicinal virtues of the plants thus treated, and incidentally their administration was rendered more agreeable. Fresh plants not being at all seasons attainable, it became customary to use some in their dried condition, either in the form of powder or unpowdered, and to beat them with the requisite quantity of water and sugar. Medicinal roots not containing enough moisture were usually steeped in hot water before the sugar was added.

ELECTUARIES differ from conserves mainly in being mixtures of powders with pulps, syrups, or honey, and are made by triturating the ingredients together in a mortar. The powders should be very fine; when extracts are to be added they are previously liquefied by trituration with a little water or other suitable menstruum, and gum resins, if not pulverizable, are best converted into an emulsion to insure their uniform distribution. Soluble as well as insoluble salts may be given in this form, but of the latter kind only the lighter ones should be used, since heavy insoluble salts are apt to gradually subside in the soft mixture. Of other insoluble substances volatile oils should first be rubbed with a portion of the sugar, or an absorbent powder, and fixed oils are suspended in mucilage before they are incorporated.

If intended to be kept on hand, electuaries are made of such a consistence, that they are rather soft, but at the same time firm enough to prevent the separation of the ingredients. For immediate use, they are made somewhat softer, so that the mixture, when taken upon a spatula, will gradually drop off; they are then in a condition to be swallowed without mastication, and if partial separation should have occurred on standing, a uniform mixture is readily obtained again by stirring.

If the main excipients of electuaries are pulps and honey, they will for a long time insure a proper consistence and prevent the preparation from becoming hard and dry. With sugar as the principal constituent, as is the case with conserves, the gradual evaporation of water will often cause it to become hard, and the sugar to crystallize; it should then be worked over, if necessary, with the addition of some water or a little glycerin; but the substitution of common for refined sugar should not be resorted to.

CONFECT. AMYGDAL. See PULV. AMYGD. COMP., *Br.*

CONFECTIO AROMATICA, *U. S.*—AROMATIC CONFECTION.

Electuarium aromaticum.—*Électuaire* (*Confection*) *aromatique*, Fr.; *Aromatische Latwerge*, *Gewürzlatwerge*, G.

Preparation.—Take of Aromatic Powder four troyounces; Clarified Honey four troyounces, or a sufficient quantity. Rub the aromatic powder with clarified honey until a uniform mass of the proper consistence is obtained. *U. S.*

The absorption of the moisture by the vegetable tissue will render this confection gradually crummy, and necessitate the further addition of honey. If properly prepared, it will, though dry in appearance, become pliable and adhesive under the pestle.

Medical Uses.—The carminative and stimulant action of the spices contained in this preparation is more or less blunted by the honey with which they are mixed. It is apparently intended to relieve flatulent colic and dyspepsia, and to serve as an excipient for drastic cathartics. The *dose* is from one to sixty grains.

CONFECTIO AURANTII CORTICIS, *U. S.*—CONFECTION OF ORANGE PEEL.

Conserva Aurantii.—*Conserve d'écorce d'orange*, Fr.; *Apfelsinenschalen-Conserve*, G.

Preparation.—Take of Sweet Orange Peel recently separated from the fruit by grating twelve troyounces; Sugar thirty-six troyounces. Beat the orange peel with the sugar, gradually added, until they are thoroughly mixed. *U. S.*

Medical Uses.—This confection may be used for disguising the taste and qualifying the acrid action of various medicinal powders, especially those of the cathartic class.

CONFECTIO OPII, *U. S.*, *Br.*—CONFECTION OF OPIUM.

Electuarium theriaca, P. G.—*Confection* (*Electuaire*) *opiacé*, *Thériaque*, Fr.; *Opiumlatwerge*, *Theriak*, G.

Preparation.—Take of Opium in fine powder two hundred and seventy grains; Aromatic Powder six troyounces; Clarified Honey fourteen troyounces. Rub the opium with the aromatic powder; then add the honey, and beat the whole together until thoroughly mixed. *U. S.*

The British Pharmacopœia directs 192 grains of compound powder of opium to be mixed with one fluidounce of simple syrup.

Made according to the first formula, 40 grains of the confection represent 1 grain of opium. The same quantity is contained in 50 grains of confection made by the second formula and by the French Codex; and in 100 grains of that of the German Pharmacopœia. The formula of the latter is more complex than those given above, and the Codex orders not less than sixty ingredients.

Medical Uses.—Introduced as a substitute for the ancient compound, theriaca, it is especially useful in simple *diarrhœa* affecting persons of a debilitated habit of body, with feeble digestion associated with flatulent colic, especially in gouty subjects, and during the exhausting heats of summer. But one grain of opium is contained in thirty-six grains of the mass, and, therefore, as the bulk of the medicine may be objectionable where a strong anodyne impression is desired, the proportion of the narcotic may be increased extemporaneously.

CONFECTIO PIPERIS, *Br.*—CONFECTION OF PEPPER.

Electuarium piperis.—*Electuaire* (*Confection*) *de poivre*, Fr.; *Pfefferlatwerge*, G.

Preparation.—Take of Black Pepper in fine powder two ounces; Caraway Fruit in fine powder three ounces; Clarified Honey fifteen ounces. Rub them well together in a mortar. *Br.*

Medical Uses.—This confection was prepared in imitation of Ward's paste, which acquired great vogue in the treatment of *hemorrhoids*, with ulceration or a discharge of mucus. A piece of the size of a nutmeg may be taken two or three times a day.

CONFECTIO ROSÆ, *U. S.*—CONFECTION OF ROSE.

Confectio rosæ gallicæ, Br.; *Conserva rosarum.*—*Conserve de rose rouge*, Fr.; *Rosenconserve*, G.

Preparation.—Take of Red Rose in fine powder four troyounces; Sugar in fine powder thirty troyounces; Clarified Honey six troyounces; Rose Water eight fluidounces. Rub the rose with the rose-water heated to 150°; then gradually add the sugar and honey, and beat the whole together until thoroughly mixed. *U. S.*

The British Pharmacopœia directs one pound of fresh red-rose petals to be beaten in a stone mortar with three pounds of sugar.

The formula of the French Codex is similar to the first one, but omits the honey. With a good quality of powdered red-rose petals a very good confection is obtained.

Pharmaceutical Uses.—It is used as an excipient in Pilula aloes barbad., Pil. aloes et assafœtidæ, Pil. aloes et ferri, Pil. aloes et myrrhæ, Pil. aloes socotr., Pil. ferri carbonatis, Pil. hydrargyri, Pil. plumbi cum opio, *Br.*, and is occasionally serviceable for the same purpose in extemporaneous pill masses.

CONFECTIO ROSÆ CANINÆ, *Br.*—CONFECTION OF HIPS.

Confectio cynosbati, *Conserva cynorrhodi*, F. P.—*Conserve de cynorrhodon*, Fr.; *Hainbutten-Conserve*, G.

Preparation.—Take of Hips deprived of their seeds one pound; Refined Sugar two pounds. Beat the hips to a pulp in a stone mortar, and rub the pulp through a sieve; then add the sugar, and rub them well together. *Br.*

It is used as an excipient in Pilula quiniæ. *Br.*

Medical Uses—Confection of rose or of hips is used only as an excipient for substances given in pilular form, and which it is desired to have promptly diffused in the stomach.

CONFECTIO SCAMMONII, *Br.*—CONFECTION OF SCAMMONY.

Électuaire (Confection) de scammonée, Fr.; *Scammonium-Latwerge*, G.

Preparation.—Take of Scammony in fine powder three ounces; Ginger in fine powder one and a half ounce; Oil of Caraway one fluidrachm; Oil of Cloves one-half fluidrachm; Syrup three fluidounces; Clarified Honey one and a half ounce. Rub the powders with the syrup and the honey into a uniform mass, then add the oils and mix. *Br.*

Medical Uses.—This confection is intended, by the stimulants and carminatives which it contains, to moderate the drastic operation of the scammony. The dose is from ten to thirty grains.

CONFECTIO SENNÆ, *U. S.*, *Br.*—CONFECTION OF SENNA.

Electuarium e Senna, P. G.; *Electuarium de senna compositum*, *Electuarium lenitivum.*—*Lenitive electuary*, E.; *Electuaire de séné composé*, *Electuaire lénitif*, Fr.; *Sennalatwerge*, G.

Preparation.—Take of Senna in fine powder eight troyounces; Coriander in fine powder four troyounces; Purging Cassia finely bruised sixteen troyounces; Tamarind ten troyounces; Prune sliced seven troyounces; Fig bruised twelve troyounces; Sugar in coarse powder thirty troyounces; Water a sufficient quantity. Place the purging cassia, tamarind, prune, and fig in a close vessel with three pints of water, and digest for three hours by means of a water-bath. Separate the coarser portions with the hand, and rub the pulpy mass, first through a coarse hair sieve, and then through a fine one, or through a muslin cloth. Mix the residue with a pint of water, and, having digested the mixture for a short time, treat it as before, and add the product to the pulpy liquid first obtained. Then, by means of a water-bath, dissolve the sugar in the pulpy liquid, and evaporate the whole until it weighs eighty-four troyounces. Lastly, add the senna and coriander, and incorporate them thoroughly with the other ingredients while yet warm. The whole should weigh ninety-six troyounces. *U. S.*

Take of Senna in fine powder seven ounces; Coriander Fruit in fine powder three ounces; Figs twelve ounces; Tamarind nine ounces; Cassia Pulp nine ounces; Prunes six ounces; Extract of Liquorice three-quarter ounce; Refined Sugar thirty ounces; Distilled Water a sufficiency. Boil the figs and prunes gently with twenty-four ounces of distilled water in a covered vessel for four hours, then, having added more distilled water to make up the quantity to its original volume, mix the tamarind and cassia pulp, digest for four hours, and rub the softened pulp of the fruits through a hair sieve, rejecting the seeds and other hard parts. To the pulped product add the sugar and extract of liquorice, and dissolve them with a gentle heat; while the mixture is still warm, add to it gradually the mixed senna and coriander powders, and mix the whole thoroughly, making the weight of the resulting confection seventy-five ounces, either by evaporation or by the addition of more distilled water. *Br.*

Take of Senna powdered ten parts; Coriander Seed powdered one part. Mix and add of Simple Syrup fifty parts, purified Tamarind Pulp fifteen parts. Prepare a confection by means of a steam-bath. It is greenish-brown, and should be preserved in a dry and cool place. *P. G.*

The last formula is the simplest, and, like the others, yields a pleasant and effectual preparation; that of the French Codex is of more complex composition.

Medical Uses.—This confection forms an eligible basis for various purgative compounds, and is itself a mild and efficient laxative in the *dose* of one hundred and twenty grains.

CONFECTIO SULPHURIS, *Br.*—CONFECTION OF SULPHUR.

Electuarium sulphuris.—*Électuaire* (*Opiat*) *de soufre*, Fr.; *Schwefel-Latwerge*, G.

Preparation.—Take of Sublimed Sulphur four ounces; Acid Tartrate of Potash in powder one ounce; Syrup of Orange Peel four fluidounces. Rub them well together. *Br.*

Medical Uses.—Like confection of senna, this preparation is well adapted to procure copious semi-solid stools without actively purging or causing irritation of the rectum. These qualities adapt it for use as a laxative in hemorrhoidal cases. The *dose* is from one to two drachms.

CONFECTIO TEREBINTHINÆ, *Br.*—CONFECTION OF TURPENTINE.

Electuarium terebinthinatum.—Électuaire (*Opiat*) *térébenthiné*, Fr.; *Terpentinöl-Latwerge*, G.

Preparation.—Take of Oil of Turpentine one fluidounce; Liquorice Root in powder one ounce; Clarified Honey two ounces. Rub the oil of turpentine with the liquorice, add the honey, and mix to a uniform consistence. *Br.*

Medical Uses.—In this mixture the repulsive taste of the oil of turpentine is masked by the liquorice powder more thoroughly than can be effected in an emulsion. It is used occasionally in passive *hemorrhage*, *flatulence*, *lumbricoid worms*, *rheumatism*, etc. The *dose* is one or two drachms.

CONII FOLIA, *U. S.*, *Br.*—CONIUM LEAVES.

Herba conii, P. G.; *Herba cicutæ majoris.—Hemlock leaves*, E.; *Feuilles de grande ciguë* (*de ciguë officinale*), Fr.; *Schierlingskraut*, *Schierlings-Blätter*, G.

The leaves (also fresh leaves and young branches, *Br.*) of Spotted Hemlock, Conium maculatum, *Lin.* Flor. Lond., plate 17.

CONII FRUCTUS, *U. S.*, *Br.*—CONIUM FRUIT.

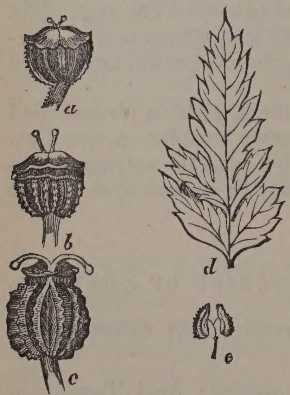
Hemlock fruit, E.; *Fruits de grande ciguë*, Fr.; *Schierlingsfrüchte*, G.

The full-grown fruit of Conium maculatum, gathered while yet green (ripe, *Br.*), and carefully dried.

Nat. Ord.—Umbelliferæ, Campylospermæ.

Origin.—Spotted hemlock is indigenous to the temperate countries of Asia and Europe, south to the Mediterranean, and has been naturalized in some portions of New England and New York, and in South America. It grows in waste places and along streams. It has a biennial, whitish, simple, or somewhat branched root, and a round furrowed stem, which is six to eight feet high, hollow except at the joints, smooth, glaucous, and covered with numerous brown or brown-red spots. The numerous branches are terminated by umbels of ten to twenty rays, with the one-sided involucels of three or four ovate or lanceolate bracts united at the base, and with small white flowers.

Fig. 46.



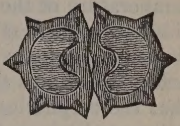
Conium maculatum, *Lin.*—*a*, *b*, *c*. Ovary in different stages of development, magnified. *d*. Leaflet. *e*. Fruit, natural size.

Description. 1. THE LEAVES.—The lower leaves are about a foot long, upon long hollow and sheathing petioles, broadly ovate or triangular in general outline, pinnately decompound with the pinnæ oblong lanceolate, pinnatifid, or incised, the upper ones toothed, each lobe or tooth terminating with a small whitish point. The upper leaves are smaller, almost sessile, and less decompound; all are smooth. In the fresh state they are of a dark-green color above, paler and somewhat glossy beneath, and acquire on drying a dull-green color and a characteristic odor, which has been likened to that of the urine of mice. They are collected from plants in full bloom, when the fruit begins to form.

The leaves of Æthusa cynapium, *Lin.*, Anthriscus sylvestris, *Hoffm.*, and different species of Chærophyllum have been occasionally collected in place of conium; but the plants have only a superficial resemblance to the latter, and the leaves do not agree with all the characters given above. The leaves of the first plant are glossy beneath and have lanceolate lobes; the others have pubescent or ciliate leaflets.

2. THE FRUIT.—The fruit is about $\frac{1}{8}$ inch long, broadly ovate, somewhat compressed at the sides, crowned with the short stylopodium, and readily separating into the two mericarps, each one marked on the back with 5 wavy crenate ribs, which become nearly smooth in the ripe fruit. The furrows are faintly wrinkled longitudinally, and, like the face, destitute of oil tubes. The integuments of the fruit are convex upon the face and penetrate into the albumen, which, upon a transverse section, shows a roundish heart-shaped or reniform outline. The fruit has a green color, or is grayish if collected as directed by the British Pharmacopœia. It is nearly inodorous, and has but a slight taste; when triturated with an alkali, it evolves the disagreeable odor of the leaves. Conium fruit has been occasionally observed as an adulteration of anise, to which, when ripe, it bears some resemblance.

Fig. 47.



Conium Fruit.—Transverse section magnified.

Constituents.—The most important constituent of both drugs is the volatile alkaloid conia, $C_8H_{15}N$. Giseke (1827) obtained it as an impure sulphate. Geiger (1831) prepared it pure. It is contained in the distillate, prepared with an alkali from the drug or its extract, and freed from ammonia by converting it into sulphate and exhausting this with a mixture of strong alcohol and ether, which leaves ammonium sulphate undissolved; conia may then be liberated by treatment with an alkali and distillation, but, though colorless, is accompanied by *conhydrina*, $C_8H_{17}NO$, and often by methylconia, $C_8H_{14}.CH_3.N$; the former of which is left in the retort on the careful distillation of the colorless crude conia. *Conhydrina* forms pearly iridescent laminæ, which are easily fusible, sublime above 150° C. (302° F.), and have a slight odor of conia, into which it is converted by phosphoric anhydrid, water being formed at the same time. *Conia* is a colorless, inflammable, oily liquid, specific gravity 0.88, has a strong alkaline reaction, a penetrating tobacco-like odor, and when pure the boiling point 163.5° C. (326.3° F.). It dissolves in the cold its own weight of water, which is separated again on warming; but it is only slightly soluble in water. Like ammonia, it forms dense white fumes with volatile acids, and combines with acids to salts, which are mostly uncrystallizable and freely soluble in water and alcohol. It deviates polarized light to the right, while an alkaloid of the same composition, artificially prepared by Schiff (1871), is optically indifferent.

Conium fruit contains, besides the usual principles, also a fixed oil, a minute portion of volatile oil having the odor of cumin, and probably malic acid in combination with the alkaloids. The herb contains acetates and malates, and a non-poisonous volatile oil of a disagreeable odor. The amount of alkaloid in the herb is minute, but appears to vary; the mature but still green fruit contains about 0.8 per cent. or less of conia; conhydrina is always present in very minute proportion.

Off. Prep.—1. Of the leaves: Cataplasma conii, *Br.*; Extractum conii, *U. S.*, *Br.*; Extr. conii alcohol., *U. S.*; Succus conii, *U. S.*, *Br.*; Tinct. conii, *U. S.* 2. Of the fruit: Extract. conii fruct. fluid., *U. S.*; Tinctura conii, *Br.*

Physiological Action. *On Animals.*—The effects of conium upon various animals accidentally poisoned by it, or made the subjects of experiment with its different preparations, agree essentially with one another in the occurrence of paralysis, first of the voluntary muscles, and then of the muscles of respiration, and, through the latter operation, in the production of death by asphyxia. Experimenters are not agreed whether it directly slows the heart or does so indirectly, or, finally, whether it does so at all. Nor is it certain, according to them, whether the toxical and paralyzing operation of the drug proceeds from the spinal centres to the periphery, or commences in the terminal nerves; but the latter opinion seems to be the most generally accepted. It is alleged that, in either case, the muscular contractility is unimpaired. It would seem that, if the dose be not directly lethal, convulsions may precede the death of the animal; but otherwise death occurs without spasm. It is not clear that anæsthesia precedes death in animals unless the poisoning be slow. Nor is it quite certain, according to the same authorities, what influence conium and its alkaloid exert upon the animal temperature; for while it is generally maintained that they diminish the temperature of the body, one writer, at least, asserts that it decidedly increases the temperature of animals poisoned by it. While one affirms that, in poisonous doses, it prevents the coagulation of the blood, rendering it dark and fluid; another declares that the blood does not appear to undergo any alteration, and that the corpuscles retain their power of absorbing oxygen. One declares that it is not eliminated with the urine, while others have found it in that secretion. These antagonistic results of experiments conducted under determinate conditions illustrate the difficulty of drawing definite conclusions from such data, and the wisdom of preferring clinical bases for clinical rules.

On Man.—There is no apparent relation between the physiological and the toxical effects of conium on the one hand, and its medicinal operation on the other, and in this respect it resembles the greater number of medicines. Supposing a really active preparation to be employed, the action of small and long-continued doses is exhibited by an increase of the perspiration and the urine, which latter, however, does not appear to contain conia; the appetite, digestion, and defecation are improved, and the strength and flesh are increased. But a protracted use of the drug produces an opposite condition, with impaired nutrition, which mainly affects the glandular organs, so that the mammæ and testes may undergo atrophy. The analogy of these with the effects of iodine are striking. In larger but not toxical doses it renders the pulse somewhat slower and fuller, and the temperature slightly lower; it sometimes occasions a papular or erythematous eruption upon the skin, injection of the eyes, a sense of fulness in the head, giddiness, some cloudiness of sight, feebleness of the limbs, and diaphoresis. Still larger doses show their direct operation most evidently upon the muscular system, inducing an impression of excessive fatigue or weariness, and a gradual loss of power, beginning with the hands and feet; the eyelids fall, the eye loses its power of accommodation, and the pupils are dilated. The hearing is dull. There is no mental disorder, nor drowsiness, the mind remaining calm, but active. Dr. John Harley, who has studied this subject with peculiar thoroughness, states the following as the effects of a full dose of conium juice given to palliate chronic muscular spasm: "The whole muscular system is completely relaxed. The orbicularis is incapable of resistance. The movements of the eyeball are very sluggish, and there is more or less complete ptosis. The muscles of mastication and deglutition are nearly paralyzed. Speech is slow, and effected with exertion; the voice is gruff, from relaxation of the laryngeal muscles. Withal, the heart and breathing are normal, sensation and intelligence are perfect, and the mind is calm." Even in fatal cases the pulse and respiration may be natural until the approach of death, which often is preceded by convulsions. The face is apt to be pale, and the hands and feet are cold, and either pale or bluish. After death from conium-poisoning no lesions are uniformly found. There is no evidence that conium impairs sensibility when taken internally. The external use of conium may produce local effects, as where friction with an ointment containing conia has temporarily caused paralysis of the fingers that applied it.

Medical Uses.—Conium has had a wide reputation for its virtues in the treatment of *cancer*, and there is no doubt that it has removed tumors reported to be of this nature, both when used as a dressing and when given internally. That when applied locally it mitigates the pain and improves the condition of sores regarded as open cancer is certain; and that it causes certain glandular swellings, reputed to be of the same nature, to disappear is also true. It is therefore a medicine not to be lightly neglected in cases of this kind. In *scrofulous* glandular sores similar good effects are sometimes observed. Enlargement and induration of the *liver* by simple engorgement, or by a degree of hyperplasia, with the attendant symptoms jaundice and ascites, appear to have been cured by a prolonged use of the medicine. During a like use of it the *mammary gland* has been known to become atrophied, and its secretion to have been gradually suspended. Conium plasters were formerly used to *dry up the milk*. *Cutaneous affections*, especially those of a strumous nature, appear to be favorably modified by this medicine. The reputed benefits of conium in *melancholy* seem to be attributable rather to the associated treatment, except where the mental disorder depended upon one of the visceral infarctions above alluded to. In *mania* its sedative operation has been used to control violence; and in *erotic insanity* it appears to lessen the evidences of sexual excitement. For the latter purpose it was anciently employed. In various *neuralgic* affections conium is reputed to be efficacious, but it is probably in those only in which the paroxysm is due to congestion or other pressure upon nervous trunks. The same may be said of its use in *ophthalmia* with *photophobia*, in *toothache*, *whooping-cough*, *laryngismus stridulus*, and *epilepsy* due to congested conditions of the motor centres. Its efficiency in some aggravated cases of *chorea* is still more striking. In this and other spasmodic affections the full exhibition of its physiological operation is essential to the cure. Dr. Harley has called attention to the utility of conium juice in *trismus*, in *spasm of the orbicularis* and of the *gullet*, and in *dislocations of joints* where the action of powerful muscles resists the efforts to reduce them, and in cases of the *impaction of artificial teeth* in the œsophagus. He dwells upon the important circumstance that patients under its influence are not prevented from assisting the surgeon by their efforts and guiding him by their sensations.

Conium and its preparations are contraindicated in cases of great exhaustion and debility. Diseases interfering with the rhythm of the heart suggest a cautious use of the medicine.

The proper antidotes to hemlock poisoning are evacuation of the stomach, and the use of alcoholic stimulants, with external warmth.

Administration.—Supposing the preparations to be good, which they seldom are, the extract of conium may be given in doses of one grain repeated at intervals of an hour or more until the physiological operation begins to appear; the dose of the tincture (an ineligible preparation) is half a fluidrachm; and of the juice the commencing dose is one fluidrachm. The average dose of conia is about one-sixtieth of a grain. It has been proposed to use hypodermically the bromohydrate of conia in the dose of one-fifth of a grain. The following solution has been suggested for this purpose: Crystallized bromohydrate of conia, gr. viij; alcohol, gr. xxij; Cherry laurel water, f℥vj.—M. Fifteen grains of this solution contain about two-fifths of a grain of the salt.

CONTRAYERVA.—CONTRAYERVA.

Contrayerve, Fr.; *Bezoarwurzel*, *Giftwurzel*, G.

The root of Dorstenia contrayerva, *Lin.*, and D. brasiliensis, *Lam.*

Nat. Ord.—Urticaceæ, Artocarpeæ.

Origin.—The first species is indigenous to the West Indies, Central America, and southward to Peru; the second to Brazil and other parts of South America.

Both are acaulescent perennials, with a fleshy quadrangular or circular inflorescence, in which the minute nutlets are imbedded.

Description.—The root has one or two short annulate heads, is fusiform, about half an inch thick, two or three inches long, and below divided into fine fibres; that of the second species is globular ovate, about $\frac{3}{4}$ inch long, annulate and beset with fine fibres. The color is reddish-brown, internally whitish. The bark is thick, with the inner portion of a punctate appearance, and incloses a brownish-yellow wood which is radiately marked by the medullary rays. The root has a rather unpleasant odor and a bitter and acrid taste.

Dorstenia dracena, *Lin.;* D. opifera, *Mart.;* D. tubicina, *R. and Pav.;* and perhaps other species yield similar roots.

Constituents.—Geiger obtained from the root some volatile oil, resin, starch, and a bitter amorphous principle.

Medical Action and Uses.—Contrayerva, meaning antidotal plant, appears to be a stimulant bitter tonic; in its native country it is used in *low fevers*, very much as serpentaria is elsewhere, and also as a remedy both internal and local for the *bites of serpents.* The dose of the powdered root is stated to be half a drachm.

CONVALLARIA.—LILY OF THE VALLEY.

Muguet, Fr.; *Maiblumen*, G.

Convallaria majalis, *Lin.* *Nat. Ord.*—Liliaceæ, Asparagineæ.

Description.—This stemless perennial is indigenous to Europe, Northern Asia, and to the Alleghany Mountains of the United States from Virginia southward. It is frequently cultivated in gardens, and has spontaneously appeared in several places. It has a creeping, whitish, much branching rhizome of the thickness of a quill, two, or occasionally three, elliptic and smooth radical leaves, and a one-sided raceme of about ten nodding white flowers, which are about a quarter of an inch long, bell-shaped, six-lobed, with the lobes recurved, have six stamens inserted near the base of the perianth, and produce globular, few-seeded red berries. The cultivated flowers are somewhat larger. They are very fragrant, and have a bitter and acrid taste. The rhizome and flowers have been used in medicine.

Constituents.—The odorous principle of the flowers was obtained by Herberger (1835) in the form of volatile crystals, possessing a strong odor, occasioning headache, but very fragrant when largely diluted. The bitter principle of the plant is the glucoside *convallamarin* $C_{23}H_{44}O_{12}$, which was isolated by Walz (1858) as a white, somewhat crystalline powder, has a bitter-sweet taste, is soluble in water and alcohol, and insoluble in ether; its solutions are precipitated by tannin, but not by lead salts, and when boiled with dilute acids it yields sugar and *convallamaretin.* The same author isolated the acrid principle *convallarin*, $C_{34}H_{62}O_{11}$, in the form of rectangular prisms, which are soluble in alcohol, insoluble in ether, and sparingly soluble in water, but foaming with it like saponin. On being boiled with dilute acids it is split into sugar and *convallaretin.*

Allied Plants.—POLYGONATUM MULTIFLORUM, *Allioni* (Convallaria multiflora, *Lin.*), and POL. OFFICINALE, *All.* (Conv. polygonatum, *Lin.*); Solomon's seal, *E.;* Sceau de Salomon, Genouillet, *Fr.;* Weisswurzel, Salomon's Siegel, *G.* The plants are indigenous to Europe and Northern Asia, and have simple stems with alternate sessile leaves, the axils of which contain one to five cylindrical flowers. The rhizome is horizontal, brownish-yellow, about six inches long, nearly cylindrical, jointed, and bearing on the upper side of each joint a circular concave stem-scar; internally it is whitish, rather spongy, and has a zone of many scattered wood bundles near the centre. Walz found in the rhizome and herb convallarin, asparagin, mucilage, sugar, starch, pectin, etc.

POLYGONATUM GIGANTEUM, *Dietrich* (Conv. canaliculata, *Willd.*), and POL. BIFLORUM, *Ell.* (Conv. biflora, *Walt.*), which are North American species, have rhizomes agreeing with the description just given, and are collected here as Solomon's seal.

SMILACINA RACEMOSA, *Desf.*, likewise indigenous to North America, has a similar rhizome, but with shorter and thicker joints, and is known as *false Solomon's seal.*

Physiological Action and Medical Uses.—Lily of the valley is well known by its poetical associations, its delicate beauty, and its fragrance, which resembles that of orange flowers. The powder made from the flowers when dry has long been employed as a *sternutatory*, its effect being to excite a copious flow of tears and nasal mucus. The root and the flowers possess purgative properties, as does also an extract made from the former. Its mode of purgation has been compared to that of aloes and of scammony. The dried flowers have been used to prepare fomentations for the removal of *ecchymoses* and *bruises*, and, as well as the root, for the cure of *worms*, *intermittent fever*, and even *epilepsy*. The active properties of the plant appear to depend upon convallarin and convallamarin. The former is stated to act upon animals as a drastic purge, in the dose of five grains, while the latter is emetic even in small doses, and when injected into the veins reduces the pulse rate like digitalin. Hypodermically, in the dose of from a sixtieth to a thirtieth of a grain, it was fatal to pigeons, arresting the heart in systole, and producing convulsions. The slowing of the heart was not attended with diminished power in that organ, but the respiratory movements were quickened.

The acrid and bitter taste of the rhizome, and more or less of the herb, flowers, and fruit of the plant, appears to explain the nauseant and emetic effects which its internal administration produces. Solomon's seal is said to be used in Russia as a remedy for *gout* and *rheumatism;* it has also been alleged to act as a diuretic, and to have cured *dropsy*. But it is chiefly employed as a domestic remedy for *freckles*, for dissipating *bruises*, and relieving *sprains*. For these purposes whiskey or other spirituous liquor, in which the plant has been long steeped, may be employed.

COPAIBA, *U.S.*, *Br.*—COPAIVA.

Balsamum copaivæ, P. G.—*Balsam copaiva, Balsam capivi*, E.; *Copahu, Oleo-résine* (*Baume*) *de copahu*, Fr.; *Copaivabalsam*, G.

The oleoresin of Copaifera multijuga, *Hayne*, and of other species of Copaifera.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The genus Copaifera is indigenous to the tropical part of South America, and consists of ten or twelve species, the majority of which are medium sized or large trees, with mostly abruptly pinnate coriaceous leaves and racemose whitish apetalous flowers, producing coriaceous obliquely elliptical or obovate one-seeded legumes. The following may be enumerated as having been mentioned as sources of copaiva: *Cop. officinalis*, Lin. (*C. Jacquini*, Desf.), indigenous to Venezuela, New Granada, and some West Indian islands; *Cop. guianensis*, Desf., found in Guiana and in Brazil near Rio Negro; *Cop. multijuga*, Hayne, *Cop. Langsdorffii*, Desf., *Cop. bijuga*, Hayne; *Cop. coriacea*, Mart., and others occur in various parts of Brazil.

Collection.—In the interior of the stem, ducts, sometimes of large dimensions, are formed, in which the oleoresin collects in such quantities that old stems not unfrequently burst from the internal pressure exerted by the liquid. This is gained from bore-holes or incisions made into the trunk near its base, from which the oleoresin exudes at once so abundantly that twelve pounds are sometimes obtained in the space of three hours. If, however, no copaiva should flow, the wound is closed with wax or clay and reopened in a fortnight, when an abundant discharge takes place. Old trees occasionally yield it two or three times a year.

Copaiva is imported in barrels principally from Para, to which place it is brought from the northern tributaries of the Amazon. It is, perhaps, mainly obtained from C. multijuga and guianensis. Notable quantities are also brought from Maranham and some from Rio de Janeiro, the latter supposed to be procured from *C. Langsdorffii* and *coriacea*. The copaiva exported from Maracaibo and Carthagena appears to be chiefly procured from *C. officinalis*. 228,159 pounds of copaiva were imported into the United States during the year 1876–1877.

Description.—Copaiva is a more or less clear and viscid liquid, varying in color from very light yellow to brownish-yellow, having a peculiar aromatic odor and a bitterish, acrid, and nauseous taste. Its specific gravity ranges between 0.94 and 0.99; by keeping it becomes thicker and denser. It is insoluble in water, dissolves in three to four times its weight of strong alcohol, and freely in ether, volatile and fixed oils, acetone and petroleum benzin; the latter solution becomes opalescent on the addition of more (three to five volumes) petroleum benzin, and deposits on standing a little resinous matter, at the same time becoming transparent again. Its optical behavior varies, as has been shown by Buignet (1861) and Flückiger (1867).

The different kinds are commercially distinguished from their ports of exportation, but even as obtained from the same places are not always identical in every particular. *Para copaiva* is the most limpid and the lightest kind, and usually contains from 75 to 85 per cent. of volatile oil. *Maranham copaiva* is a little denser, has about the consistence of olive oil, differs somewhat in odor from the preceding, and contains from 40 to 50 per cent of volatile oil. *Rio Janeiro copaiva* resembles the last. These Brazilian copaivas yield with one-third to one-half their weight of ammonia compounds, which form perfectly clear solutions in the volatile oils contained in them; a larger quantity of ammonia renders the solution quite milky; but, in the presence of a fixed oil, clear solutions are not obtained. *Maracaibo copaiva* is the thickest variety, usually of a dark yellow color, and not quite transparent. It contains less volatile oil, and does not always yield a clear mixture with little ammonia water; but it solidifies readily with magnesia, and is well adapted for making the officinal Pilulæ copaibæ.

Adulterations.—The variable condition of commercial copaiva, depending on its origin from different species, renders a detection of adulterations by no means an easy task. A copaiva which dissolves clear in strong alcohol, yields with one-third ammonia a transparent mixture, is free from turpentine odor, and on evaporation of the volatile oil leaves a hard resin, may be considered pure. Fixed oils are left behind with the resin, and render it soft and sticky; if other than castor oil is present, neither the copaiva nor the residuary resin will yield a clear solution with alcohol. Castor oil, being nearly insoluble in petroleum benzin, may be detected by shaking the suspected copaiva with four to five, or even ten, volumes of that solvent, when the adulterant will separate; but the volatile oil present exerts a marked solvent power on the castor oil. Flückiger and Hanbury recommend heating the sample of copaiva with four parts of 85 per cent. alcohol, and allowing the mixture to cool; the upper layer is then evaporated to expel the alcohol and volatile oil, and the remaining castor oil recognized by heating it with caustic soda and lime, when œnanthol will be formed, recognizable by its peculiar smell; even one per cent. of castor oil is stated to be thus detected.

When a drop of pure copaiva is evaporated from a piece of filtering paper, it will leave a sharply defined transparent spot of resin behind, which, if a fixed oil was present, will be surrounded by a greasy areola. Tomlinson (1864) has recommended the examination of the cohesion figures produced by a drop upon water, which are said to be quite characteristic for pure copaiva.

The presence of other volatile oils and turpentines usually becomes quite evident by a different odor on slowly heating a little of the copaiva.

The presence of gurjun balsam in copaiva is stated to be detected by shaking together in a test-tube 19 drops of carbon bisulphide and one drop of the oleoresin, and adding, with some agitation, one drop of a mixture of equal parts of concentrated sulphuric and nitric acids; copaiva assumes a faint reddish-brown color, and deposits resin on the side of the tube; in the presence of wood oil an intense purplish-red color is produced, changing to violet. The oleoresin of *Hardwickia pinnata*, Roxb., which resembles copaiva, will, under the same circumstances, produce a pale greenish-yellow color (Pharmacographia).

Constituents.—Copaiva owes its limpidity to the presence of volatile oil (see Oleum copaibæ); but the acrid and bitter taste is due to the brittle resin, which possesses acid properties, and is occasionally deposited from copaiva in a crystalline form, also from a clear mixture of copaiva and ammonia water when exposed to a low temperature. This *copaivic acid* has the same composition, but not the properties of abietic acid, and is readily soluble in alcohol, benzol and amylic alcohol, less so in ether; its formula is $C_{20}H_{32}O_2$; its salts are uncrystallizable. A deposit from Para copaiva was recognized by Fehling (1841) as distinct from the above; it is *oxycopaivic acid*, $C_{20}H_{28}O_3$. Strauss's (1865) *metacopaivic acid*, $C_{22}H_{34}O_4$, is contained in Maracaibo copaiva, from which it is obtained by agitation with ammonium carbonate, and by precipitating the aqueous liquid with muriatic acid. When copaiva is kept on hand it gradually becomes thicker through the alteration of the volatile oil, and its conversion into a soft resinous body.

Pharmaceutical Uses and Preparations.—Copaiva is readily emulsified by the aid of yolk of egg or gum arabic. It is sometimes given in the form of electuary, and requires then some absorbent for the volatile oil, for which purpose powdered marshmallow, liquorice root, or gum arabic is adapted; or the copaiva may be preferably fused together with some wax, spermaceti, or cacao-butter, the quantity of which will vary with the amount of volatile oil, between one-half and one part. (See also Oleum copaibæ and Pilulæ copaibæ.)

Physiological Action.—In continued or excessive doses copaiva deranges the digestion, impairs the appetite, and causes eructations, nausea, and diarrhœa. It appears to augment the watery element of the urine, rendering this secretion darker, bitter, and somewhat fragrant, as well as more or less turbid from the resin of copaiva, which also forms an iridescent pellicle upon its surface. The addition to it of nitric acid gives a turbid precipitate which, unlike albumen, is soluble in alcohol. Large doses or the long-continued use of copaiva also irritate the bladder, causing micturition, and sometimes hæmaturia with feverishness. It appears to be excreted by the pulmonary and the cutaneous surfaces; the former is shown by the odor it gives to the breath, and the latter by the eruptions of roseola, urticaria, etc., which it occasionally excites. In rare instances it seems to have caused convulsions, muscular rigidity, and even paralysis. The cutaneous and nervous symptoms of copaiva are apparently due to its essential oil, and its modifications of the mucous membranes to the resin and the acid it contains. To the latter is especially due its diuretic operation. Originally suggested by Monro, in 1827, the diuretic power of copaiva was again observed (Richter, Dixon); and its reality was confirmed by experiment before 1832 (Wibmer). It was afterwards mentioned by systematic writers, as Pereira, Strumpf, and Garrod. From 1869 clinical illustrations of its efficacy began to abound, and were furnished by Duffin, Thompson, Lineing, and others.

In 1873 Wilks showed that the resin was even more efficient than copaiva itself. In 1875 Dixon proved by three cases of dropsy that copaiva acted as a diuretic, increasing the daily quantity of urine from 8½ to 82 ounces; from 15 to 108 ounces; and from 8 to 93 ounces, in the several cases. In 1876 Carter published two cases of ascites, independent of cardiac or renal disease, entirely cured by the diuretic operation of the resin of copaiva, after the complete failure of other diuretics, purgatives, etc. He tested its action upon a stout man who was suffering from erythema of one leg, but otherwise healthy. It was given three times a day in doses of about seven grains. In the first twenty-four hours after the medicine was begun, the quantity of urine increased from 22 to 38 ounces, and finally reached 82 ounces; the specific gravity declined from 1019 to 1014, and the total solids increased from 16.25 grams to 40.48 grams, of which last amount 18.48 grains were inorganic. The total solids had therefore increased fourfold. The urea, however, had increased by only four-fifths. These results have been fully confirmed by Frederick Taylor, who administered the resin in more than sixty cases of different forms of dropsy. The diuretic operation failed, however, in cases of renal dropsy depending upon tubular nephritis, acute or chronic, a fact which renders almost certain that the diuresis produced by copaiva is due to its action upon the secreting elements of the kidneys.

Medical Uses.—The most important uses of copaiva are in the treatment of mucous profluvia, especially of the urinary and the air-passages. There can be no doubt that it acts by modifying the urine in the first, and the bronchial mucous membrane itself in the second, of these cases, and in both by a substitutive operation. It is well known that copaiva given internally does not often cure vaginal *gonorrhœa*, while it arrests the urethral form of the disease in the female as readily as in the male. It is also known that in hypospadic males affected with gonorrhœa the internal administration of copaiva will arrest the discharge from behind the urethral aperture, but not from that part over which the urine does not flow. Hence an explanation of the clinical rule to administer as much copaiva as can be taken without disordering the stomach or irritating the urinary organs. In this manner it exerts a stimulant and moderately substitutive action upon the inflamed membrane, which results in a diminution of the discharge. According to some, the agent in this operation is exclusively copaivic acid; but, since the resin abundantly appears in the urine, this constituent cannot be denied its share in the cure. It is probable, also, that the essential oil is the most active agent when copaiva cures *bronchitis*, since it is largely eliminated through the bronchia. During the acute stage of gonorrhœa, and also of bronchitis, copaiva is contraindicated, for in the former disease it causes strangury, swelling of the testicle, and other local disturbances; while in bronchitis it tends to arrest the bronchial secretion and thereby occasion fever and dyspnœa. Besides administering copaiva by the mouth for the cure of gonorrhœa and gleet, it has sometimes been thrown into the rectum, a clumsy, uncertain, and injurious method. It has also been injected as an emulsion into the urethra, but without decided advantage, since the urine remaining unmodified continued to irritate the inflamed mucous membrane. The urine passed by the patient taking copaiva has been used as a urethral injection for the cure of gonorrhœa; an unnecessary and barbarous expedient when so many more appropriate injections are available. *Vesical catarrh* is often greatly benefited, and may sometimes be cured by means of this medicine, perseveringly administered in moderate doses. In some cases an emulsion of it injected into the bladder has been serviceable. It is an efficient remedy in many cases of *irritability of the bladder* depending upon previous gonorrhœa or excessive sexual indulgence. In some cases of *leucorrhœa* it is reputed to have been curative; but there is more evidence of its favorable action in the treatment of inflamed and ulcerated *hemorrhoids*, and in chronic *dysentery*. In 1863 it was announced as a specific for *membranous croup*, and even in 1875 the same deceptive statement was repeated. In various inflammations of the *eye* it is reputed to have had an almost "specific" influence, especially in *iritis, sclerotitis*, and *purulent ophthalmia*. In the two first-named diseases it was given internally in drachm doses, but in the last only applied upon the skin around the orbit. The evidence upon these points is inconclusive. There is more clinical proof of its curative power in *cutaneous scaly diseases*, and its correctness is rendered more probable by the well-known action of the medicine upon the skin. The diuretic operation of copaiva appears to be very decided in certain cases of dropsy. This operation has been described in a previous paragraph. A careful examination of the clinical records touching this matter shows that the medicine is of little use in any form of dropsy depending upon renal disease, and least of all in the cases which most require it, viz., those of a scanty secretion of urine due to tubular nephritis. In cardiac dropsy the influence of the medicine is more favorable, but only in proportion as the effusion is due to general causes rather than to the mechanical obstruction in the heart. The cases in which copaiva and its resin have produced the most remarkable results are those of hepatic dropsy. In the most successful the nature of the hepatic obstruction was only conjectural, but was probably a condition analogous to that of commencing cirrhosis. Certain it is that in many cases of ascites which improved but slightly, or did not improve at all, under the use of the medicine, and which ultimately proved fatal, advanced cirrhosis of the liver was found after death.

Externally, copaiva, like other terebinthinates, serves to stimulate, and at the same time protect, parts to which it is applied. It forms an excellent dressing for *chilblains, sore nipples, anal* and other *fissures*, etc.

Administration.—Copaiva is most commonly administered in gelatin capsules, each containing about ten drops, which is the minimum dose. The maximum dose ordinarily given is about one fluidrachm. Much larger quantities, even as much as an ounce, have been prescribed, but without necessity or advantage. The medicine is sometimes given in magnesia, with which it forms a solid and very insoluble mass. Equal quantities of copaiva and solution of potassa make a perfect solution, which can be diluted and flavored. Next to the capsules, emulsions of copaiva are to be preferred. They are made with the yolk of egg, or mucilage, and some aromatic water, to which a small proportion of laudanum is usually added. Each tablespoonful should contain from ten to forty drops of copaiva. Resin of copaiva has been administered in pill in the dose of from four or five to fifteen grains, but more frequently in emulsion. One mode of preparing the latter is to take three ounces of the resin, softened by the addition of half its bulk of rectified spirit, and rub it down with four ounces of compound tragacanth powder (Br. Ph.), mixed with four pints of water. One ounce of this mixture contains twelve or thirteen grains of the resin, and is given three times daily. Another formula is the following: Resin of copaiva 15 gr.; compound powder of almonds 30 gr.; water to f℥j.

COPTIS, *U. S.*—GOLD THREAD.

Coptide, Fr.; *Gelbe (Kleinste) Niesswurz*, G.

The entire plant, Coptis trifolia, *Salisb.*, s. Helleborus trifolius, *Lin.* Bigelow, Med. Bot. i. t. 5; Bentley and Trimen, Med. Plants, 3.

Nat. Ord.—Ranunculaceæ, Aconiteæ.

Origin.—The plant is indigenous to the northern half of this continent from Pennsylvania northward to Greenland and Labrador, and also from the northern portion of Europe and Siberia to Kamchatka.

Description.—Gold thread has a filiform creeping rhizome of a golden-yellow color, with very thin fibrous rootlets. The radical leaves originate from a scaly base, are petiolate and trifoliate; the leaflets are about half an inch long, obovate with a wedge-shaped base, obtusely three-lobed, and mucronately crenate; the scape is 2 to 3 inches long, exceeding the petioles, and bears a single yellowish-white flower, producing about seven oblong follicles, which are acuminate with the persistent style, and contain a few oblong, black and glossy seeds. The whole plant is glabrous, without odor, and has a strongly bitter taste.

Constituents.—Mayer (1862) found in gold thread berberina and a white alkaloid. Analyzed by E. Z. Gross (1873), the absence of starch, tannin and gallic acid was established; besides some sugar, albumen, fat and resin, two alkaloids were isolated, *berberina* and *coptina;* the latter is colorless, insoluble in alkalies, neutralizes acids, dissolves in strong nitric and hydrochloric acids without change, and produces with warm concentrated sulphuric acid a purplish color, similar to that of hydrastia. The acids naturally combined with the alkaloids have not been ascertained. The herb yielded between 4 and 5 per cent. of ash, about one-tenth of which was silica.

The rhizome of *Coptis teeta*, Wallich, which has the thickness of a quill, contains 8½ per cent. of berberina, and is used in India as a pure bitter tonic.

Medical Action and Uses.—Coptis has no ascertained virtues beyond those of other simple bitters, for which, if necessary, it may be substituted. An infusion of it may be made with an ounce of the root to a pint of water, and given in the *dose* of one or two ounces. It is used as a wash for *aphthous sore mouth.* A tincture is made with alcohol, a pint to an ounce of the bruised root. *Dose,* a fluidrachm.

CORALLIUM.—Coral.

Corail, Fr.; *Koralle*, G.

Oculina virginea, *Lam.*, and Corallium rubrum, *Lam.* (s. Isis nobilis, *Pallas*). Class Polypiphera.

Description.—Corals are polypipherous animals, inhabiting the sea, and consisting of a skeleton, and a fleshy portion. Those which were formerly, and are still occasionally, employed in medicine, have a calcareous skeleton which branches considerably, assuming the form of a tree or shrub, on the branches of which the individual animals are located in tube-like apertures. Of the numerous species which have been distinguished, the skeletons of only two have been used. The first one mentioned above has a milk-white color, the second is of a dull-red.

Constituents.—Besides a small quantity of organic matter, coral consists almost exclusively of carbonate of calcium, with a little carbonate of magnesium. The color of red coral is due to about 4.25 per cent. of ferric oxide.

Allied Drugs of Animal Origin. Os SEPIÆ.—Cuttlefish bone, *E.* Os de sèche, *Fr.;* Sepie, Weisses Fischbein, *G.*—It comes chiefly from the Mediterranean, from Sepia officinalis, *Lin.*, class *Cephalopoda*, and is the calcareous bone contained in the mantle of the animal. It is oval-oblong in shape, both sides slightly convex, the rear surface being smooth, hard, and glossy, the remainder porous in texture and friable. It is of a white color, and consists of 80–85 per cent. of calcium carbonate, with traces of phosphate, 12 to 16 per cent. of animal matter, and about 4 per cent. of moisture.

LAPIDES (s. OCULI, s. CALCULI, s. LAPILLI) CANCRORUM.—Crabs' eyes, Crabs' stones, *E.;* Yeux (Pierres) d'écrevisses, *Fr.;* Krebsaugen, Krebssteine, *G.*—They are concretions contained in the stomach of the *crawfish*, Astacus fluviatilis, *Fabr.*, class *Crustacea*, and are obtained in Russia by allowing the animals to putrefy, and washing the mass with water. They are circular, ⅛ to ⅜ inch in diameter, plano-convex, with a concentric groove on the upper side, consist of several layers, acquire in boiling water a rose-red color, and dissolve partly with effervescence in hydrochloric acid, leaving a cartilaginous mass of the shape of the crabs' stones. They contain about 63 per cent. of calcium carbonate, and 17 per cent. of calcium phosphate, the remainder being various animal matters, with small quantities of other salts. Factitious crabs' stones, which were formerly sometimes met with, are completely dissolved or disintegrated by muriatic acid.

Medical Action and Uses.—Coral, crabs' eyes, crabs' claws, oyster shells, etc., consist essentially of chalk or carbonate of lime, whose medicinal uses are discussed elsewhere (Creta præparata); but their action is modified, and perhaps rendered somewhat gentler, by the animal matter which they contain. Powdered cuttle-fish bone is used as an ingredient of dentifrices on account of its hardness.

CORALLORHIZA.—CORAL ROOT.

The root of Corallorhiza odontorhiza, *Nutt.* *Nat. Ord.*—Orchidaceæ.

Origin.—The plant is a parasite, of a purplish-brown color, has a slender stem about 10 inches high, and bears from 8 to 20 flowers, with their lips nearly entire. It is indigenous to North America east of the Mississippi. It is not unlikely that the more common Corallorhiza multiflora, *Nutt.*, may furnish some of the commercial coral root; it is stouter, and has from 15 to 30 flowers, which are spurred at the base, and have the lip deeply three-lobed. It is found westward to the Rocky Mountains.

Description.—Coral root consists of numerous small fleshy tubers, which are united by their broader sides, and form many branches of different length, but of the same articulated appearance, resembling coral in arrangement. It is of a brown color externally, whitish within, and has, particularly in the fresh state, a peculiar odor and a bitter and astringent taste. Its proximate constituents have not been ascertained.

Medical Uses.—There appears to be nothing to be added to the stereotyped account of this plant, to the effect that it is an active diaphoretic, and useful in fevers and inflammations. It is administered in powder in the dose of thirty grains every two hours.

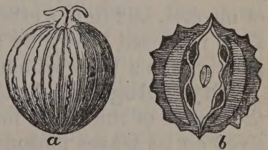
CORIANDRUM, *U. S.*—CORIANDER.

Coriandri fructus, Br.; *Fructus coriandri*, P. G.—*Coriander fruit*, E.; *Coriandre*, Fr.; *Koriander*, G.

The fruit of Coriandrum sativum, *Lin.* *Nat. Ord.*—Umbelliferæ, Cœlospermæ.

Origin.—The plant is probably indigenous to China and to the eastern portion of the northern shore of the Mediterranean, but is now extensively naturalized in the fields of temperate Asia and Europe, where it is also cultivated. It is occasionally cultivated in the United States and in some parts of South America. It is a smooth annual about 2 feet high, and of a very offensive odor, somewhat like that of bedbugs. The leaves are decompound, the segments of the lower broadly cuneate, and of the upper ones narrow and linear; the umbels are 3- to 5-rayed, without involucre; the umbellets 6- to 15-rayed, with an involucel of 3 linear bracts. The flowers are white or rose-colored. 49,133 pounds of coriander were imported in 1866–1867; in the recent returns coriander is included with caraway.

Fig. 48.



Coriander Fruit.—*a*. Entire. *b*. Transverse section.

Description.—The cremocarp of coriander is nearly globular, about one-sixth inch in diameter, smooth, crowned with the unequal calyx-teeth and stylopodium, and of a buff or pale brownish-yellow color. Each of the two mericarps forms a thin hemispherical shell, the two being united at the edge by the thin pericarp, thus inclosing a flattish cavity, and separating only by slight pressure. The five primary ribs of each half-fruit are obsolete, forming merely raised wavy lines; the four secondary ribs are more prominent as straight ridges, and similar ridges are formed at the junction of the mericarps. The longitudinal and transverse sections of the mericarp show the albumen to be of a semilunar shape; upon the latter two oil tubes are seen on the face and none on the back. On ripening, the fruit becomes gratefully aromatic.

Constituents.—Trommsdorff obtained from coriander nearly one-half of one per cent. of volatile oil (see *Oleum coriandri*) and 13 per cent. of fatty matter, besides a small amount of mucilage, malic acid, and traces of tannin.

Off. Prep.—Coriander fruit is used in preparing Confectio sennæ; Infusum (Mistura) gentianæ comp., *U. S.*, *Br.*; Infus. sennæ, *U. S.*; Syrupus rhei, Tinct. rhei, *Br.*; Tinct. rhei et sennæ, *U. S.*; Tinct. sennæ, *Br.*

Medical Action and Uses.—Coriander fruit is aromatic and stimulant, and is chiefly employed to promote the *digestion* of certain kinds of pastry; and in medicine to correct or assist the action of purgatives, such as rhubarb, senna, and jalap.

CORIARIA.—Currier's Sumach.

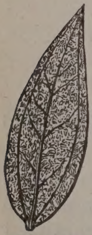
Redoul, *Sumac des corroyeurs*, Fr.; *Gerberstrauch*, G.

Coriaria myrtifolia, *Lin.* *Nat. Ord.*—Coriariaceæ.

Origin.—It is a shrub about 6 feet high, growing in Southern Europe and Northern Africa.

Description.—The branches are quadrangular; the leaves opposite, 1 to $1\frac{1}{2}$ inch long, on short petioles, ovate-lanceolate, acute, entire, even at the base, smooth, bluish-green and shining above, pale green beneath, with a strong mid-rib and two lateral nerves running to near the apex. The flowers are in small terminal racemes, have a bell-shaped calyx, 5 fleshy, scale-like petals, 5 long linear stigmas, and produce each 5 blackish-brown obliquely ovate nutlets, which are surrounded by the enlarged scales and have a berry-like appearance. The leaves have a strongly astringent, bitter, and somewhat acrid taste.

Fig. 49.



Coriaria Leaf.

Constituents.—The leaves contain tannin, which produces blue-black precipitates with salts of iron. The poisonous principle *coriamyrtin* has been isolated and studied by Riban (1864–1866), who precipitates the decoction with subacetate of lead, removes the lead from the filtrate, and evaporates to a syrupy consistence; from this residue the principle is dissolved by ether. It is in white or colorless, very bitter prisms, which dissolve in 70 parts of water, in 50 of alcohol, and in less ether, chloroform, and benzol. Its composition is $C_{30}H_{36}O_{10}$. It is rendered brown by alkalies, and, on being boiled with dilute hydrochloric acid, yields a body which reduces Fehling's solution, but differs from sugar.

Physiological Action.—Accidental poisoning has occurred by mistaking the leaves of this plant for senna and the fruit for blackberries; snails that had lived on its leaves poisoned those who ate them. The toxical phenomena generally consisted of nausea, vomiting, colic, trismus, and general convulsions, ending fatally in some cases within twenty-four hours. Experiments upon various animals gave the same general results, but rabbits were usually unaffected. But the latter animals were destroyed by coriamyrtin in the dose of a grain and a half given internally, and an eighth of a grain administered hypodermically. Three grains of this substance sufficed to bring on fatal convulsions in dogs in periods varying from twenty to seventy-five minutes. The phenomena of poisoning by the plant and its extract resemble those induced by picrotoxin, including spasm, frothing at the mouth, and contraction of the pupils; and the lesions after death present a similar analogy, for they consist of a normal appearance of the gastro-intestinal mucous membrane, congestion of the meninges, rapid occurrence of rigor mortis, distension of the heart with dark blood, and ecchymoses in the lungs. The toot poison of New Zealand has been proved to be furnished by one or more species of coriaria.

CORNUS CIRCINATA, *U. S.*—ROUND-LEAVED DOGWOOD BARK.

Écorce de cornouiller à feuilles arrondies, Fr.; *Canadische (Rundblätterige) Cornelrinde*, G.

The bark of Cornus circinata, *L'Her.* *Nat. Ord.*—Cornaceæ.

Origin.—This shrub is met with in Canada and the United States as far south as Virginia and west to Indiana, growing in copses in rich soil. It attains a height of 6 to 8 feet, has greenish warty dotted branches and orbicular or broadly ovate opposite leaves, which are 5 inches or less long, abruptly pointed, and white woolly beneath. The white flowers are in flat cymes; the fruit is drupaceous, light blue.

Description.—It is in thin, irregular pieces or short quills, which are externally greenish and warty when from young branches, or from older branches of a brownish-gray color with the warts confluent in slightly raised longitudinal lines of a glossy brown. The inner surface is cinnamon-brown, even, and very finely striate. The bark breaks with an even, scarcely fibrous fracture through the pale reddish inner layer. The odor is slight; the taste not unpleasant, somewhat astringent, and bitter.

The *constituents* are probably similar to those of the next.

Medical Action and Uses.—They are identical with those of *C. Florida.*

CORNUS FLORIDA, *U. S.*—DOGWOOD BARK.

Écorce de cornouiller à grandes fleurs, Fr.; *Grossblüthige Cornelrinde*, G.

The bark of Cornus florida, *Lin.*, Bigelow, Med. Flora, t. 28. Bentley and Trimen, Med. Plants, 136.

Nat. Ord.—Cornaceæ.

Origin.—The tree is found in woodlands from Canada southward throughout the United States east of the Mississippi; it is usually from 15 to 20 feet high, and in favorable localities attains double that height. The opposite leaves are ovate, pointed, about 4 inches long, and become crimson in autumn; the small greenish flowers are in capitate clusters, which are surrounded by four large involucral leaves, which are notched at the apex, of a white color, sometimes tinged with purple, and quite showy. The drupaceous fruit is bright red.

Description.—The bark of the root, which is preferred, is usually met with in commerce, and is in broken somewhat curved pieces, about $\frac{1}{8}$ inch thick and not over 1 or 2 inches long and wide. The outer surface is dark ash-colored or brown-gray and covered with a furrowed corky layer, or deprived of the latter and of a reddish color, irregularly striate and, in the young bark, marked by small oblong white spots. The inner surface is of a rusty-rose color and striate; the longitudinal, as well as the transverse fracture is short, of a whitish color, and with brown-yellow striæ of stone-cells. It is almost without odor, and has an astringent and bitter taste.

Constituents.—Geiger (1836) separated the bitter principle, *cornin* or *cornic acid*, by treating the cold infusion with plumbic hydrate, evaporating the filtrate, treating the extract with absolute alcohol, adding ether, and crystallizing. It is in white, silky, bitter needles, readily soluble in water and alcohol, little in ether colored dark by alkalies. We observed (1859) that the bitter principle, when in aqueous solution, is altered and destroyed by exposure to air and heat. Geiger separated also a resinous body crystallizing in shining needles. Cockburn (1835), besides some unimportant principles, obtained some gallic acid and tannin, producing a bluish-black coloration with iron. Bowman (1869) obtained only 3 per cent. of the latter.

Off. Prep.—Decoctum cornus floridæ; Extr. Cornus floridæ fluid., *U. S.*

Medical Action and Uses.—Dogwood is tonic, astringent, and slightly stimulant, and in the recent state is apt to produce nausea. Like other vegetable bitters, it has been popularly used as a remedy for *intermittent fever.* Its virtues as a stomachic *tonic* are more demonstrable. The dose of the powdered bark as a tonic is about twenty grains; and three times that quantity, repeated six or seven times during the apyrexia, may be given in intermittent fever. The officinal decoction is to be preferred.

Swamp dogwood is less, and round-leaved dogwood more, bitter than this species, while the first-named excels in astringency.

CORNUS SERICEA, *U. S.*—SWAMP DOGWOOD.

Écorce de cornouiller soyeux, Fr.; *Sumpfcornel-Rinde*, G.

The bark of Cornus sericea, *L'Her.* *Nat. Ord.*—Cornaceæ.

Origin.—This common shrub is found in moist woods, on the margin of streams and swamps, from Canada south to the mountains of South Carolina. It is 6 to 10 feet high, has purplish branches and opposite, elliptic-ovate, and pointed leaves, which are covered underneath with rust-colored silky down. The yellowish-white flowers are in close, flat, and woolly pubescent cymes, followed by pale blue fruits.

Description.—It is usually in much broken pieces, resembling the bark of C. circinata, but having a distinct purple tint, and being less warty. Its constituents are probably the same.

Medical Action and Uses.—See *C. Florida.*

CORYDALIS.—TURKEY CORN.

Squirrel corn, Turkey pea, E.

The tubers of Dicentra canadensis, *D. C.*, s. Dielytra eximia, *Pursh.* *Nat. Ord.*—Fumariaceæ.

Origin.—The plant is a perennial, has biternate, somewhat glaucous radical leaves, with the leaflets dissected into linear oblong segments, and several scapes, bearing about four greenish-white flowers, which are tinged with purple, nearly ½ inch long, heart-shaped, and have 2 short and rounded spurs. It grows in rich rocky woods as far south as Kentucky, but is more frequent further north and in Canada.

Description.—The thin subterranean shoots bear small tubers which are collected. They are depressed globose, ¼ to ⅜ inch thick, of a tawny-yellow color, nearly smooth, with a scar on each of the depressed sides, internally yellow or yellowish-white. The tuber breaks with a somewhat horny or slightly mealy fracture, is nearly inodorous, and has a bitterish and rather persistent taste.

Constituents.—W. T. Wenzell (1855) obtained from it corydalia, fumaric acid, yellow bitter extractive, an acrid resin, starch, and other common principles of plants. The alkaloid was obtained by evaporating the tincture, separating the resin by filtration, precipitating the filtrate with ammonia, and exhausting the precipitate with alcohol. This solution was evaporated, the residue treated with dilute hydrochloric acid, the salt thus formed again precipitated by ammonia, and the alkaloid purified by repeated crystallization. *Corydalia* was discovered by Wackenroder (1826) in the tubers of Corydalis tuberosa and fabacea. It is a white amorphous powder, crystallizing from alcohol in colorless prisms and scales, its solution having a very bitter taste. It is soluble in alcohol, ether, chloroform, and in the fixed and volatile oils, fuses at about 70° C. (158° F.), yields mostly amorphous salts, and is colored dark red by sulphuric acid, and yellow by nitric acid, or, if it contains resin, blood-red by the last-named agent.

Allied Plants. CORYDALIS TUBEROSA, *D. C.*—Fumeterre bulbeuse, *Fr.*; Hohlwurzel, Helmwurzel, *G.* It is indigenous to the hilly woodlands of Europe. The tubers vary from ½ to 3 inches in thickness, are roundish, gray-brown, internally greenish-yellow or whitish, firm, when old hollow and frequently lobed.

COR. FABACEA, *Pers.*, another European plant, has small tubers which are never hollow.

DICENTRA EXIMIA, *D. C.*, s. Corydalis formosa, *Pursh*, indigenous to the United States, has a scaly rhizome and a compound raceme of oblong purplish flowers, which are about ¾ inch long and have 2 very short saccate spurs.

Medical Uses.—As long ago as 1855 it was stated that "the root of C. formosa is supposed to be tonic, diuretic, and alterative, and is given in syphilitic, scrofulous, and cutaneous affections, in the dose of from ten to thirty grains." Since then, there appears to have been nothing more definite made known respecting the virtues of this plant. The resin which it contains, and on which depend whatever virtues it may possess, is probably worthy of being suitably tested. Numerous species of corydalis occur in Europe, from one of which a resin is obtained, by precipitation from a tincture, which is alleged to have cured intermittent fever.

CORYLUS.—HAZEL.

Noisetier, Fr.; *Hasel*, G.

Nat. Ord.—Cupuliferæ.

Description.—The following species have been used :—

CORYLUS AVELLANA, *Lin.*, is a shrub 10 to 15 feet high, common in woodlands and thickets in Europe and Northern Asia, and cultivated to some extent in the United States. It has somewhat hairy, roundish-ovate and pointed leaves, with a heart-shaped base, flowers in March, and ripens its fruit in autumn. It has bony nuts, which are inclosed in a bell-shaped involucre, are nearly an inch long, and have a smooth, light brown, woody shell inclosing a white, oily, and sweetish kernel. The nut is known as *filbert.*

CORYLUS AMERICANA, *Walt.*, is common in thickets in North America, has obovate cordate, and acuminate leaves, and yields a fruit about ½ inch long and wide, which is inclosed in an open involucre of about twice the length of the fruit.

CORYLUS ROSTRATA, *Ait.*, grows in Canada, in the northern part of the United States and along the Alleghanies, and is about 2 to 5 feet high. The leaves are oblong-ovate, pointed, and somewhat heart-shaped. The fruit is inclosed in a long hirsute involucre, which above is contracted into a long tubular beak.

Medical Uses.—The spicula which cover the involucre of the last-named species, have been used with alleged effect as a substitute for those of *Mucuna* in the treatment of *intestinal worms.*

COTULA, *U. S.*—MAY WEED.

Herba chamomillæ fœtidæ.—Wild chamomile, Dog chamomile, E.; *Herbe de camomille puante, Herbe de maroute,* Fr.; *Hundskamillen-Kraut,* G.

The herb of Maruta cotula, *D. C.;* s. Maruta fœtida, *Cass.;* s. Anthemis cotula, *Lin.*

Nat. Ord.—Compositæ, Anthemideæ.

Description.—This nearly smooth annual is originally indigenous to Europe, but is now a very common weed in many parts of North America, growing along roadsides, in neglected fields, and waste places. The stem is about a foot high, with ascending branches from the base, cylindrical, furrowed, somewhat hairy above. The sessile leaves are obovate in outline, thrice pinnately divided, with linear subulate lobes, pale green, and slightly hairy beneath. The flower heads terminate the branches upon soft hairy peduncles. The numerous involucral scales are somewhat imbricate, ovate, with whitish scarious margins. The receptacle is conical, not hollow; chaff nearly subulate, shorter than the florets; ray florets white, ligulate, three-toothed, neutral; disk florets tubular, yellow; akenes obovoid, ribbed, and without pappus. The plant begins to flower in June, and has an unpleasant aromatic odor and a bitterish acrid taste.

Constituents.—The flowers were analyzed by Wm. H. Warner (1858), and found to contain a little volatile oil, some tannin, valerianic and oxalic acids, an acrid fatty substance, bitter extractive, etc.

Medical Action and Uses.—May weed, or wild chamomile, resembles officinal chamomile in most of its qualities and uses; but its smell is different in being fetid, and its juice is capable of blistering the skin. Its rank odor and acrid qualities probably led to its being used as a nervous stimulant in such cases as those for which valerian is usually employed. Its excitant properties adapted it to popular use as a sudorific and antispasmodic. The leaves are more commonly applied externally, but an infusion of the flowers is preferable for internal use.

COTYLEDON.—NAVELWORT.

Pennywort, E.; *Cotylet, Nombril de Vénus,* Fr.; *Nabelkraut,* G.

The herb of Cotyledon umbilicus, *Lin.;* s. Umbilicus pendulinus, *D. C.*

Nat. Ord.—Crassulaceæ.

Description.—A perennial herb of Southern and Western Europe, growing on rocks and old walls. It has a fleshy tuberous root, and an erect stem about six inches high. The leaves are smooth, fleshy, peltate, concave, roundish, and repand-crenate, about an inch broad, the upper ones smaller, roundish, wedge-shaped, and on shorter petioles. The numerous small flowers are greenish-yellow and tubular, bell-shaped, with a five-parted corolla, ten stamens, and five many-ovuled ovaries. The dry plant is inodorous, and has a mucilaginous taste.

Constituents.—Navelwort was analyzed by Hétet (1864) with the following results: The fresh plant contains 95 per cent. of water, 0.001 per cent. of salt of *trimethylamina*, the same quantity of ammonia salt, 0.9 per cent. nitrate of potassium, 2.063 per cent. of other salts, the remaining 2.035 per cent. being sugar, mucilage, starch, cellulose, etc.

Medical Action and Uses.—About 1854 several English practitioners abounded in eulogies of this plant as a remedy for *epilepsy*. They were, for the most part, gentlemen of good and even of eminent professional standing, and their opinions for a time led physicians astray; but when the medicine had been tried by experts both in England and upon the Continent, it was adjudged to be utterly worthless. And against this sentence there has been no appeal.

CREASOTUM, *U. S.*, *Br.*—CREASOTE.

Kreosotum, P. G.—*Créosote*, Fr.; *Kreosot*, G.

Origin and Preparation.—Creasote, which was discovered by Reichenbach (1830), is one of the numerous products resulting from the dry distillation of wood. According to Voelckel it is not produced from cellulose, but rather from the incrusting layers of the wood cells. Crude wood vinegar is stated to contain about 1 per cent., but beechwood tar occasionally 25 per cent. of it; the latter is, therefore, the best material for its preparation. To obtain it the tar is distilled until about one-half has passed over, and dense vapors of paraffin, etc., make their appearance. The distillate separates into a heavy and light oily layer, with an intervening aqueous stratum of an acid reaction. The light oil is mainly *eupion*. The heavy oil is treated with a concentrated solution of sodium carbonate, and the separated oily liquid distilled; that portion of the distillate being collected only which is heavier than water. This distillate is treated with potassa solution, spec. gr. 1.12, whereby the creasote is dissolved and *eupion* separated. The potassa solution is now supersaturated with sulphuric acid, the precipitated creasote well washed with water and rectified, the product distilling at and above 203° C. (397° F.) being collected. The treatment with potassa and sulphuric acid is repeated until the potassium creasote solution does not turn brown on being heated in the air.

To obtain it from crude pyroligneous acid, the oily constituents are first separated by saturating the crude acid with sodium sulphate at about 70° C. (158° F.), and while warm skimming off the supernatant layer. The cold thick oil is distilled, treated with sodium carbonate, and further purified as before.

Properties.—Creasote is a colorless oily liquid; age renders it slightly yellowish; it is very refractive to light, neutral to test-paper, of a peculiar penetrating smoky odor, and of a caustic and burning taste. It boils at about 203° C. (397° F.), and volatilizes without leaving any residue. It does not solidify at —27° C. (—17° F.). Its specific gravity is 1.046 *U. S.*, 1.071 *Br.* It dissolves in about 80 parts of cold and in 24 parts of hot water, the excess being separated again after several days. It takes up 50 per cent. of glycerin or 15 per cent. of ammonia sp. gr. 0.940, and is freely soluble in alcohol, ether, carbon bisulphide, glacial acetic acid, fixed and volatile oils. When agitated with ammonia water, it separates unchanged on standing, but it dissolves in potassa solution, the liquid giving off creasote when heated to boiling. When ignited it burns with a white and sooty flame. It causes precipitates with solutions of gum and albumen, but not with gelatin, and does not render collodion gelatinous. It preserves meat, probably in consequence of its behavior with albumen, and is present in the smoke of burning wood. Creasote is decomposed by strong nitric and sulphuric acids, and in contact with silver nitrate the latter is reduced.

Composition.—That creasote is a mixture of a number of different compounds has been long known; but their isolation has been a matter of great difficulty. In 1867 Gorup-Besanez recognized the presence of *guaiacol* $C_7H_8O_2$, and *creósol* $C_8H_{10}O_2$, in beechwood-tar creasote; both are oily liquids of the general properties of creasote, the former boiling at 200° C. (392° F.), the latter at 219° C. (426° F.). Heated with hydriodic acid, both yield methyl iodide, and in addition thereto *pyrocatechin* $C_6H_6O_2$ is produced by the former, and by the latter a non-crystallizing body, isomeric with orcin $C_7H_8O_2$. Tiemann and Mendelsohn (1876) proved also the presence of *phlorol* $C_8H_{10}O$, which had been previously supposed to exist in it, and in impure carbolic acid, the so-called *coal-tar creasote*. They dissolved the portion obtained by fractional distillation near 220° C. (428° F.) in ether, and added concentrated potassa solution, whereby its compound with creosol was separated, while the phlorol remained in the mother liquor. Reimer observed (1876) that guaiacol, treated with chloroform and soda, and afterwards with an acid, is converted into *vanillin*, the aldehyd of *vanillic acid*, which latter was obtained from creosol by converting it first into acetyl-creosol, and oxidizing this with potassium permanganate (Tiemann and Mendelsohn, 1877).

Among the other compounds present in creasote may be mentioned *cresol* C_7H_8O, *xylenol* $C_8H_{10}O$, *phenol* C_6H_6O, besides other allied compounds difficult to separate from one another.

Tests.—It is obvious that unfailing tests can hardly be expected for a variable mixture of compounds some of which are still unknown; yet since guaiacol is the principal constituent, the tests for this principle are generally applicable, or rather the absence of the impurities which are likely to be present may be proven by the non-appearance of their characteristic reactions. Thus the absence of *fixed oils* is shown by the complete volatility of the sample; a drop may be put upon bibulous paper, and this exposed to a temperature near 100 C. (212° F.), when the greasy stain should gradually completely disappear. For the absence of *carbolic acid* the United States Pharmacopœia offers two tests: 1, that it should not coagulate collodion; and, 2, that a slip of pine wood dipped first into an alkaline solution of creasote, and, after drying, into muriatic acid, should not acquire a blue color (see Carbolic acid). The first test will not detect small quantities of carbolic acid, and perhaps the best test for distinguishing between the two articles is their behavior with ferric chloride, which for both beechwood-tar creasote and carbolic acid may be very similar when in a concentrated state or in alcoholic solution, but is markedly different in dilute aqueous solution. A clear watery solution of beechwood-tar creasote acquires with little ferric chloride a blue, then brown, and finally yellowish or yellowish-green turbidity; a similar solution of carbolic acid gives a blue or violet coloration. On adding a strong solution of ferric chloride to a strong alcoholic solution of creasote, a blue and then a green color is produced; with a similar solution of carbolic acid, the coloration will be at first blue, then brown, or, in certain proportions, green; if now six or eight times the bulk of water be added, the creasote mixture will become dingy-brown, with the separation of minute oily drops; but the carbolic acid mixture will remain perfectly transparent, and acquire a beautiful blue color. J. Williams (1872) did not succeed in detecting with these reactions adulterations of creasote with carbolic acid. Morson (1872) proposed as a test for pure creasote its insolubility in glycerin, in which it becomes readily soluble on the addition of carbolic acid. The test was, however, soon proven to be unreliable for German beechwood-tar creasote, and to be applicable only to English pinewood (Norway) tar creasote, and the cause was explained by Graetzel (1877) to be the presence in the latter of oil of turpentine, derived from the tar; he suggests the approximate determination of the quantity of carbolic acid by the fractional distillation of the suspected creasote, or by combining it with saturated potassa solution and crystallizing from ether, when carbolic acid will be liberated from the mother liquor, by acidulating with sulphuric acid and distilling. *Froehde's reagent*, prepared by dissolving 1 part of molybdic acid in 100 parts of sulphuric acid, has been found by E. W. Davy (1878) to be a reliable test for detecting an admixture of carbolic acid in creasote; the former producing with the reagent a yellowish or brownish tint, passing into maroon or reddish-brown, and finally into beautiful purple; the latter causes a brown or reddish-brown color, which becomes fainter, and finally light yellowish-brown. The test is applied by adding 1 or 2 drops of the aqueous solution of the substance to 3 or 4 drops of the reagent; warming the mixture gently will hasten the production of the final coloration. If the creasote contains but a small quantity of carbolic acid, 10 drops of it are dissolved in half an ounce of water, and the solution distilled. The first portion of the distillate will give the creasote reaction, and the last portions that of carbolic acid.

It should be stated that much of the commercial creasote is coal-tar creasote, and readily recognizable as such by its behavior to ferric chloride.

Off. Prep.—Aqua creasoti, *U. S.;* Mistura creasoti, *Br.;* Unguentum creasoti, *U. S.*, *Br.;* Vapor creasoti, *Br.*

Physiological Action.[1] *On Animals.*—A small proportion of creasote is sufficient to cause plants to fade and wither, and it is equally fatal to the insect tribes. Given to animals it excites inflammation of the stomach, pain, vomiting, salivation, laborious breathing, convulsions, and death. Injected into the veins, according to the dose and degree of its concentration, it causes death by stoppage of the heart, or this result follows previous embarrassment of the breathing. Such effects are due to its coagulating action on the blood.

On Man.—Applied pure to a mucous membrane or to the raw cutis it excites a severe burning pain, coagulates the albumen of the secretion, and may even produce ulceration. The taste is very penetrating and peculiar, and may be detected in a solution of one part of creasote in a thousand of water. In doses of one or two drops it causes burning in the throat and œsophagus. Larger medicinal doses, if continued, are apt to occasion a sort of intoxication, with giddiness, dulness, debility, frequent pulse, and dyspnœa. The urine is increased and blackened, and exhales the odor of the medicine; sometimes there is strangury. The vapor, when inhaled, is soporific. Applied externally to an ulcer, creasote has occasioned faintness, palpitation, etc. Excessive doses may cause severe abdominal pain, and bloody stools. A case in which two drachms were taken ended fatally.

Medical Uses.—The first medicinal use of creasote was to check vomiting in cholera, and subsequently it was found to relieve this symptom produced by reflex irritation, by exhaustion in alcoholism, by sea-sickness, by Bright's disease, by malignant disease of the stomach, and in certain forms of dyspepsia, probably of the fermentative sort. Its manifest hæmostatic powers in external *hemorrhage* led to its use in bleeding from the lungs, stomach, bowels, kidneys, bladder, and uterus; and its analogous operation was employed to correct excessive secretion in *diabetes*, *polyuria*, and *bronchorrhœa.* When creasote was first introduced, it was vaunted as a remedy for pulmonary *phthisis*, but naturally fell into the same discredit as all other medicines for which this claim is made. It is, however, true that both by inhalation and by its internal administration, it tends to reduce excessive bronchial secretion, and thereby prolong life, just as many other medicines and dietetic agents are known to do. When a solution of two or three drops of creasote in a fluidrachm of alcohol is diluted with six fluidrachms of water, it forms one of the best atomized remedies for the symptom in question. Administered by the stomach it is less efficient, but still useful. It may be given most advantageously with cod-liver oil in the dose of about one drop. The preceding remarks are equally applicable to *chronic*

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[1] The almost complete substitution in commerce of carbolic acid for creasote, and the very close analogy of the operations of the two liquids, render a detailed account of the latter unnecessary.

bronchitis; and, indeed, in pulmonary consumption the medicine can reach only the effects of the disease, not the essential organic cause of those effects. There is no better agent for the relief of *toothache* due to caries and inflammation of the dental pulp. For this purpose it should be applied upon a small and dense wad of cotton or lint. Creasote water is sometimes used as an injection to cure *leuchorrhœa* and *gleet;* it is an excellent application to *burns* and *chilblains,* and to all forms of *ulcers* requiring stimulation, but especially to such as present flabby and bloody granulations and a fetid discharge, as in *cancer, gangrene,* mercurial *stomatitis,* chronic *glanders, ozæna,* etc. It is a useful stimulant in certain cases of *deafness* due to dryness of the external auditory canal. The anti-putrid power of this substance has caused it to be used to preserve dead animal matter for *dissection,* etc. It has been applied as a means of allaying *itching* in numerous diseases of the skin; but in a concentrated form it is more efficient in causing the shrivelling and destruction of *warts, condylomata,* and *nævi materni.* If carbolic acid were not so universally used instead of creasote, it would still be preferable as having a less persistent and disagreeable smell. This may be removed from the body or clothing by chlorinated lotions. The poisonous effects of creasote may be combated with wine, coffee, and other stimulants.

The *dose* of creasote is one or two drops. It may be given in pill or emulsion, or in the form of creasote water. It is rendered more miscible with water by the addition of an equal quantity of solution of potassa. The taste may be disguised by aromatic waters. It may also be used by inhalation, as above described.

CRETA, *U. S., Br.*—CHALK.

Craie, Fr.; *Kreide,* G.

Native friable carbonate of calcium (lime).

CRETA PRÆPARATA, *U. S., Br.*—PREPARED CHALK.

Craie préparée, Fr.; *Präparirte Kreide,* G.

Origin.—Chalk is a mineral, found abundantly on the coasts of the English Channel, consists mainly of carbonate of calcium, and generally contains a little silica, alumina, iron, and magnesia; it is usually soft and earthy, but occasionally compact and rather hard, often of a yellowish-white, but as met with in commerce is nearly white. Its specific gravity is about 2.5. It is much used for making marks, which are readily effaced. Freed from the hard silicious portions by pulverization and diffusion in water, it constitutes *whiting,* and when in the purified state it is mixed with coloring matters and moulded into pencils it forms the main ingredient in *pastil* colors. Being very rapidly and almost completely dissolved by muriatic acid, it is not adapted for generating a continuous stream of carbonic acid gas. To be suitable for medicinal purposes, it requires to be purified or *prepared.*

Preparation of Prepared Chalk.—Take of Chalk a convenient quantity. Add a little water to the chalk, and rub it into fine powder. Throw this into a large vessel nearly full of water, stir briskly, and, after a short interval, decant into another vessel the supernatant liquid, while yet turbid. Treat the coarser particles of chalk, remaining in the first vessel, in a similar manner, and add the turbid liquid to that previously decanted. Lastly, let the powder subside, and, having poured off the water, dry it. *U. S.*

The directions given here explain the *process of elutriation,* which consists in separating the finer and lighter from the coarser and heavier particles by suspending them in water, and after the latter have subsided, pouring off the water, holding the former still in suspension, which are then allowed to subside. The powder, while still moist, is then usually dried in the form of small nodules, which are usually made by putting the sediment, still moist, into a funnel-shaped vessel, and depositing it in small quantities upon the surface prepared for it, either by striking the funnel against it, or pushing the soft mass through the funnel-tube by the aid of a suitable rod. The surface used for drying is either glass or a smooth calcareous stone, the latter serving for the rapid absorption of the moisture; the dry powder adheres loosely in the form of small cones. The heavy portion, which subsided first, is again triturated, *levigated* with some water, and again subjected to elutriation.

Bismuth subcarbonate and subnitrate, and other pulverulent mineral salts, are sometimes dried in the same manner.

Properties and Tests.—Prepared chalk is a white amorphous powder, and, being nearly pure calcium carbonate, should almost completely dissolve with effervescence in dilute hydrochloric acid; the solution should assume only a light-blue color on the addition of potassium ferrocyanide (iron), and when completely precipitated by ammonium carbonate the filtrate generally gives a turbidity on the addition of ammonium phosphate (magnesia).

Off. Prep.—Hydrarg. cum cretâ, Mistura cretæ, *U. S.*, *Br.;* Pulvis cretæ aromaticus, Pulv. cretæ arom. cum opio, *Br.;* Trochisci cretæ, *U. S.*

Medical Action and Uses.—These preparations are antacid, absorbent, and thereby astringent. Externally they are applied as dusting powders to absorb and neutralize the cutaneous secretions and those of superficial ulcers, and to protect *erythematous inflammations.* An ointment made with chalk is sometimes used, but the combination in a great degree defeats the purpose of the chalk. Internally, prepared chalk is in common use, and is a most valuable remedy for the cure or palliation of almost every form of *diarrhœa*, but especially of those forms in which the intestinal discharges are acid. As a rule its use in these cases should be preceded by an evacuant to remove undigested food or other irritating substances. There is no better remedy for the premonitory diarrhœa of *cholera* than this simple preparation. It is usual to associate chalk with opiates and astringents; thus to chalk mixture (*Mistura cretæ*) are added the tinctures of opium, kino, catechu, etc.

The *dose* of prepared chalk is from five to sixty grains, according as its antacid or its astringent operation is chiefly sought.

CROCUS, *U. S.*, *Br.*—SAFFRON.

Safran, Fr., G.

The stigmas (and part of the style, *Br.*) of Crocus sativus, *Lin.*

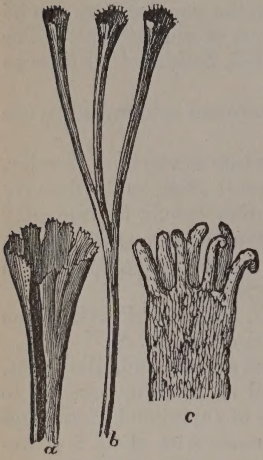
Nat. Ord.—Iridaceæ.

Origin.—The saffron plant is indigenous to oriental countries, probably from Greece and Asia Minor eastward to Persia; it has been cultivated from an early period, and grows spontaneously in some parts of Southern Europe. At the present time commerce is supplied with saffron chiefly from Spain (Alicante and Valencia), and France (Gatinais). It is also grown in Austria, and to a limited extent in some of the southeastern counties of Pennsylvania. Asia Minor, Persia, Kashmir, and China are the principal countries which supply the oriental regions with it.

The plant has a depressed tuberous bulb or corm which, in the latter part of summer, or early in autumn, produces about nine grasslike, keeled, and dark-green leaves, and afterwards a few pale, purplish, red-veined, six-lobed flowers, with three stamens and a filiform style, which is whitish below, yellow above, and divided into three orange-red stigmas. It flowers in autumn. Saffron is imported into the United States to the amount of between 10,000 and 20,000 pounds annually.

Description.—Each stigma is about an inch long, flattish, tubular, almost filiform below, gradually enlarged above, slit on the inner side, and with several roundish teeth on the edge. The three stigmas are usually united, and occasionally are collected with a considerable portion of the yellow style. Dried saffron is flexible and tough, of a brownish-red color, somewhat unctuous to the touch, of a peculiar aromatic odor, and a bitter, aromatic, and warm taste.

Fig. 50.



Crocus sativus, *Lin.*
a. Stigma, upper part, magnified four diameters. *b.* Style with stigmas. *c.* Papillose margin of stigma magnified 120 diameters.

Cake saffron is now not met with in commerce. In its loose condition it is sometimes called *hay-saffron.* Several varieties are distinguished. *Spanish saffron* is usually collected with considerable portions of the styles, which are easily distinguished by their yellow color. *French* or *Gatinais saffron* is mostly of a better quality. The handsome saffron collected in Austria is rarely if ever seen in our markets. The excellent saffron collected in Eastern Pennsylvania is known there as *American saffron,* a term which in other parts of the United States is used to designate the florets of Carthamus tinctorius. Heinitsh (1866) calculated that 33 to 36 pounds of saffron may be raised to an acre, and found 300 stigmas to weigh 13 to 14 grains, which requires over 50,000 flowers to obtain a pound.

Constituents.—Saffron contains gum, albumen, wax, fat, about one per cent. of volatile oil and coloring matter, called *polychroit,* or by some authors *crocin.* Weiss (1867) prepares polychroit, $C_{48}H_{60}O_{18}$, by exhausting saffron first with ether, afterwards with water. The infusion is precipitated by strong alcohol, and the filtrate by ether. The precipitate contains a little sugar, is very deliquescent, and dries over sulphuric acid to a hard rubicolored mass, which is inodorous, of a sweetish taste, readily soluble in water and dilute alcohol, slightly in absolute alcohol, and insoluble in ether and benzol. On being treated with dilute sulphuric acid in an atmosphere of hydrogen, polychroit is decomposed into a volatile oil having the composition of carvol $C_{10}H_{14}O$, sugar $C_6H_{12}O_6$, and *crocin* $C_{16}H_{18}O_6$. The latter is a red powder, insoluble in ether, scarcely soluble in water, and freely soluble in alcohol and diluted alkalies. Warm concentrated potassa evolves from it vapors of a pungent odor; concentrated sulphuric acid produces a deep blue color, changing to violet and brown; nitric acid colors green, then yellow and brown. The same colors are produced by sulphuric and nitric acids with polychroit. The volatile oil obtained by the decomposition of polychroit has the odor and general properties of the volatile oil obtained from saffron by distillation with water. Quadrat (1851) observed that polychroit (his crocin) yielded, with concentrated solution of alkalies, a neutral volatile oil, which was lighter than water, and had an odor distinct from saffron. Lagrange and Vogel (1811) obtained from saffron 7.5, Aschoff (1818) 1.4, and Hagen 1.25 per cent. of volatile oil; the first result must have been mostly the volatile oil formed from the polychroit.

Adulterations.—The admixture in true saffron of considerable portions of the yellow style has been noticed above. The appearance of inferior saffron is sometimes improved by oil; it then leaves a greasy stain on being slightly pressed between paper. Partially exhausted, mixed with good saffron, is recognized by the lighter and more uniform color of the stigmas. The tubular florets of carthamus are easily distinguished by their five-toothed corolla, and the projecting anthers with style. The styles of crocus, suitably dyed, have appeared in commerce as *feminelle*, a name also given to the dyed ligulate florets of *Calendula officinalis*, Lin.; the latter are strap-shaped, with a three-toothed margin, and are easily distinguished from true saffron after soaking in water. The cut petals of the pomegranate and the stamens of crocus, and perhaps other flowers, are by the same means easily recognized. About 1860, and again since 1870, Spanish (Alicante) saffron has often appeared adulterated with chalk, gypsum, or heavy spar, the powders having been rendered glutinous by some honey, and mixed with the saffron; they then become yellowish and of the appearance of pollen. The adulteration is detected without difficulty by throwing a pinch upon water, when the mineral matter will subside, and may be identified by appropriate tests. Powdered emery is said to be used in the same manner. The amount of such adulteration is sometimes 20 per cent., and may be estimated by incineration; good saffron yields four to five per cent. of ash.

An article has sometimes (1872) been offered as *African saffron;* it is mostly safflower, but occasionally it consisted of the corolla of *Lyperia crocea*, Eckl., a scrophulariaceous plant indigenous to Southern Africa.

Off. Prep.—Saffron is no longer used in any of the preparations of the United States Pharmacopœia, but enters into the composition of the following: Decoct. aloes comp.; Pil. aloes et myrrhæ; Pulv. cretæ arom.; Tinct. cinchonæ comp.; Tinct. croci; Tinct. opii ammon.; Tinct. rhei, *Br.*

Medical Action and Uses.—Saffron is generally regarded as a stimulant aromatic. Like other powerfully odorous vegetable substances its emanations occasion headache, sleep, stupor, and even death. It also displays anodyne and antispasmodic properties. Its aromatic action is exhibited by its general use as a condiment in tropical countries, where the heat enfeebles digestion, and vegetable food is chiefly used. Like other agents of its class it sometimes appears to stimulate the pelvic organs, as shown by its employment, from remote periods, as an emmenagogue and also as an aphrodisiac. During its use the urine is colored yellow.

As just indicated, its most common use is to prevent or relieve flatulent *dyspepsia*, and its accompanying *colic*, for, by expelling the gaseous contents of the digestive canal, it enables that organ to perform its functions more perfectly. It may be prescribed, like other aromatics, to allay the pain of *dysmenorrhœa.* Hot infusions of saffron are sometimes given to favor *exanthematous eruptions.* It has long been reported efficacious in spasmodic *coughs* and *asthma;* but its value in these affections is very slight. Yet the preparations of saffron may be conveniently employed as vehicles for more powerful drugs. Like the flowers of other plants containing a volatile oil, those of saffron have long entered into various compounds in popular use to relieve *rheumatic* and *neuralgic pains*, to remove the soreness and discoloration of *bruises*, and to promote the healing of *abrasions* and superficial *sores.* A collyrium of saffron has been employed in subacute and chronic inflammations of the *conjunctiva;* and saffron ointment has been reputed to be an excellent palliative of *hemorrhoids.* A strong infusion of saffron, applied to the gums, is said to allay the pain of *dentition.*

Saffron has been omitted from most of the officinal preparations into which it formerly entered, a change justifiable, if at all, upon economical rather than upon medical grounds.

The *dose* of saffron is from five to thirty grains, the former quantity sufficing as a gastric, the latter as a general, stimulant. But the dose should be repeated at short intervals. Only the pure and well-preserved specimens can be depended upon. An infusion may be made with two drachms of saffron to a pint of boiling water, of which four ounces may be given at intervals of half an hour or an hour.

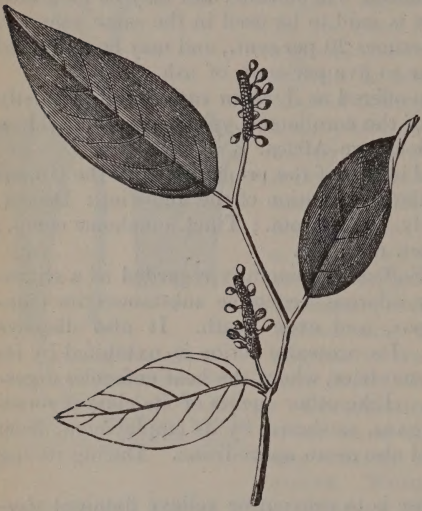
CUBEBA, *U. S.*, *Br.*—CUBEB.

Cubebæ, P. G.; *Fructus* (*s. Baccæ*) *cubebæ*, *Piper caudatum.*—*Cubebs*, E.; *Cubêbe*, *Poivre à queue*, Fr.; *Kubeben*, G.

The unripe fruit of Cubeba officinalis, *Miquel;* s. Piper cubeba, *Lin.* Steph. and Church, Med. Bot., plate 175; Bentley and Trimen, Med. Plants, 243.

Origin.—The cubeb plant, which is indigenous to Java and some of the adjacent islands, is a climbing diœcious shrub, about 20 feet high, with ovate or ovate-lanceolate, leathery and shining leaves upon petioles about as long as the peduncles of the spikes. It is cultivated chiefly in coffee plantations, and the fruit collected before it is ripe. From 66,000 to 100,000 pounds of cubebs are annually imported into the United States.

Fig. 51.



Cubeba officinalis, *Miq.*

Description.—Cubebs are of the size and general appearance of black pepper, about one-eighth inch in diameter, at the base contracted into a kind of stalk rather more than one-third inch long, very slightly pointed at the apex, of a brown-gray to blackish-gray color, and reticulately wrinkled surface. It has a strong spicy odor, and a pungent aromatic and bitterish taste. The integuments of the fruit consist of a thin dried fleshy layer and a smooth lighter-colored shell, which is nearly empty with an undeveloped seed at the base. The fruit is very frequently mixed with the nearly inodorous rachis or common axis, which is from one to one and a half inch long, and has a pitted surface.

Constituents.—Cubebs contain from 5 to 15 per cent. of volatile oil (see Oleum cubebæ), fixed oil, waxy matter, resin, cubebin, gum, malates, etc. The medicinally most important constituents are the *indifferent resin* and *cubebic acid;* they were isolated by Bernatzik (1863) and further examined by E. A. Schmidt (1870, 1873). *Cubeb resin* is little soluble in ether, carbon-bisulphide, or chloroform, but dissolves in caustic alkalies and alcohol, without being precipitated from the latter solution by acetate of lead. *Cubebic acid* $C_{14}H_{16}O_4$ is an amorphous yellowish mass, soluble in ether, chloroform, carbon bisulphide, benzol, and petroleum-benzin, and is precipitated from its alcoholic solution by lead acetate; its sodium salt crystallizes from hot alkaline liquids and from alcohol. Both resinous compounds are colored red by sulphuric acid. The indifferent resin has been obtained in quantities of 2.5 to 3.5 per cent., and the cubebic acid in amounts of 0.96 to 3.4 per cent.

Cubebin $C_{33}H_{34}O_{10}$, according to Schmidt, was first obtained pure by Soubeiran and Capitaine (1839), and forms the principal portion of the deposit in the ethereal extract. It crystallizes in tasteless and inodorous white needles or pearly scales, which are colored red by sulphuric acid, and dissolves in 26.6 parts of ether, and in 10 parts of boiling alcohol. Medicinally it appears to be inactive; its percentage varies between 0.4 and 2.5.

Potassium chloride has been found among the saline constituents of cubebs.

Impurities and Substitutions.—The presence of cubeb stems (the rachis) has been alluded to before. Black pepper and other piperaceous fruits occur sometimes as accidental, rarely if ever as intentional impurities. The fruit of Rhamnus catharticus has only a very superficial resemblance, and is at once distinguished by the true pedicel and its four seeds. Allspice is much larger, has no pedicel, contains two seeds, and is crowned with the calyx limb.

The following two species are mentioned in Pharmacographia as yielding fruits extremely cubeb-like: Cubeba Lowong, *Miq.* (Piper Lowong, *Bl.*), and Cub. Wallichii, *Miq.* (Pip. ribesioides, *Wall.*). The fruit of Cub. canina, *Miq.* (Pip. caninum, *Dietr.*), is smaller than cubeb, and contracted below into a stalk of only half the diameter of the globular portion. In 1863 a fruit was sold as cubeb which by Grœnewegen was referred to Piper anisatum, *H. and B.;* it is probably the same which Flückiger and Hanbury refer to Cubeba crassipes, *Miq.* (Pip. crassipes, *Korthals*). The fruit of Cub. Clusii, *Miq.*, of Western Africa resembles cubeb; but according to Stenhouse (1855) it contains piperina, instead of cubebin.

Off. Prep.—Cubebs are used for the distillation of Oleum cubebæ, and for the preparation of Oleoresina cubebæ, *U. S.*, and Tinctura cubebæ, *U. S.*, *Br.*

Physiological Action.—Cubeb is a local irritant. Taken into the stomach it stimulates the whole intestinal tract, after the manner of black pepper, thereby exciting more or less irritation of the rectum and other pelvic organs. At the same time its active principle is absorbed, causing flushing of the face and diffused warmth, and increasing the urinary secretion as well as giving it a peculiar odor. It does not derange the digestion like copaiva. Its direct and indirect operation upon the genito-urinary apparatus may be attended with painful irritation of these parts if the medicine is given when they are actively inflamed. Excessive doses may produce vomiting, gastro-intestinal irritation, and a general feverish condition. Cubeb sometimes produces an erythematous eruption on the skin.

Medical Uses.—The chief medicinal applications of cubeb are to inflammations of the urinary passages. It has long been used for the cure of *gonorrhœa;* but, at present, like copaiva, it is in a great degree superseded by the local treatment of that affection. In efficacy it is inferior to copaiva, but it is more readily tolerated by the digestive organs. The cases of gonorrhœa to which it is most appropriate are those in which the attack is recent and the inflammation moderate; but more inflammatory conditions accompanied with chordée, scalding urine, and even swelled testicle, do not contraindicate the medicine, although they call for caution in its use, that is to say, for the administration of small rather than large doses. The former may be represented by about fifteen grains three times a day; the latter, which usually should be reached by gradual increase, may be stated to be half a drachm or more. Few persons can long tolerate so large a dose, which is apt to cause vomiting and diarrhœa, besides inspiring invincible disgust. In any case it should not be continued longer than a week or ten days unless the gonorrhœal discharge declines, in which case the dose should be gradually reduced. It is asserted that the efficient element of cubeb in the cure of gonorrhœa is cubebic acid, which appears capable of curing the acute affection when given in doses of two or three grains every two or three hours; but, on the whole, it seems to be less successful than cubeb itself.

Irritability of the urethra in females, with accompanying vesical tenesmus and scalding of the urine, a condition often associated with catamenial congestion, is apt to be mitigated by cubeb in doses of from twenty to thirty grains two or three times a day. *Vesical irritability* and *tenesmus* produced by cold or by cantharidal irritation, and nocturnal *incontinence of urine*, may often be cured in the same manner. Chronic *cystitis* and *vaginal discharges* are favorably influenced by cubeb; and, like copaiva, but less surely, this medicine may be useful in *chronic bronchitis.* Its local stimulant action seems to have been useful in certain cases of *pseudo-membranous angina.* It was given mixed with powdered sugar, which itself was probably not without influence on the result. But its use, while stimulating the fauces and the system generally, also prevented the meddlesome medication which has not a little to answer for in this disease. Cubeb has been thought to be efficacious in certain nervous disorders, comprising *headache, vertigo, fainting, impaired memory,* and even *paralysis;* doubtless such symptoms, depending upon exhaustion of the nervous centres, may be ameliorated by whatever stimulates the nervous system primarily, and also secondarily improves the digestion, and, therefore, the composition of the blood.

Cubeb is administered in *doses* of ten grains and upwards, either mixed with water or with powdered sugar, or inclosed in wafers. In the last case it should be followed by a mouthful of water.

CUCUMIS.—CUCUMBER.

Concombre, Fr.; *Gurke,* G.

The fruit and seed of Cucumis sativus, *Lin.* *Nat. Ord.*—Cucurbitaceæ.

Origin.—The cucumber is indigenous to Southern and Central Asia, but is now extensively cultivated in most civilized countries. It has a roundish hispid stem, climbing by simple tendrils; alternate, heart-shaped, and somewhat five-lobed rough leaves, and unisexual yellow flowers.

Description.—THE FRUIT is at first rough and somewhat verrucose, but becomes smooth on ripening. It is cylindrical-oblong, somewhat triangular, obtuse at both ends, sometimes curved, and varies considerably in size and color. It has a slight, but quite characteristic odor, and a slightly saline and rather harsh taste.

THE SEEDS are about one-third inch long, oblong-ovate, flat, rather acute on the edge, and with a short point above. They are white, inodorous, and of an oily taste. The embryo is of the shape of the seed, and consists of 2 plano-convex white cotyledons, with a small plumule in the pointed end.

Pharmaceutical Uses.—Prof. Procter (1853) gave a formula for *cucumber ointment,* which is prepared by grating 7 lbs. of green cucumbers, expressing the juice, and incorporating it, about one-third at a time, with 15 ounces of suet and 24 ounces of lard, the fats having been previously fused together and allowed to cool until the mixture commences to thicken. After all the juice has been in contact with the fat, the latter is melted, strained, and preserved in glass jars covered with a layer of rosewater; the jars should be well closed. When intended for use a portion of the ointment is triturated with a little rose-water until it becomes white and creamy.

Allied Plants.—The following plants are indigenous to Southern Asia, and at present cultivated in many warm countries:—

CUCUMIS MELO, *Lin.; Muskmelon.*—The seeds resemble cucumber seeds, but are somewhat larger, and rather more blunt on the edge.

CUCUMIS (CUCURBITA, *Lin.*) CITRULLUS, *Séringe,* s. Citrullus vulgaris, *Schrader; Watermelon.*—The seeds are about ½ inch long, blackish or brown and marbled, broadly ovate, flat, blunt on the edge, near the pointed end with two thin converging ridges.

LAGENARIA VULGARIS, *Sér.,* s. Cucurbita lagenaria, *Lin.; Gourd.*—The seeds are ¾ inch long, oblong, obtuse at both ends, thickened, and with two furrows near the margin, the surface yellowish-white and soft felt-like.

MOMORDICA BALSAMINA, *Lin.*—The fruit is ovate in shape, narrowed at both ends, somewhat angular and warty, bright red or orange colored, and separating laterally. It contains numerous flat, oval, and wrinkled brownish seeds, which are surrounded with a fleshy red arillus.

Medical Action and Uses—The ointment prepared with cucumber-juice is supposed to be peculiarly mild, emollient, and healing, when applied to abrasions and other analogous lesions.

The juice of the watermelon increases somewhat the secretion of urine, an effect which is probably due to the sugar it contains. An infusion of the whole seeds is decidedly diuretic, and that of the bruised seeds is also demulcent. No better drink than the latter infusion can be used in all cases of irritation of the *kidneys* or *bladder*, and especially in cases of *retention of urine* produced by cold.

CUMINUM.—Cumin.

Fructus cumini s. cymini.—Cumin, Fr.; *Kreuzkümmel, Mutterkümmel, Römischer (langer, scharfer) Kümmel*, G.

The fruit of Cuminum cyminum, *Lin.*

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The cumin plant is indigenous to Egypt and other parts of Africa, and is cultivated in various parts of Asia and Europe, in the latter continent chiefly in Southern Italy and the neighboring islands. It is an annual about a foot high; the leaves are divided into narrow linear segments; the umbels are small, and the umbellets have about 5 white or purplish flowers. 20,874 pounds of cumin fruit were imported into the United States in the year 1866–1867.

Description.—The fruit is about $\frac{1}{4}$ inch long, oblong, narrowed at both ends, slightly compressed laterally, and of a yellowish-brown color. The two mericarps are usually united; each has 5 lighter-colored filiform ribs which are beset with soft short hairs and are separated by broad brown furrows, each containing a paler, rough, hairy, secondary rib and covering one oil-tube. Two oil-tubes (vittæ) are contained on the face, or six in each mericarp. The strong aromatic odor and taste somewhat resemble those of caraway. Cumin is very prone to the attacks of insects, which eat the entire seed, leaving only the fruit-shell.

Constituents.—Examined by Bley (1829) cumin was found to contain 7.7 per cent. of fat, 13.5 of resin, 15.5 of protein compounds, 8 of gum, and only 0.24 of volatile oil, the remainder being extractive, salts mainly malates, cellulose, and 9 per cent. of moisture. Raybaud obtained nearly 3 per cent. of volatile oil. The latter consists of several hydrocarbons, one having the composition $C_{10}H_{16}$, another being *cymol* or *cymene*, $C_{10}H_{14}$, which at 15° C. (59° F.) has the specific gravity 0.860, boils at 175° C. (347° F.), and has a lemon-like odor (Gerhardt and Cahours); and of an oxygenated body, *cuminol* or *cuminaldehyd*, $C_{10}H_{12}O$, which has the density 0.972, boils at about 230° C. (446° F.), has a caraway-like odor, and yields with nitric acid crystallizable *cuminic acid*, $C_{10}H_{12}O_2$. Volatile oils identical with *oil of cumin* have been obtained by Trapp (1858) from the fruit of Cicuta virosa, *Lin.*, and by Haines (1856) from the fruit of Ptychotis ajowan, *D. C.*; the latter, however, was shown by Stenhouse to contain thymol.

Medical Action and Uses.—Cumin is mildly stimulant and carminative, in the same manner as anise and caraway, and may be used for the same purposes. It is, however, very seldom employed. The *dose* may be stated at from fifteen to thirty grains.

CUPRI SUBACETAS, *U. S.*—SUBACETATE OF COPPER.

Ærugo, P. G.; *Viride æris, Subacetas cupricus.*—*Verdigris*, E.; *Acétate basique de cuivre, Vert-de-gris, Verdet gris*, Fr.; *Grünspan, Spangrün, Basiches essig-saures Kupfer* (*Kupferoxyd*), G.

Formula of pure verdigris $(Cu_2O)2C_2H_3O_2$. Molecular weight 261.

Impure subacetate of copper.

Preparation.—In the wine districts of Southern Europe, and particularly in the neighborhood of Montpellier, verdigris is prepared by the aid of the marc of the wine-press. These grape husks are allowed to undergo the acetic fermentation, and are then stratified in earthen vessels, with sheets of copper which, if new, have been previously superficially corroded by a solution of acetate of copper. After 3 or 4 weeks the plates are removed, placed upright to dry, and for the following 6 or 8 weeks are occasionally dipped into water and exposed until the neutral acetate at first formed has been converted into a thick layer of verdigris, which is scraped off. The sheets are then replaced in the grape husks and the process repeated until the copper has been completely corroded. The scrapings are formed with water into cakes of convenient size and dried. Verdigris of inferior quality is said to be made in the cider districts of England, in a similar manner, from pommage or apple-marc; and in some places it is obtained by exposing the copper to the vapors of vinegar or pyroligneous acid, or by treating impure cupric oxide with the latter. The annual importation of verdigris into the United States averages about 156,000 pounds.

Properties.—Verdigris is met with in commerce in heavy and hard bluish-green masses, containing a considerable number of small crystals, and breaking with an earthy, somewhat crystalline fracture. It varies in composition, but always consists mainly of hydrated oxyacetate of copper, and contains between 45 and 50 per cent. of cupric oxide. It is decomposed by, and but partially soluble in water, insoluble in alcohol, but completely soluble, the impurities excepted, in ammonia, dilute sulphuric, acetic, and muriatic acids. Acids should produce but little effervescence, showing the absence of carbonate. The presence of chalk as an impurity is determined by the copious effervescence when dissolving a sample in warm acetic acid, and by the precipitate occurring in the solution on the addition of ammonium oxalate.

The solution of verdigris in hot acetic acid, when crystallized, yields

CUPRI ACETAS, *s. Cuprum aceticum s. Ærugo destillata s. Flores viridis æris.*—*Acetate of copper, Copper verditer*, E.; *Verdet cristallisé, Cristaux de Vénus*, Fr.; *Gereinigter* (*Distillirter*) *Grünspan*, G. It is in oblique rhombic prisms of a deep blue-green color, soluble in about 14 parts of cold water, and in alcohol containing some acetic acid; the aqueous solution, on boiling, evolves acetic acid and deposits a basic salt. Its formula is $Cu2C_2H_3O_2.H_2O$; molecular weight, 199.5. It should be completely soluble, with a deep blue color, in ammonia and ammonium carbonate. It is mainly employed in the arts, but is occasionally prescribed as TINCTURA CUPRI ACETICI RADEMACHERI, which may be prepared by dissolving 1 part of crystallized acetate of copper in 10 parts of warm water and adding 8 parts of alcohol.

Medical Uses.—Verdigris is very rarely used internally, and seldom as a local application. Its stimulant or escharotic action, according to the strength of the solution employed, is sometimes taken advantage of in the treatment of indolent *ulcers* and chronic tuberculated affections of the *skin*, and to remove *warts*, especially of the soft description and those due to *syphilis*.

CUPRI SULPHAS, *U. S.*, *Br.*—SULPHATE OF COPPER.

Cuprum sulfuricum purum, P. G.; *Sulfas cupricus*, *Cuprum vitriolatum*. —*Blue vitriol*, *Bluestone*, E.; *Vitriol bleu*, *Sulfate de cuivre*, Fr.; *Kupfervitriol*, *Blauer Vitriol*, *Schwefelsaures Kupfer* (*Kupferoxyd*), G.

Formula $CuSO_4.5H_2O$. Molecular weight 249.5.

Preparation.—Blue vitriol is obtained on a large scale from the native (*copper pyrites*) or artificially prepared sulphide by converting it through oxidation into the sulphate; for this purpose the sulphide is obtained by heating sheet copper to redness and throwing sulphur upon it. The water accumulating in copper mines contains the sulphate in solution, formed by the oxidation of the native sulphide. The iron contained in this is removed either by digesting with oxide or carbonate of copper, or by evaporating to dryness and heating until the iron salt is decomposed. The same salt is also formed in the preparation of sulphurous acid from copper and hot oil of vitriol, and in the extraction or purification of silver, by precipitating this metal from its sulphuric acid solution by means of copper; also by dissolving the black scales obtained in coppersmithing in weak sulphuric acid (chamber acid).

Purification.—Sulphate of copper cannot by recrystallization be separated from the sulphates of the allied and of the alkaline metals, owing to the formation of double salts. If iron alone is present it may be conveniently removed by oxidizing with nitric acid and digesting the solution with barium carbonate; ferric hydrate and barium sulphate will be precipitated with the excess of the carbonate, and the filtrate will yield pure crystals. If contaminated with other metals its purification will be difficult, and it is more convenient to prepare the salt directly by heating 3 parts of copper with 10 parts of sulphuric acid; or with 5 parts of sulphuric acid, 50 of water, and 4 or 5 of nitric acid.

Properties.—Sulphate of copper crystallizes in handsome blue oblique prisms, which yield a whitish-blue powder and dissolve in 3 parts of cold and about one-half their weight of boiling water. The solution has a pale blue color, a strong acid reaction, and a very styptic metallic taste. It yields a white precipitate with barium chloride (sulphuric acid), and a blue one with ammonia water, soluble in excess of the latter. For detecting a small quantity of ferrous salt, it should be oxidized by chlorine. If now ammonia water be added in excess, all the iron will precipitate as ferric hydrate, while the copper will form a deep blue solution. The presence of zinc, earthy, or alkaline sulphates is most conveniently detected by precipitating the solution completely with sulphuretted hydrogen gas and evaporating the filtrate to dryness, when, in case a residue should have been left, its nature may be ascertained by the appropriate tests.

Though the ordinary bluestone of commerce is sometimes quite impure, there is no difficulty in finding in our market very good and pure sulphate of copper.

CUPRUM ALUMINATUM s. *Lapis divinus* is the name of an old preparation, used in eye-waters, which is still recognized in Europe. It is prepared by powdering 16 parts each of pure cupric sulphate, potassium nitrate, and alum, fusing the mixture in a porcelain capsule at a moderate heat, adding a previously prepared mixture of finely powdered camphor and alum each one part, stirring well, and immediately pouring upon a porcelain slab or plate to cool and harden, when it is broken into pieces and preserved in well-stopped bottles. (P. G.) The *pierre divine* or *pierre ophthalmique* of the French Codex contains a trifle less of camphor. In dispensing the *aluminated copper* it should be well triturated in a mortar with a few drops of water before the remainder is added to facilitate the solution of the camphor. A collyrium, *Collyre de pierre divine*

(F. P.), is made by dissolving 4 parts of aluminated copper in 1000 parts of water and filtering.

Off. Prep.—Cuprum ammoniatum, *U. S.*

Physiological Action.—Given to animals, sulphate of copper excites violent vomiting, and, if this is prevented by tying the œsophagus, insensibility, convulsions, and paralysis ensue. Sixty grains of the salt thoroughly dissolved in water and injected under the skin of a dog destroy the animal in twenty-four hours, death following contraction of the pupils, paralysis of the hind legs, and a rapid pulse and respiration. The lungs, liver, and kidneys are gorged with dark blood, and the gastric mucous membrane is inflamed. This change in the blood, which becomes dark as well as thick and sticky, is considered by Laborde to be a primary effect of the poison.

Workers in copper are said to be subject to giddiness, lassitude, and dyspepsia, and to have sallow complexions. It seems to be a fact that, during epidemics of Asiatic cholera, these workmen have generally escaped the disease. Taken in small doses by man its action may be regarded as astringent and tonic. It does not destroy healthy tissue as a caustic. In emetic doses its action is prompt and rapid, and it leaves no nausea nor depression behind it. Even in very large, and in what may be called poisonous, doses, it is rarely fatal to life, and recovery is usually rapid and complete, although in some cases derangement of the digestive function with diarrhœa may for a time continue. The symptoms of acute poisoning by this substance are headache, convulsions, colic, vomiting, collapse, suppression of urine, and sometimes jaundice. In the rare cases of death following directly upon poisoning by sulphate of copper, congestion of the gastro-intestinal mucous membrane was the only discoverable lesion; in some instances of death occurring at a later period, ulceration and even sloughing and perforation of the bowel have been found.

Medical Uses.—The emetic operation of sulphate of copper is peculiarly appropriate to the treatment of pseudo-membranous *croup*, on account of its sustained mechanical and expulsive action unaccompanied by nausea or other cause of depression. It has no specific operation whatever upon the seat of the plastic exudation, and, therefore, it can only be useful when the membrane has become spontaneously loose or been loosened by other agents, such, for instance, as mercury, inhaled lime-water, and possibly in some cases by depletion. In *malignant sore-throat* a solution of two grains to the ounce has been given in tablespoonful doses every ten or fifteen minutes with alleged success. It is probable that the local application by means of a sponge of this or of a stronger solution would be, at the least, as efficient. There is some reason to think that *quartan agues* have been cured by sulphate of copper in doses of a quarter of a grain three times a day. Solutions of the salt form efficient injections for *gleet* and *leucorrhœa*. They should have a strength of one or two grains to the ounce. *Dysentery* and *diarrhœa* in their chronic forms, but especially the former disease, are often materially benefited by enemas of a pint of tepid water holding in solution from ten to twenty grains of sulphate of copper. All forms of *ulcers* are very advantageously modified by it, as ulcers of the cornea, nostrils, mouth, vagina, and general surface, especially when they present an indolent aspect, or arise in vitiated states of the system, for example, as they occur in ulcerative *stomatitis*, gangrene of the *pharynx*, *mercurial sore-mouth*, etc. In *conjunctivitis*, especially of the chronic, and most of all of the granular, form, this salt is of great service. When the granulations are large, a crystal of sulphate of copper should be used. The same agent will sometimes suffice to arrest *hemorrhage* from bleeding surfaces; for this purpose also it is sometimes used in the form of a powder, which may be mixed with an equal quantity of powdered gum arabic. The stimulant and astringent action of the salt has been applied to the cure of various local affections of the skin, such as *acne rosacea*, *ichthyosis*, *alopecia*, etc.

Administration.—As an emetic, sulphate of copper may be given in doses of from two to ten grains of the powdered salt mixed with pulverized sugar, and repeated every ten or fifteen minutes if necessary. As a tonic or astringent, the dose is from a quarter of a grain to two or more grains in pill. For local application, solutions containing from one to ten or more grains to the ounce of water may be used. Pencils of sulphate of copper are made by fusing together two parts of this salt with one of alum.

CUPRUM, *U. S.*, *Br.*—COPPER.

Cupreum filum.—*Copper wire*, E.; *Cuivre, Fil de cuivre*, Fr.; *Kupfer, Kupferdraht*, G.

Symbol Cu. Atomicity bivalent. Atomic weight 63.5.

Fine copper wire, about No. 25.

Origin.—Copper is often found in the metallic state as native copper, notably near Lake Superior; occasionally it is met with in the oxidized state as black and red copper ore, or as a carbonate in malachite, and frequently as sulphuret in copper pyrites, copper glance, and gray copper ore, etc. It is a natural constituent in minute quantities of some mineral springs, and of many vegetable and animal organisms. The smelting process is rather complicated for many ores, and depends mainly upon the oxidation of the sulphurets by roasting and the reduction of the metal by means of charcoal or by fusing a mixture of oxide and sulphide of copper. Arsenic and antimony, which are often present, are expelled by the repeated roastings, together with the sulphur, and the iron is made to enter the slag.

Properties.—Copper is a very sonorous, malleable, and ductile metal of a reddish color, having the specific gravity 8.92, or when hammered 8.95. It is inferior to iron in tenacity or strength and in hardness, and it fuses at a lower temperature; but is a much better conductor of electricity and heat, and resists the chemical action of moist air much better than iron. It is not acted upon by cold concentrated or hot dilute sulphuric acid, but it dissolves readily in nitric acid. The most important of the numerous alloys of copper are *brass*, containing about 28 to 36 per cent. of zinc; *bronze*, containing 8 to 12 per cent. of tin and sometimes some zinc and lead; *bell metal*, containing 20 to 25 per cent. of tin; and *German silver*, composed of 8 copper, $3\frac{1}{2}$ zinc, and 3 or 4 nickel.

Chemical Characteristics.—Copper forms two series of salts, *cuprous* and *cupric*, the former of which are of little importance. The anhydrous cupric salts are usually white, the hydrated, green or blue; the soluble ones have an acid reaction, and their solutions are decomposed by iron, zinc, and the earth metals, with the precipitation of copper. Potassa precipitates a greenish-blue basic salt, or blue hydrate, which, when heated, turns to black CuO. Potassium carbonate precipitates green oxycarbonate of copper, the precipitate turning black on boiling. Ammonia water and ammonium carbonate occasion bluish-green precipitates, which dissolve in an excess, forming deep azure-blue solutions. Ferrocyanide of potassium yields a brown-red precipitate, which is insoluble in dilute acids. Sulphuretted hydrogen separates from acid solutions brown-black sulphide of copper. Potassium iodide produces a grayish-white precipitate of cuprous oxide, one-half of the iodine being at the same time liberated.

Pharmaceutical Uses.—Copper wire is employed in the preparation of Spiritus ætheris nitrosi for generating nitrous acid.

Physiological Action.—Copper in the metallic state is not known to exercise any specific action upon the economy. Workers in the metal, although constantly covered with its dust and receiving such large quantities of it into the system through the lungs and digestive apparatus that it is readily detected in the urine, do not appear to be liable to any special diseases, although they have a more or less anæmic appearance. Indeed, as stated elsewhere, copper-founders are said to enjoy a peculiar immunity from epidemic cholera.

CUPRUM AMMONIATUM, *U. S.*—AMMONIATED COPPER.

Cuprum sulfuricum ammoniatum, P. G.—*Ammonio-sulphate of copper*, E.; *Sulfate de cuivre ammoniacal, Cuivre ammoniacal*, Fr.; *Schwefelsaures Kupferoxyd-Ammoniak* (*Kupfer-Ammonium, Cuprammonium*), G.

Formula of crystals $Cu(NH_3)_4SO_4.H_2O$. Molecular weight 245.5.

Preparation.—Take of Sulphate of Copper half a troyounce; Carbonate of Ammonium three hundred and sixty grains. Rub them together in a glass mortar until effervescence ceases. Then wrap the ammoniated copper in bibulous paper, dry it with a gentle heat, and keep it in a well-stopped bottle. *U. S.*

Take of Pure Sulphate of Copper one part, dissolve it by stirring in Water of Ammonia three parts, to the filtered liquid add of Alcohol six parts. Collect the resulting precipitate on a filter, and dry it between bibulous paper without heat. *P. G.*

These two processes yield somewhat different results. On rubbing together sulphate of copper and carbonate of ammonium, the mixture becomes soft from the extrication of the water of crystallization, carbonic acid is given off, and the color changes to deep azure-blue. But the two salts not being used in proportions of their combining weights, the preparation must necessarily be a mixture of several compounds, and contain an excess of ammonium carbonate. The second process yields a definite chemical compound, which is precipitated in a crystalline condition on mixing the aqueous solution with alcohol. Larger and well-defined crystals will be obtained, if the alcohol be carefully poured upon the watery solution; in proportion as the water will be abstracted by the alcohol, crystals will be deposited. It is contained in the preparation of the U. S. Pharmacopœia.

Properties.—The salt has a deep-blue color, and an ammoniacal odor; exposed to the air, it loses ammonia, and gradually changes to light blue. It dissolves in 1½ parts of cold water; the solution has an alkaline reaction and metallic taste, and on the addition of more water becomes turbid, and produces a sediment. With a solution of arsenious acid, a green precipitate, Scheele's green, is produced. When the salt is heated to 150° C. (302° F.), ammonia and water are given off, and an apple-green powder remains, having the composition $Cu(NH_3)_2SO_4$, being a cuprodiammonium sulphate, while the officinal salt is a cuprotetrammonium sulphate; this contains 27.10 per cent. of ammonia and 32.38 oxide of copper. Berzelius obtained 26.40 and 34.0 per cent.

Physiological Action.—In medicinal doses this preparation does not produce any immediately sensible effects upon the healthy system, but in large doses it occasions nausea, giddiness, confusion or dimness of sight, vomiting, colic, constipation or diarrhœa, and, if persisted in, is said to cause muscular spasms or paralysis, wasting of the body, and death.

Medical Uses.—Ammoniated copper was once reputed to be an efficient remedy for *epilepsy*, but more accurate and continued observation has not sustained its character. It is one of the many medicines to which cures of *chorea* have been ascribed, and sometimes with such emphasis and detailed proofs that some faith in its efficacy cannot easily be withheld. If employed in this disease, it should be given at first in doses of half a grain three or four times a day, in an aromatic vehicle, with a small proportion of laudanum, and rapidly but gradually increased until it begins to disturb the stomach. It should be administered when the stomach contains food. Locally, it has been employed for the same purposes as sulphate of copper, in solution and in ointments.

CURARE.

Urari, Wourari, Wourali, Woorara.

Preparation.—The latest information concerning the preparation of this South American arrow-poison is from Dr. Jobert (1878), who, writing from Belin de Para to the French Academy, made the following statements: The principal ingredients are *urariu va* (probably *Strychnos Castelnæ*, Wed.) and *eko*, also called *pani du maharão* (probably *Cocculus toxiferus*, Wed.). The young bark of these plants is well scraped, and the scrapings mixed in the proportion of four parts of the former and one part of the latter; the mixture is well kneaded with the hands and in a funnel made of a palm leaf exhausted with cold water, the liquid being returned seven or eight times. The red infusion is boiled with fragments of *taja* (an aroidea) and *mucura-ea-ha* or *eone* (probably *Didelphys cancrivora*). After about six hours the liquid has acquired a thick consistence, and is mixed with the scrapings of three species of pepper (Artanthe?) and *tauma-gere*, and again boiled and allowed to cool, when it will have the consistence of a thick paste.

It is, however, very probable that in different parts of South America it is prepared from different plants. Indeed, it has been stated that the *curare* of Guiana, which is always met with in small earthen jars, is obtained from Rouhamon guianensis, *Aubl.*, and Strychnos cogens, *Benth.*, and that the *urari* consists chiefly of the extract of Strychnos toxifera, *Schomb.*, and is always preserved in calabashes. Paullinia cururu, *Lin.*, has likewise been named as one of the ingredients.

Properties.—Curare is a blackish-brown extract, brittle or hygroscopic, of a very bitter taste, and generally almost completely soluble in water.

Constituents.—Boussingault and Roulin (1828) have separated from curare some fat, brown resin, red coloring matter, gum, clay, and the alkaloid *curarina* or *curaria*, which was previously discovered by A. Buchner (1827). In its pure state the alkaloid forms colorless prisms, which have a very bitter taste, but less persistent than strychnia. It has a slight alkaline reaction, is deliquescent in moist air, freely soluble in alcohol, sparingly so in chloroform and amylic alcohol, and insoluble in absolute ether, carbon bisulphide, and benzol. It is colored deep red by nitric acid, and by concentrated sulphuric acid acquires a carmine-red (Boussingault) or blue color (Preyer), which, on the addition of bichromate of potassium, becomes violet, the reaction being very similar to that produced by strychnia under the same treatment, but the coloration is more permanent. Its composition is stated to be $C_{10}NH_{15}$.

Physiological Action. *On Animals.*—The observations made more than half a century ago by Fontana, Brodie, Emmert, and others, agree essentially with the results of recent experimenters as to the action of this substance. They found that it acted much more energetically upon birds than upon quadrupeds, a peculiarity which is now known to depend upon its very slow elimination with the urine in the former, and its rapid discharge with the same excretion in the latter class of animals. So complete is this elimination, that the urine of an animal poisoned by woorara is itself actively poisonous. The most conspicuous phenomena observed, when a solution of the poison is injected into the blood or hypodermically, are the following: A general muscular paralysis, including that of the muscles of respiration, which first affects the hinder limbs of quadrupeds, but ultimately involves all of the voluntary muscles, so that if the dose be duly proportioned, the animal may remain for hours alive, but entirely motionless. Occasionally, when death is rapid, convulsions occur, which are occasioned by asphyxia due to respiratory paralysis; but the heart continues to beat after other signs of life become extinct, and even then the poisoned animal may sometimes be revived by artificial respiration.

On Man.—The original experiments upon animals agree with those subsequently made upon man, in showing that woorara is rarely poisonous when taken into the stomach. Locally, however, it acts as an irritant to the denuded cutis, causing severe pain and subsequently inflammation; when used hypodermically it is apt to produce obstinate and painful ulcers; its powder irritates the mucous membranes, exciting lachrymation and a copious nasal and salivary flux. Internally it is a diaphoretic, and in some cases is said to have rendered the urine saccharine. It does not seem to influence the pulse or the temperature. In large doses taken hypodermically or by the stomach, it sometimes causes chilliness followed by fever and sweating, but more usually its effects are exhibited by the voluntary muscular system, which is in every part relaxed. This action upon the muscles of the face produces an apathetic, dull expression, especially as the upper eyelid falls, covering the eyeball; and, as the patient is unable to open his eyes, he is apt to believe himself stricken with blindness. In other cases the muscles of the eyeball are affected, and mydriasis, diplopia, strabismus, and ptosis occur. The lower limbs are first and chiefly affected with loss of muscular power, so that the gait is staggering. These phenomena are variously explained by different observers and experimenters according to their several theories of the nervous functions. It seems probable, however, that the primary operation of woorara is upon the terminations of the nerves, and not upon their central origin.

Medical Uses.—Woorara has been employed chiefly in the treatment of several grave diseases attended with nervous spasm, and especially tetanus, epilepsy, chorea, and hydrophobia. It is well known that *tetanus*, even of the traumatic form, has been treated successfully with various medicines which control muscular action, and this one is reported to have cured thirteen out of thirty-three cases (Demme, Busch). Other persons have published similar results, but in isolated cases. There can be no doubt that, appropriately administered, it effectually controls the spasms, probably by its direct action upon the muscles, and thereby spares the patient the exhaustion which the spasms produce. Practically, however, woorara is seldom used in the treatment of tetanus. In *epilepsy* and *chorea* it is useless. It has also been tried in *rabies*, uniformly with the result of appeasing or suspending the spasms, and, in at least three cases, it is said to have cured the disease. A critical examination of these cases leaves an impression of doubt as to their nature. The reporters do not always seem to have been aware of the distinction between rabies canina and hydrophobia, nor of the alleged cures of the disease by various remedies, such as xanthium spinosum, the hot vapor bath, oxygen, etc. Woorara is best administerd hypodermically in a filtered watery solution, of the strength of one per cent., each injection containing about one-tenth of a grain. It should be repeated until muscular relaxation is produced. It has also been used endermically and by the rectum. Woorarin, or curarin, has been used as a sulphate in from one-twentieth to one-tenth of the dose of woorara.

CURCAS.—Purging Nut.

Semen ricini majoris.—Physic nut, Barbadoes nut, E.; *Pignon d'Inde (des Barbades), Semence du médicinier,* Fr.; *Purgirnuss, Schwarze Brechnuss,* G.

The seed of Curcas purgans, *Adanson*, s. Jatropha curcas, *Lin.*

Nat. Ord.—Euphorbiaceæ.

Origin.—A medium-sized monœcious shrub, indigenous to the West Indies and South America, but naturalized in other tropical countries. It has smooth, angular-cordate leaves, paniculate cymes of greenish-yellow bell-shaped flowers, the pistillate ones few and largest, and tricoccous, obtusely triangular, and blackish capsules, each cell containing one seed.

Description.—The seeds are about an inch long, ovate-oblong, flattened from the back, with a broad whitish hilum and caruncle at one end, black, not shining, somewhat rough, and marked with numerous small cracks. The kernel has the shape of the seed, and consists of an oily albumen which incloses the embryo. The seeds are inodorous; the kernels have a sweetish and oily taste, which gradually becomes acrid and burning.

Constituents.—The principal constituent is the fixed oil, of which Arnaudon and Ubaldini (1858) obtained 37.5 per cent. It is light yellow or colorless, of spec. grav. 0.92, congealing to a butyraceous mass at —8° C. (17.6° F.), inodorous and nearly insoluble in alcohol. When distilled with potassa, caprylic alcohol is obtained. Bouis (1854) separated a liquid and solid fatty acid, and named the latter *isocetic acid*, $C_{15}H_{30}O_2$. Cadet de Gassicourt (1824) found in the seeds also an acrid resin.

Allied Seeds.—Curcas multifidus, *Endl.*, s. Jatropha multifida, *Lin.*, a South American shrub, the seeds of which resemble the preceding, but are smoother and brown. According to Soubeiran, the oils of the two seeds are very similar if not identical.

Euphorbia lathyris, *Lin.*, s. Tithymalus lathyris, *Kl.* and *Garcke.* A South European herb, cultivated in gardens and somewhat naturalized in North America, the seeds of which were formerly officinal as *semen cataputiæ minoris.* They are about one-eighth of an inch long, oval, obtuse, on one end with the hilum and caruncle, brown, marbled with gray, and rugose. The oil separates a crystalline mass on standing.

Physiological Action.—It is said that the expressed oil of Jatropha nuts acts chiefly as a purgative, and that in the dose of about twelve drops it produces effects like those of an ounce of castor oil. It is more like croton oil in its effects. The acrid emetic principle resides chiefly in the embryo. It is stated that if the embryo is wholly removed, four or five of the seeds may be used as a purgative without their producing either vomiting or griping. This opinion is supported by experiments upon dogs with the seeds. A number of cases have occurred of poisoning by eating the seeds entire. In one case, a man who had eaten five of them soon complained of a burning in the mouth and throat, and the whole abdomen felt distended and sore. In a few minutes vomiting occurred, and was repeated five times in the course of an hour, accompanied with active purging. The pain continued, the patient complained of feeling hot and giddy; he then became delirious, and afterwards insensible. On recovering consciousness several hours later, his face was pale, his hands cool, the pulse 110 and weak. He recovered. In 1854, at Birmingham, Eng., above thirty boys were poisoned by eating these seeds. In some of them, besides the symptoms just mentioned, there was a hot skin, and an appearance of drowsiness, which may, however, have been due to exhaustion produced by the evacuations. They all made good recoveries. The oil applied to the skin irritates it.

Medical Uses.—In the East Indies the juice of the plant and the oil are said to be used locally in the treatment of *cutaneous eruptions*, *rheumatism*, and *hemorrhoids*, and, in liniments, to stimulate the secretion of *milk*. The oil has been employed internally in *constipation*, *dropsy*, *worms*, etc.; and internally in the diseases mentioned, and also in *paralyses*, pain in the *ears*, *deafness*, etc. In a word, it has, in a less degree, the qualities and medical virtues of croton oil.

CURCUMA, *U. S.*—TURMERIC.

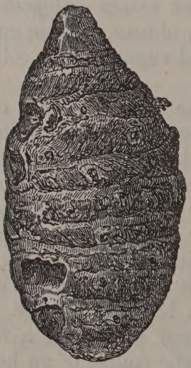
Rhizoma curcumæ, P. G.—*Curcuma, Souchet des Indes*, Fr.; *Kurkuma, Gelbwurz*, G.

The rhizome of Curcuma longa, *Lin.;* s. Amomum curcuma, *Jacq.;* s. Curcuma rotunda, *Lin.* Woodville, Med. Bot. 252; Bentley and Trimen, Med. Plants, 269. *Nat. Ord.*—Zingiberaceæ.

Origin.—The plant yielding turmeric is a perennial, indigenous to India, and is extensively cultivated throughout Southern Asia, and in many islands of the Indian Ocean. It produces a tuft of radical leaves, which are about three feet long, and have a prominent midrib; the scape bears a few sheathing bracts below, and terminates with a spike of six inches, bearing orange-colored flowers in pairs from the axils of spreading bracts.

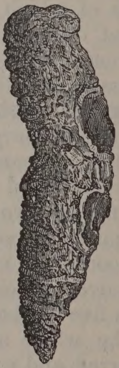
Description.—The central portion of the rhizome of the different species of curcuma is tuberous, and sends out nearly cylindrical branches, some of which become fusiformly thickened towards their ends, and then contain a very pure starch. Aside from these spindle-shaped, amylaceous tubers, the subterraneous stem is of two forms, and the commercial turmeric must vary as one or the other or both forms are collected, which were supposed by Linnæus to have been produced by two distinct species.

Fig. 52.



Round Turmeric.

Fig. 53.



Long Turmeric.

Curcuma rotunda, or round turmeric, attains a length of one and a half to two inches, with a diameter of one inch or more; it varies in shape between globular, oblong, and pyriform; has annular marks from the scars of the leaf-sheaths, and is beset with root-scars and a few fibres or their remnants. *Curcuma longa*, or long turmeric, is one and a half to two inches long; one-fourth to one-half inch thick, straight or curved, mostly simple, nearly cylindrical, and somewhat annulated by the leaf-scars. The two varieties are externally covered with a yellowish-gray, soft and friable corky layer, and break with a short and smooth fracture of a resinous lustre. The interior is of a gamboge to brown-yellow color, the centre usually of a deeper tint, and separated from the outer portion by a circular line, indicating the nucleus sheath. The fibro-vascular bundles are scattered throughout the entire rhizome, and are more numerous within the nucleus sheath. The nearly uniform color and glossy appearance of the interior are due to the scalding of the rhizomes previous to drying, whereby the starch has been converted into a pasty mass. The quality of turmeric is approximately judged by the brightness of the tint, and the degree of lustre upon the fracture. Turmeric has a peculiar aromatic odor, and a warm, aromatic, and bitterish taste.

The principal commercial varieties are: *Chinese turmeric* consists of many central rhizomes with well-developed branches. *Bengal turmeric* is mostly in slender branches of a deep reddish tint. *Madras turmeric* is in thick lateral branches, mixed with transversely cut tubers of a gamboge tint. *Java turmeric* consists of rather small tubers and branches, which are often transversely and longitudinally cut. *Cochin turmeric* is in sections or slices of a larger tuber, some being marked with rather large depressed stem-scars; they are probably derived from another unknown species.

Constituents.—According to recent investigations turmeric contains starch and about 1 per cent. of volatile oil, which Bolley, Suida, and Lange (1868) found to consist of a small quantity of hydrocarbon and of *curcumol*, which is probably isomeric with carvol and thymol, $C_{10}H_{14}O$. Rectified at a temperature not exceeding 245° C. (473° F.) the oil leaves a brownish body, having the consistence of turpentine and a pungent odor.

The coloring matter *curcumin* was obtained by Gajewsky (1870) by removing the oil from the powder with carbon bisulphide, exhausting the coloring matter with ether, and recrystallizing it from ether or benzol; subsequently (1873) he washed the ethereal extract with weak ammonia, dissolved the remainder in hot, strong ammonia, and precipitated by carbonic acid. Daube (1870) exhausted with boiling benzol, dissolved the crystals obtained on cooling, in cold alcohol, precipitated the filtrate with alcoholic solution of plumbic subacetate, leaving the liquid faintly acid, decomposed the precipitate with hydrogen sulphide, and crystallized from alcohol. The yellow crystals, $C_{10}H_{10}O_3$, have a vanilla-like odor, fuse at 165° C. (329° F.), are readily soluble in alcohol and ether, very little in benzol, and freely and with a red-brown color in alkalies, from which solutions curcumin is precipitated by acids. The red compound with lead is easily altered. By boiling an alcoholic solution of curcumin with boracic acid, and decomposing the compound with hot water, Schlumberger (1866) obtained yellow *pseudo-curcumin*, which is not reddened by boracic acid, and is soluble in alkalies with a greenish-gray color. Boiling as before, but in the presence of sulphuric acid, *rosocyanin* is formed, which is crystalline, insoluble in water, benzol, and ether, and soluble with a beautiful red color in alcohol. Alkalies color it blue, the solution on boiling turns blood-red, then yellow, and now contains pseudo-curcumin.

Kachler (1870) separated from the infusion of turmeric a notable quantity of *acid potassium oxalate*. The other constituents are unimportant. Tincture of turmeric shows a blue fluorescence, due to curcumin.

Pharmaceutical Uses.—Turmeric is employed for the detection of alkalies and of borates. Paper saturated with the tincture is colored brown-red by alkalies, the yellow color being restored by acids. Soluble borates likewise produce a brown-red color, which is not altered on the addition of dilute acids. It is occasionally employed for coloring pomades and ointments, as in the *Unguentum flavum s. Ung. althææ*, P. G., which is made by digesting for half an hour 1 part of turmeric with 50 parts of lard, fusing together with yellow wax and Burgundy pitch, each three parts, and straining.

Medical Uses.—Turmeric has no medicinal properties that require notice. Its sole use is to prepare a test-paper. In India and China it is employed as a condiment.

CYCLAMEN.—CYCLAMEN.

Sow-bread.—*Arthanite, Pain de pourceau,* Fr.; *Erdscheibe, Erdbrot, Schweinebrot,* G.

The tuber of Cyclamen europæum, *Lin.* *Nat. Ord.*—Primulaceæ.

Origin.—The species grows in shady places and rocky woodlands of Southern Europe, and is met with in cultivation. It has a few roundish heart-shaped leaves of a dark-green color, marked with white above, and purple beneath, and several stalks, each bearing a nodding, fragrant, pink-colored flower, and coiling up after flowering so as to bring the capsule to the ground.

Description.—The tuber is one to two inches thick, flattish, circular or depressed globose, dark-brown externally, internally white, mealy, with a rather thin bark and with narrow and short fibro-vascular bundles loosely arranged in irregular circles. In the fresh state it has a burning acrid taste; after drying this is milder.

The similar tubers of Cyclamen hederæfolium, *Ait.*, and C. persicum, *Mill.*, which are indigenous to Southern Europe and the Levant, have similar properties.

The pyriform or spindle-shaped tubers of Lathyrus tuberosus, *Lin.*, which are of the size of a walnut, are said to be occasionally substituted for those of cyclamen; they have a mucilaginous taste.

Constituents.—Aside from starch, gum, pectin, and other common principles, Saladin (1830) isolated *cyclamin* or *arthanitin* $C_{20}H_{24}O_{10}$. It is white amorphous or in minute crystals, of a bitter and acrid taste, soluble in bisulphide of carbon, chloroform, alcohol, and in water, and insoluble in ether and fixed and volatile oils. Its aqueous solution foams like soap-water, is precipitated by tannin, and when boiled with dilute acids yields glucose and resinous *cyclamiretin.*

Physiological Action and Medical Uses.—Experiments made by Claude Bernard led him to the conclusion that cyclamin resembled woorara in its action; but as he injected a large amount of liquid in which the cyclamin was dissolved into the trachea of the animals, it is evident that they died of asphyxia and not of cyclamin. While pigs can eat any quantity of cyclamen root without harm, fish are poisoned by its juice as well as by cyclamin. The former is said to be used in Sicily and Italy for catching fish. They are not affected tetanically as by cocculus, but die asphyxiated through imperfect respiration. Small fish die in water containing the one three-thousandth part of the juice of cyclamen root. According to Schroff, 1. Cyclamin does not act upon the sound skin. 2. In the mouth it produces a very unpleasant sensation and taste, and excites salivation. 3. In the stomach it causes burning, oppression, nausea, and vomiting, and in this organ, as in the intestine, it occasions inflammation. 4. In the connective tissue it excites inflammation which may be followed by gangrene. 5. It does not affect the brain, spinal marrow, or nerves. 6. It salivates men when not taken by the mouth, but by the veins. 7. Its action is analogous to that of smilacin, senegin, and saponin.

Cyclamen root loses much of its acrimony by keeping, and has been recommended under such circumstances as a purgative in the dose of ten grains triturated with powdered gum. On the other hand, the fresh root has sometimes occasioned alarming effects. Bulliard states that "in the north of France, where it is much used as a purgative, it often produces violent vomiting, followed by cold sweats, vertigo, ringing in the ears, and gyratory or convulsive movements;

often blood is ejected by vomiting or purging, and sometimes there is even fatal hypercatharsis." Formerly it entered, with other drastic purgatives, into a liniment which caused purgation when applied to the abdomen in cases of *worms* and of *dropsy*. It has been stated by Vulpian that when cyclamin is given to frogs the animals sicken, and, after a few days, die. Their blood is found to contain a multitude of vibrios, some of which are even in the interior of the red corpuscles. Externally, the fresh tuber has been proposed as a stimulating cataplasm for *carbuncles*, *abscesses*, enlarged *glands*, etc.

CYDONIUM, *U. S.*—QUINCE-SEED.

Semen cydoniæ, P. G.—*Semences* (*Pépins*) *des coing*, Fr.; *Quittensamen*, *Quittenkerne*, G.

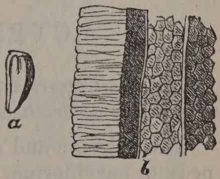
The seed of Cydonia vulgaris, *Persoon*, s. Cyd. europæa, *Sav.*, s. Pyrus Cydonia, *Lin.*, s. Sorbus cydonia, *Crantz.* Woodville, Med. Bot. 182; Bentley and Trimen, Med. Plants, 106.

Nat. Ord.—Rosaceæ, Pomeæ.

Origin.—The quince tree, which attains a height of 20 feet or remains shrubby, is probably indigenous to Asia Minor and Persia, but was anciently cultivated, and is now naturalized in the Mediterranean basin and cultivated in the temperate parts of Asia, Africa, Europe, and America. It has shortly petiolate, entire, ovate leaves, which are woolly beneath, ovate, glandular, and denticulate stipules, handsome pale rose-colored flowers, and a pyriform, golden-yellow, fragrant fruit with five cells, each containing about twelve closely-packed seeds.

Description.—The seeds are one-quarter or three-eighth inch long, of an oblong or oval shape, but flattened and three-sided by mutual pressure, the somewhat pointed hilum at one end is connected by the ridge-like raphe along the sharper edge, with the chalaza at the other slightly beaked end. The testa is of a brown color, covered with a mucilaginous epithelium by which the seeds of one cell are united into a mass. The embryo is of the size and shape of the seed, consists of two plano-convex oily cotyledons with a thick straight radicle pointing towards the hilum, and possesses the taste of bitter almonds. The unbroken seeds are mucilaginous. The mucilage is contained in the epithelial cells, which form the grayish covering of the seed, and when immersed in water, swell up considerably, forming a thick jelly-like mass with forty parts of water to one of seeds.

Fig. 54.



Quince-seed.—*a*. Natural size. *b*. Magnified section through epithelium, testa and tegmen into a cotyledon.

Constituents.—Quince-seeds yield about 20 per cent. of dry mucilage which has the composition $C_{12}H_{20}O_{10}$ and contains some calcium salts and albumen. Treated with nitric acid it yields oxalic acid. The mucilage has little adhesive power, is not affected by solution of borax, and is precipitated by alcohol and by metallic salts.

Pharmaceutical Uses.—Mucilago cydoniæ, *P. G.*, is made by macerating 1 part of quince-seed with 50 parts of rose-water for half an hour, with frequent agitation, and straining.

Bandolin is a mucilage of quince-seeds used for dressing the hair; it is made by macerating two drachms of the unbroken seeds in a pint of water, straining the mucilage, and adding about one ounce of Cologne water with some other scent to suit.

Medical Uses.—The mucilage of quince-seeds is a lenitive and protective, and like other mucilages may be applied to the *inflamed skin*, or given internally in *gastro-intestinal* inflammations, or used to allay *cough* produced by dryness or irritation of the throat.

CYNANCHUM.—SWALLOWWORT.

Dompte-venin, Hirundinaria, Fr.; *Schwalbenwurz, Giftwende*, G.

The root of Cynanchum (Asclepias, *Lin.*) vincetoxicum, *Pers.*, s. Vincetoxicum officinale, *Moench.*

Nat. Ord.—Asclepiadaceæ.

Origin.—This plant grows in rocky places, throughout the greater part of Europe. It is about 2 feet high, and has nearly sessile cordate-ovate and acuminate leaves, the axils of which bear the small umbels of about 9 flowers.

Description.—The subterraneous portion consists of a very knotty, many-headed horizontal rootstock, with cupshaped stem-scars, and with numerous nearly simple rootlets, which are about 6 inches long, longitudinally wrinkled, pale-brownish externally, and showing upon the transverse fracture a rather thick brownish bark, with white dots, and a finely porous yellowish meditullium. The peculiar odor of the fresh root, which resembles that of valerian, disappears nearly altogether on drying; the taste is sweet, bitterish, and acrid.

Constituents.—Feneulle (1825) submitted the root to analysis, but did not succeed in isolating the emetic principle. He determined the presence of pectin, fat, volatile oil, etc.

Medical Action and Uses.—This plant and a bitter principle derived from it are extremely irritant, and, taken internally, occasion nausea, vomiting, and purging, depending upon active irritation of the gastro-intestinal mucous membrane, as experiments on animals show. Its action has been compared to that of scammony, for which it has been proposed as a substitute in France. Occasionally it has been used in *dropsy* and *diseases of the skin.*

CYPRIPEDIUM, *U.S.*—CYPRIPEDIUM.

Rhizoma cypripedii.—Ladies' slipper root, E.; *Racine de cypripède jaune, Valériane américaine*, Fr.; *Gelbfrauenschuh-Wurzel*, G.

The rhizome and rootlets of Cypripedium pubescens, *Willd.*, and of Cypripedium parviflorum, *Salisb.*

Nat. Ord.—Orchidaceæ.

Origin.—These are herbaceous plants which are indigenous to Canada and to the United States as far south as North Carolina; they grow in low woodlands and boggy localities, and flower in May and June. The two plants are distinguished from each other by their size, *Cypr. pubescens* being the taller, growing about 2 feet high, and by their flowers, which in the species named have lanceolate sepals and a laterally flattened lip which is arched above, while the flowers of Cypr. parviflorum are smaller, with lance-ovate sepals, and the lip flattened from above. In both species the lip of the yellow flowers forms an inflated obtuse sac which is likened to a slipper.

Description.—The rhizomes are horizontal, bent up and down, nearly cylindrical, about $\frac{1}{8}$ inch in diameter, nearly 4 inches long, above beset with broad circular cupshaped scars of the overground stems, the more recent ones with fibrous tufts of ligneous tissue; the numerous simple rootlets are mainly attached on the lower half of the rhizome, attain a length of 6 to 8, occasionally even 18 or 20 inches. The rhizomes and rootlets of *Cyp. parviflorum* are rather more slender and shorter, and after drying, of an orange-brown color, while the coarser parts of *Cyp. pubescens* dry of a black-brown. Both break with a short fracture, which is white with scattered wood-bundles, have a peculiar slight but heavy odor, and a sweetish, bitter, and pungent taste.

The rhizome of *Hydrastis canadensis* is not unfrequently mixed with the commercial cypripedium; it is readily distinguished by its different shape, its yellowish-gray color externally, and by its transverse section, which is bright-yellow, and shows a circular arrangement of the wood wedges.

Constituents.—Cypripedium was analyzed by H. C. Blair (1866), who found a minute quantity of volatile oil, a volatile acid, two resins, tannin, starch, etc. The rhizomes of both species deserve to be again carefully analyzed.

Medical Action and Uses.—Cypripedium was among the medicinal plants used by the aborigines of this country; subsequently it was resorted to by the country people for the relief of nervous affections, such as *chorea* and *hysteria*. It is one of the numberless agents said to cure *epilepsy*. In its action and uses it is generally supposed to resemble valerian. The *dose* is stated to be fifteen grains of the powdered root, or the equivalent of that quantity in tincture or infusion, three times a day. The oleoresin precipitated from the tincture by water may be prescribed in doses of one or more grains.

DAMIANA.—Damiana.

Origin and Description.—Since 1874, the leaves of two or three Mexican plants have appeared in commerce under the above name, and were ascertained by E. M. Holmes (1876) to come from the following species :—

Turnera microphylla, *D. C.* (Fig. 56.) *Nat. Ord.* Turneraceæ.—The leaves are alternate, obovate, entire at the base, and above on each side with three or four teeth, light green, rather rough, and covered with short whitish hairs. They readily fall off, and the much-branched stems, if present, have some resemblance to broom tops. The leaves have an aromatic taste, suggesting that of confection of senna. Leaves of the shape seen in Fig. 55 belong either to a variety of the same, or to a closely allied species. They are usually of a darker green, smooth, and have a somewhat mint-like flavor.

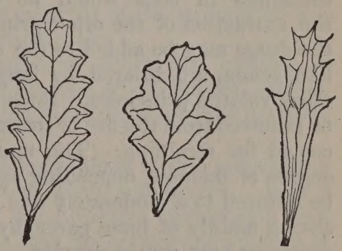


Fig. 55. Fig. 56. Fig. 57.

Damiana, natural size.

Aplopappus (Haplopappus) discoideus, *D. C.* *Nat. Ord.* Compositæ.—The leaves are lanceolate, above with about three sharp teeth on each side, the lower half entire, rather coriaceous, roughish on the surface, light green, with occasional black dots, and with minute resin-like granules or scales. The flowers, which are usually present, have an imbricated involucre, yellow florets, and a white hairy pappus. The drug has a distinct balsamic odor and taste. Dr. Rothrock (1876) gives the following synonyms for this plant: Linosyris mexicana, *Schlechtendal;* Baccharis veneta, *H. B. K.;* and Bigelovia veneta, *Gray.*

The two genera mentioned above belong to Western North America and parts of South America. A species of *Turnera*, T. ulmifolia, *Lin.*, grows in the West Indies, where its aromatic leaves and flowers have been used for its tonic properties.

Constituents.—Nothing is known of the principles which might be supposed to contribute to whatever medicinal properties these drugs may possess; they probably contain volatile oil and resin. In making a fluid extract of the Apoplappus damiana, and using 76 per cent. alcohol, crystals of chloride of potassium were obtained by Prof. Wayne (1876).

Medical Action and Uses.—Damiana appears to have tonic and laxative properties. It has been widely and boldly advertised as a remedy for *sexual impotence* or indifference in either sex; but there is not the slightest reason for confiding in the statement.

DECOCTA, *U. S.*

Decoctions, E.; *Décoctions*, Fr.; *Abkochungen*, G.

When the active principles of vegetable drugs are exhausted by boiling with water, decoctions are obtained. Such preparations are obviously not adapted to drugs the activity of which depends upon principles of a resinous nature which are insoluble in water, nor to such as contain volatile oils or other volatile substances which would be dissipated with the vapor of water. Formerly decoctions were usually made by using a large quantity of water, and boiling it down to one-half or even to a less amount. No obvious advantage was gained by this method, and in many instances it proved to be decidedly disadvantageous, owing to the alteration and darkening of the extractive matters, and in some cases to changing the nature of the active principles. The pharmacopœias have very properly, in nearly all cases, reduced the time of boiling to 10 or 15 minutes, and by the German Pharmacopœia it is practically still more reduced, the general direction being to pour cold water upon the substance, and then to keep the mixture in a steam-bath for half an hour. The use of cold water to begin with insures the complete exhaustion from the drug of all its soluble principles by the gradually heated water, the albuminous principles being subsequently coagulated as the heat is increased to near the boiling point. If, on the other hand, the drug be at once immersed in boiling water, the albumen contained in cells would be coagulated, and thus seriously interfere with the extraction of the other principles. In preparing compound decoctions, all the drugs may be added to the cold water, with the exception of those which, like senna, are injured by long-continued heat, or which contain aromatic or other volatile principles. Such should be added, when the decoction is ready to be removed from the fire or steam-bath, and allowed to digest until it is sufficiently cooled for straining. The material should, in all cases, be cut or bruised, the degree of fineness depending upon the nature of its tissue. Woody drugs may be reduced to a moderately fine powder; leaves, however, and other drugs consisting mainly of loose parenchyma, are better used in the form of a moderately coarse or very coarse powder.

Unless the liquid is to be considerably boiled down, decoctions are best prepared in a vessel provided with a cover, which may be loosely put on until the boiling is completed, when the vessel should be well closed, particularly if additions have been made at the close of boiling, Porcelain is undoubtedly the best material for vessels used for preparing decoctions, since it is not acted upon by the various vegetable principles; for similar reasons glass flasks will answer a useful purpose in making small quantities of these preparations. As a rule, it is best to avoid metallic vessels, except when made of block-tin and used in connection with a steam-bath. As many drugs contain tannin, vessels made of iron are not adapted for preparing their decoctions, and the usually imperfect covering of galvanized (with zinc) or tinned sheet-iron renders the vessels lined with such material but little better suited for this purpose, and still inferior to properly enamelled iron vessels.

As a rule, decoctions should be allowed to cool to about 50° C. (122° F.) before they are strained; principles which are soluble only in hot water, are then mostly precipitated and removed without, in most cases, weakening the medicinal effects of the preparations. But, even with this precaution, the strained liquid may become unsightly in appearance by the further deposition, on cooling, of apotheme or matter soluble only in hot water. In such cases the pharmacist should be guided by the directions of the Pharmacopœia, or by the intentions of the physician, and not sacrifice effect to elegance. With some exceptions, decoctions which were formerly made at the house of the patient have gradually fallen into disuse through the introduction of fluid extracts and similar permanent preparations, by which the medicinal properties can be preserved unaltered for months or even years, while decoctions cannot be depended upon for more than one, or, at the utmost, a few days.

It should be mentioned that the French Codex includes decoctions under the heading of *tisanes;* and that the German Pharmacopœia orders all decoctions, unless otherwise ordered by the physician, to be made in the proportion of one part of the drug to ten parts of liquid.

DECOCTUM ALOES COMPOSITUM, *Br.*—Compound Decoction of Aloes.

Tisane (Décocté) d'aloès composée, Fr.; *Zusammengesetztes Aloedecoct*, G.

Preparation.—Take of Extract of Socotrine Aloes one hundred and twenty grains; Myrrh, Saffron, of each ninety grains; Carbonate of Potash sixty grains; Extract of Liquorice one ounce; Compound Tincture of Cardamoms eight fluidounces; Distilled Water a sufficiency. Reduce the extract of aloes and myrrh to coarse powder, and put them together with the carbonate of potash and extract of liquorice into a suitable covered vessel with a pint of distilled water; boil gently for five minutes, then add the saffron. Let the vessel with its contents cool, then add the tincture of cardamoms, and, covering the vessel closely, allow the ingredients to macerate for two hours; finally, strain through flannel, pouring as much distilled water over the contents of the strainer as will make the strained product measure thirty fluidounces. *Br.*

The alkaline carbonate is added for the purpose of aiding the solution of the resinous principles of aloes and myrrh; the tincture of cardamom, saffron, and liquorice act as correctives, the latter serving more especially for partially covering the nauseous taste of the aloes.

Medical Action and Uses.—The active ingredients of this preparation are essentially the same as those of the tincture of aloes and myrrh. It is a useful purgative in numerous cases for which the alcoholic preparation just named would be too stimulant; and it is probable that the permanent solution of its ingredients renders its purgative operation milder, an effect which is enhanced by the liquorice and cardamom it contains. It is an appropriate medicine when purgation is indicated by *amenorrhœa* due to an atonic state of the system, or simply by a torpid state of the bowels with a tendency to hemorrhoidal engorgement. Like the tincture, it is much less used than the corresponding pill (*Pilula Aloes et Myrrhæ*); but it may be prescribed in doses of from half a fluidounce to two fluidounces.

DECOCTUM CETRARIÆ, *U. S.*, *Br.*—Decoction of Iceland Moss.

Tisane (Décocté) de lichen d'Islande, Fr.; *Isländisch-Moos-Absud (Decoct)*, G.

Preparation.—Take of Iceland Moss half a troyounce; Water a sufficient quantity. Boil the Iceland moss in a pint of water for fifteen minutes, strain with compression and add sufficient water, through the strainer, to make the decoction measure a pint. *U. S.*

Take of Iceland Moss one ounce; Distilled Water one pint. Wash the moss in cold water to remove impurities, boil it with the distilled water for ten minutes in a covered vessel, and strain with gentle pressure while hot; then pour distilled water over the contents of the strainer until the strained product measures a pint (imperial). *Br.*

The first process omits the washing of the Iceland moss, which should never be neglected. It is best performed by covering the drug with about 8 times its weight of cold water, and expressing it after half an hour; neither the bitter nor the demulcent principles are removed by this operation. The tisane of the French Codex is made in the proportion of 1 to 100.

Medical Uses.—This is the best form for administering Iceland moss. It retains the bitter principle as well as the demulcent elements of the moss, and it is on the former that the therapeutical qualities of that substance chiefly depend. It should be taken in doses of from two to four ounces three or four times a day.

DECOCTUM CHIMAPHILÆ, *U. S.*—DECOCTION OF PIPSISSEWA.

Tisane de pyrole ombellée, Fr.; *Harnkrautdecoct*, G.

Preparation.—Take of Pipsissewa bruised a troyounce; Water a sufficient quantity. Boil the pipsissewa in a pint of water for fifteen minutes, strain, and add sufficient water, through the strainer, to make the decoction measure a pint. *U. S.*

As a domestic preparation, the decoction is desirable and cannot easily be spoiled, even if made by the inexperienced. Pharmaceutically, the fluid extract appears to be preferable.

Medical Uses.—The medicinal uses of chimaphila are described elsewhere. Of the decoction, a pint or more may be taken in twenty-four hours.

DECOCTUM CINCHONÆ FLAVÆ, *U. S.*, *Br.*—DECOCTION OF YELLOW CINCHONA.

Decoctum Chinæ regiæ.—Tisane (*Décocté*) *de quinquina jaune*, Fr.; *Königs-china-Absud*, G.

Preparation.—Take of Yellow Cinchona bruised a troyounce; Water a sufficient quantity. Boil the yellow cinchona in a pint of water for fifteen minutes, strain, and add sufficient water, through the strainer, to make the decoction measure a pint. *U. S.*

Take of Yellow Cinchona Bark in coarse powder one and a quarter ounce; Distilled Water one pint. Boil for ten minutes in a covered vessel. Strain the decoction when cold, and pour as much distilled water over the contents of the strainer as will make the strained product measure one pint (imperial). *Br.*

The first process yields a turbid preparation from the deposition, after cooling, of cinchonic red and cinchotannate of the alkaloids, which are removed in the second formula by straining *when cold.* The whole of the alkaloids may be kept in solution by the addition of some acid. (See *Infusum Cinchonæ.*)

Medical Uses.—*Dose*, two fluidounces, to be repeated every two, three, or four hours in acute diseases, and three times a day, before meals, as a tonic.

DECOCTUM CINCHONÆ RUBRÆ, *U. S.*—DECOCTION OF RED CINCHONA.

Decoctum Chinæ rubræ.—Tisane de quinquina rouge, Fr.; *Rothe China-Absud*, G.

Preparation.—Take of Red Cinchona bruised a troyounce; Water a sufficient quantity. Boil the red cinchona in a pint of water for fifteen minutes, strain, and add sufficient water, through the strainer, to make the decoction measure a pint. *U. S.*

The remarks made of the preceding apply also to this preparation.

Medical Uses.—*Dose*, two fluidounces. Orange-peel added to the cinchona in preparing either decoction, or the tincture of orange-peel after its preparation, renders its taste less disagreeable, and makes it more acceptable to the stomach.

DECOCTUM CORNÛS FLORIDÆ, *U. S.*—DECOCTION OF DOGWOOD.

Tisane d'écorce de cornouiller, Fr.; *Cornelrinden-Absud*, G.

Preparation.—Take of Dogwood bruised a troyounce; Water a sufficient quantity. Boil the dogwood in a pint of water for fifteen minutes, strain, and add sufficient water, through the strainer, to make the decoction measure a pint. *U. S.*

This preparation contains the bitter and astringent principles of dogwood bark.

Medical Uses.—After the fluid extract it is the best mode of exhibiting dogwood. *Dose*, two fluidounces.

DECOCTUM DULCAMARÆ, *U. S.*—DECOCTION OF BITTERSWEET.

Tisane de douce-amère, F.; *Bittersüss-Absud*, G.

Preparation.—Take of Bittersweet bruised a troyounce; Water a sufficient quantity. Boil the bittersweet in a pint of water for fifteen minutes, strain, and add sufficient water, through the strainer, to make the decoction measure a pint. *U. S.*

Except as a domestic preparation, this, like the preceding, may be considered superseded by the fluid extracts.

Medical Uses.—*Dose*, one or two fluidounces three times a day, gradually increased until some sensible effects are produced. It may be mixed with milk to conceal its nauseous taste.

DECOCTUM GRANATI RADICIS, *Br.*—DECOCTION OF POMEGRANATE ROOT.

Decoctum corticis radicis granati.—Tisane (Décocté) d'écorce de la racine de grenadier, Fr.; *Granat-Wurzel-Rinden-Absud*, G.

Preparation.—Take of Pomegranate Root Bark sliced two ounces; Distilled Water two pints. Boil down to a pint, and strain, making the strained product up to a pint (imperial), if necessary, by pouring distilled water over the contents of the strainer. *Br.*

The tissue of the bark is not firm enough to require so long-continued a boiling.

Medical Uses.—This decoction may be used for all the purposes to which vegetable astringents of moderate power are applied, such as passive *hemorrhages*, and mucous and serous *profluvia*, as a wash for open *sores* accompanied with a profuse discharge, for *relaxed states* of the mouth, vagina, rectum, etc. It is, however, most useful as a *tæniafuge*. For the mode of using it, see *Granati Radicis Cortex.*

DECOCTUM HÆMATOXYLI, *U. S.*, *Br.*—DECOCTION OF LOGWOOD.

Tisane (Décocté) de bois de Campêche, Fr.; *Blauholz-Absud*, G.

Preparation.—Take of Logwood, rasped, a troyounce; Water two pints. Boil down to a pint and strain. *U. S.*

Take of Logwood in chips one ounce; Cinnamon Bark in coarse powder sixty grains; Distilled Water one pint. Boil the logwood in the water for ten minutes in a covered vessel, adding the cinnamon towards the end. Strain the decoction, and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (imperial). *Br.*

A longer continued boiling of logwood in chips would improve the result of the second formula.

Medical Uses.—Although this decoction may be used for most of the internal disorders in which vegetable astringents are indicated, it is chiefly employed internally for the relief of *diarrhœa*, but much less so than its cognate medicines. Its mildness adapts it to the treatment of infantile diarrhœas. It is rendered more efficient by the addition of cinnamon, as in the formula of the British Pharmacopœia, especially when colicky pains are present. The *dose* for an adult is about two fluidounces; for infants and children one or two fluidrachms.

DECOCTUM HORDEI, *U. S.*, *Br.*—DECOCTION OF BARLEY.

Barley water, E.; *Tisane (Eau) d'orge perlé*, Fr.; *Gerstenschleim*, G.

Preparation.—Take of Barley two troyounces; Water a sufficient quantity. Having washed away the extraneous matters which adhere to the barley, boil it with half a pint of water for a short time, and throw away the resulting liquid. Then, having poured on it four pints of boiling water, boil down to two pints, and strain. *U. S.*

Take of Pearl Barley two ounces; Distilled Water a pint and a half (30 ounces). Wash the barley in cold water, and reject the washings; boil the washed barley with the distilled water for twenty minutes in a covered vessel, and strain. *Br.*

The washing of the barley with cold water is intended for the removal of extraneous matters, and the subsequent boiling for a short time insures the removal of any unpleasant odor and taste. By this time the barley will be considerably swollen, and the decoction, when completed, will be of a mucilaginous taste.

Medical Uses.—Barley water, the most ancient of fever drinks, continues to be the most generally employed. Highly nutritious, but extremely digestible, unirritating, tending to promote the *intestinal* and *urinary* secretions, soothing irritation in the *throat* and *air-passages*, barley seems better adapted to these purposes than rice or any other cereal. According to the state of the patient the decoction may be rendered more or less nutritious by longer or shorter boiling. If no contraindication exists it should be sweetened, and flavored with lemon juice.

DECOCTUM PAPAVERIS, *Br.*—Decoction of Poppies.

Tisane de pavot, Fr.; *Mohnkapseln-Absud*, G.

Preparation.—Take of Poppy Capsules bruised two ounces; Distilled Water a pint and a half. Boil for ten minutes in a covered vessel; then strain, and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (imperial). *Br.*

The Pharmacopœia does not direct the removal of the seeds, the oil of which will to some extent remain suspended in the mucilaginous liquid.

Medical Uses.—This preparation is endowed with slight anodyne virtues, and is also emollient in consequence of the oil and mucilage it contains. It has, however, no demonstrable advantage over preparations of flaxseed, slippery elm, and many mucilaginous substances to which oil or glycerin and laudanum have been added. This remark applies particularly to poultices and fomentations.

DECOCTUM PAREIRÆ, *Br.*—Decoction of Pareira.

Tisane de pareira brava, Fr.; *Pareirawurzel-Absud, Grieswurzel-Absud*, G.

Preparation.—Take of Pareira Root sliced an ounce and a half; Distilled Water one pint. Boil for fifteen minutes in a covered vessel, then strain, and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (imperial). *Br.*

Medical Uses.—For the action and uses of this preparation, see *Pareira*. The *dose* of the decoction is one or two fluidounces three or four times a day.

DECOCTUM QUERCÛS ALBÆ, *U. S.*—Decoction of White Oak.

Decoctum quercûs, Br.—*Decoction of oak bark*, E.; *Tisane (Décocté) d'écorce de chêne*, Fr.; *Eichenrinden-Absud*, G.

Preparation.—Take of White Oak bruised a troyounce; Water a sufficient quantity. Boil the white Oak in a pint of water for half an hour, strain, and add sufficient water, through the strainer, to make the decoction measure a pint. *U. S.*

Take of Oak Bark bruised one and a quarter ounce; Distilled Water one pint. Boil for ten minutes in a covered vessel, then strain and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (imperial). *Br.*

The tannin is readily extracted by the boiling water, and the strained liquid will cause precipitates with most salts of the heavy metals, with solutions of alkaloids, etc. Alkaline liquids will hasten the decomposition of the astringent principles.

Medical Uses.—This preparation is seldom administered internally, but may be used to restrain passive *hemorrhages*, and *chronic fluxes* of the bowels and bronchia. Externally it is sometimes employed to control *bleeding* and also *suppuration*, and to diminish excessive local *sweats*, but more frequently to constringe relaxed mucous membranes and lessen their secretion, as in cases of *flaccidity of the uvula, pharynx*, or *larynx, prolapsus* of the *rectum, hemorrhoids*, and *leucorrhœa*. It may be used to promote contraction of the *relaxed skin* of the abdomen, scrotum, etc.; to prevent the formation of *bed-sores*, and the chafing of surgical apparatus, to heal flabby and ill-conditioned *ulcers*, to restrain *gangrene* and prevent its fetor, and finally, in a general bath, to counteract extreme relaxation of the general integument. The *dose* of this decoction is two fluidounces. For external purposes a decoction of twice the officinal strength is preferable.

DECOCTUM SARSÆ, *Br.*—DECOCTION OF SARSAPARILLA.

Decoctum sarsaparillæ.—Tisane de salsepareille, F.; *Sarsaparilla-Absud*, G.

Preparation.—Take of Jamaica Sarsaparilla cut transversely two and a half ounces; Boiling Distilled Water one and a half pint. Digest the sarsaparilla in the water for an hour, then boil for ten minutes in a covered vessel, cool and strain, pouring distilled water, if required, over the contents of the strainer, or otherwise making the strained product measure a pint (imperial). *Br.*

The formula is an improvement on the older ones by which long-continued boiling was directed. The French preparation is made from 6 parts of sarsaparilla to 100 of liquid by first macerating, then heating to boiling, and finally digesting for two hours.

Medical Uses.—The purpose of this preparation is the administration of sarsaparilla without the associate ingredients of the compound decoction. It is, however, very little used. Its *dose* is from two to four fluidounces, three or four times a day.

DECOCTUM SARSAPARILLÆ COMPOSITUM, *U. S.*—COMPOUND DECOCTION OF SARSAPARILLA.

Decoctum sarsæ compositum, Br.—*Tisane (Apozème) sudorifique, Décocté de salsepareille composé*, Fr.; *Zusammengesetztes Sarsaparilla-Decoct*, G.

Preparation.—Take of Sarsaparilla sliced and bruised six troyounces; Bark of Sassafras Root sliced, Guaiacum Wood rasped, Liquorice Root bruised, each a troyounce; Mezereon sliced one hundred and eighty grains; Water a sufficient quantity. Boil in four pints of water for fifteen minutes, then digest for two hours in a covered vessel at about 200°, strain, and add sufficient water, through the strainer, to make the decoction measure four pints. *U. S.*

Take of Jamaica Sarsaparilla cut transversely two and a half ounces; Sassafras Root in chips, Guaiacum Wood Turnings, Fresh Liquorice Root bruised, each one-quarter ounce; Mezereon Bark sixty grains; Boiling Distilled Water one and a half pint. Digest the solid ingredients in the water for an hour, then boil for ten minutes in a covered vessel, cool and strain, pouring distilled water, if required, over the contents of the strainer, or otherwise making the strained product measure a pint (imperial). *Br.*

Much of the oil of sassafras must be lost during the boiling, in following either one of the above processes. The formula of the French Codex is, therefore, preferable, namely, to boil 3 parts of sarsaparilla and 6 parts of guaiacum wood with 100 parts of water, then to add 1 of sassafras and 2 of liquorice root and macerate for two hours. It will be observed that this last is much the weaker preparation, and that mezereon bark is not used in it. The first two are simplified formulas for the *Lisbon diet drink* or *decoctum lusitanicum*, which was formerly much employed. The latter may also be said of *Zittmann's decoction*, of which a *stronger* and a *milder* one are used together. The German Pharmacopœia gives the following directions for preparing *Decoctum Zittmanni fortius:* Take of sarsaparilla root cut 100 parts, digest in water 2600 parts for 24 hours; and add inclosed in a linen bag powdered sugar and alum, each 6 parts; calomel 4 parts, and cinnabar 1 part; then heat in a covered vessel placed in a steam-bath for three hours, stirring frequently; and, near the end of the boiling, add anise and fennel bruised each 4 parts, senna cut 12 parts, and liquorice root cut 12 parts. Express, strain, set aside for some time, and decant to obtain 2500 parts of clear liquid. 2500 grams of this are to be divided into 8 parts. *Decoctum Zittmanni mitius:* Take the residue left from the preceding and 50 parts of sarsaparilla, heat with water 2600 parts for three hours in a covered vessel placed in a steam-bath, stirring frequently, and when near the end of the boiling add lemon peel, cinnamon, cassia, cardamom, and liquorice root, each, cut and bruised, 3 parts. Express and operate as before to obtain 2500 parts.

Medical Uses.—The resin of guaiacum contained in this formula being insoluble in water, the virtues of the preparation must be chiefly due to the sarsaparilla and mezereon slightly reinforced by the sassafras, which, also, with the liquorice, serves to mask the acrid flavor of the mezereon. It is chiefly employed in the treatment of chronic *rheumatism*, *scrofula* of the bones, chronic *cutaneous diseases*, and above all constitutional *syphilis*. Whatever good it effects is due to its promoting the secretions of the skin and kidneys (see Sarsaparilla). The *dose* is four or five fluidounces three or four times a day.

DECOCTUM SCOPARII, *Br.*—DECOCTION OF BROOM.

Tisane de genêt à balais, Fr.; *Besenginster-Absud*, G.

Preparation.—Take of Broom Tops dried one ounce; Distilled Water one pint. Boil for ten minutes in a covered vessel, then strain and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (imperial). *Br.*

Medical Uses.—The decoction of broom is apt to excite irritation of the kidneys and urinary passages, and decidedly to increase the quantity of urine. It is the best form in which broom can be administered for the removal of *dropsical effusions*. It should be given in doses of two fluidounces repeated at intervals, so that from half a pint to a pint may be taken during the day. A compound decoction may be prepared by boiling broom tops, dandelion, and juniper berries, of each half an ounce, in a pint and a half of water, to a pint. *Dose*, one or two fluidounces.

DECOCTUM SENEGÆ, *U. S.*—DECOCTION OF SENEKA.

Tisane de polygale de Virginie, Fr.; *Senegawurzel-Absud*, G.

Preparation.—Take of Seneka bruised a troyounce; Water a sufficient quantity. Boil the seneka in a pint of water for fifteen minutes, strain, and add sufficient water, through the strainer, to make the decoction measure a pint. *U. S.*

Seneka root is easily extracted by hot water; the boiling might, with propriety, be shortened and partly replaced by digestion. The British Pharmacopœia directs an infusion instead of a decoction.

Medical Uses.—The decoction of seneka is, in most cases, preferable to the alcoholic preparations of the drug, as being more apt to promote the mucous secretions, and especially those of the bronchia. The *dose* of the decoction is about two fluidounces.

DECOCTUM TARAXACI, *Br.*—DECOCTION OF DANDELION.

Tisane de pissenlit, Fr.; *Löwenzahnwurzel-Absud*, G.

Preparation.—Take of Dried Dandelion Root sliced and bruised one ounce; Distilled Water one pint. Boil for ten minutes in a covered vessel then strain and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (imperial). *Br.*

Dandelion root, if properly cut and bruised, is readily extracted by hot water.

Medical Uses.—This preparation represents all the virtues of taraxacum, and is the most suitable mode of exhibiting the medicine. As it is apt to ferment, it should be freshly made when used. The *dose* is about two or three fluidounces, and should be taken about half an hour before meals. Its efficacy is increased by simple bitters, such as gentian and colombo, or by a little orange peel added near the end of ebullition.

DECOCTUM ULMI.—DECOCTION OF ELM BARK.

Décocté d'orme, Fr.; *Ulmenrinden-Dekokt*, G.

Preparation.—Take of Elm Bark cut in small pieces two and a half ounces; Distilled Water one pint. Boil for ten minutes in a covered vessel, then strain and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (imperial). *Br.*

Medical Uses.—The infusion of this elm bark is mucilaginous, bitter, and astringent. It is probably not used in this country. The *dose* is from two to four fluidounces.

DECOCTUM UVÆ URSI, *U. S.*—DECOCTION OF UVA URSI.

Tisane de busserole, Fr.; *Bärentraubenblätter-Absud*, G.

Preparation.—Take of Uva Ursi a troyounce; Water a sufficient quantity. Boil the uva ursi in a pint of water for fifteen minutes, strain, and add sufficient water, through the strainer, to make the decoction measure a pint. *U. S.*

This, like the decoction of chimaphila, is a desirable domestic preparation, but is rarely made by the pharmacist.

Medical Uses.—This is by far the best preparation of uva ursi, not even excepting the fluid extract. The average *dose* may be stated at a fluidounce, which, in cases of urinary disorders at least, should be repeated sufficiently often to prevent its action upon the affected organs from becoming intermittent.

DELPHINIUM, *U. S.*—LARKSPUR SEED.

Semen consolidæ s. consolidæ regalis s. calcatrippæ.—*Semence de pied d'alouette*, Fr.; *Rittersporn-Samen*, G.

The seed of Delphinium consolida, *Lin.*

Nat. Ord.—Ranunculaceæ, Aconiteæ.

Origin.—Larkspur is a glabrous annual herb, which is a common weed in the grain fields of Central Europe, is often met with as an ornamental plant in gardens, and has been naturalized in some parts of the United States, from Pennsylvania to Virginia. It has the leaves dissected into narrow linear lobes, and its purplish-blue (in cultivation sometimes whitish) flowers are in loose terminal racemes. The 5 sepals are petal-like, the upper one produced into a spur; the petals united, with two spurs inclosed in the calyx spur; the pistil is single, the pod many-seeded.

Description.—The seeds are quite small, about $\frac{1}{16}$ inch in diameter, irregularly triangular, pointed, rough, and pitted upon the surface, with a black testa and a whitish nucleus consisting of an oily albumen and a small straight embryo. They are inodorous, and have a bitter, burning, and biting taste.

All parts of the plant have the taste described and probably contain the same active principle. Formerly, the root was officinal, but has been very properly discarded. The same fate must probably await the seeds; we have, at least, noticed that they are very rarely met with in the drug trade, the seeds of

DELPHINIUM STAPHISAGRIA, *Lin.* (Bentley and Trimen, Med. Plants, 14), being very generally sold in place of the former. This is a taller hairy herb, indigenous to Southern Europe and Asia Minor, has the leaves palmately 5- to 9-lobed, the purplish flowers situated in the axils of leafy bracts, and the 3 erect hairy follicles containing about 12 seeds each. The seeds are much larger than the preceding, $\frac{1}{6}$ to $\frac{1}{8}$ inch broad, triangular or somewhat quadrangular, one side convex, and the brown, afterwards brown-gray testa covered with flattish depressions, the intervening ridges forming net-like meshes. They have a faint narcotic odor. The appearance and taste of the nucleus resemble those of the preceding. They were formerly known as *Semina staphidis agriæ s. pedicularis.*—*Stavesacre*, E.; *Staphisaigre*, Fr.; *Stephanskörner*, *Läusekörner*, G.

Del. consolida is said to have received its specific name from the supposed power of its flowers of healing or consolidating wounds. The *consoude* of the French is comfrey.

Constituents.—Larkspur seeds probably contain the same constituents as stavesacre. Thos. C. Hopkins (1839) isolated *delphinia* or *delphia*, which, in 1819, was discovered in stavesacre by Lassaigne and Feneulle and simultaneously by Brandes. Couerbe (1833) separated a second alkaloid, *staphisaina.* The alcoholic extract of the seeds is exhausted with cold acidulated water, the solution precipitated by an alkali, the precipitate dissolved in boiling alcohol, the solution treated with animal charcoal and evaporated; this is taken up by acidulated water, freed from resin by a little nitric acid, again precipitated by an alkali, and the mixed alkaloids separated by ether, which dissolves white delphinia, $C_{24}H_{35}NO_2$. Staphisaina, $C_{16}H_{23}NO_2$, is yellow amorphous; both alkaloids are very acrid.

Among the other constituents of both seeds is a considerable proportion of fixed oil. Wicke (1854) found *aconitic acid* in the herb of larkspur.

The indigenous species Del. exaltatum, *Ait.*, and D. azureum, *Mich.*, probably possess similar virtues.

Medical Action and Uses.—The officinal plant, or larkspur, of which the flowers, as well as the seeds, have been employed in medicine, and also the tall larkspur (*D. exaltatum*) appear to possess acrid and irritant qualities, and in large doses to excite vomiting and purging. They have been used in the treatment of *dropsy* and spasmodic *asthma*, generally in the form of a tincture, which has also been much employed as a lotion, or in an ointment, for the destruction of *lice.* These effects are due to the alkaloid *delphinia*, which has also been obtained from *D. staphisagria.* It has an acrid, hot taste, irritates the fauces, and is emetic and purgative. Given to dogs, delphinia, besides vomiting and purging, occasions anæsthesia, great prostration, and death preceded by convulsions. The gastro-intestinal mucous membrane is inflamed. In an ointment and rubbed upon the skin, it causes a burning and prickling sensation, and a transient redness such as veratria occasions. It has been used with reputed success in the local treatment of *neuralgia*, by applying it over the superficial sensitive points of the affected nerves. *Earache* and *toothache* have also been relieved by it. The *dose* of delphinia is stated to be half a grain repeated at intervals of three or four hours. A solution of from sixteen to thirty grains of the alkaloid in an ounce of alcohol may be used as a liniment; and an ointment may contain from ten to forty grains of delphinia to an ounce of lard.

DIGITALINUM, *U. S.*, *Br.*—DIGITALIN.

Digitaline, Fr.; *Digitalin*, G.

Preparation.—Take of Digitalis in moderately fine powder forty-eight troyounces; Stronger Alcohol six pints; Acetic Acid half a fluidounce; Purified Animal Charcoal one hundred and eighty grains; Tannic Acid two hundred grains or a sufficient quantity; Oxide of Lead in fine powder one hundred and twenty grains; Stronger Ether a fluidounce; Water of Ammonia, Diluted Alcohol, Distilled Water, each a sufficient quantity. Mix the stronger alcohol with two pints of distilled water, moisten the digitalis with a pint of the mixture, and put it in a conical percolator; pour on two pints of the mixture, and when the liquid begins to drop from the percolator, close the lower orifice with a cork, and, having closely covered the percolator to prevent evaporation, set it aside in a moderately warm place for four days. Then, having removed the cork, gradually pour on, first the remainder of the mixture, and then diluted alcohol until a gallon of tincture has been obtained. Distil off six pints and a half, add to the residue the acetic acid, and one hundred and twenty grains of the animal charcoal, set aside for twenty-four hours, and filter; to the filtered liquid add water of ammonia until the acid is almost neutralized, then add the tannic acid, previously dissolved in half a pint of distilled water, until it ceases to produce a precipitate; collect this upon a filter, wash it with a little distilled water, mix it with the oxide of lead, and dry the mixture carefully. Rub the residue to powder, mix it with the remainder of the animal charcoal, and digest with three ounces of stronger alcohol, for one hour, at a temperature of 160° F.; transfer the mixture to a small filter, wash the insoluble portion with three ounces of warm stronger alcohol, evaporate carefully to dryness, rub the residue into powder, and wash it twice with the ether, using one-half each time. Lastly, dry it carefully, and preserve it in a well-stopped bottle. *U. S.*

This process is nearly identical with that of the British Pharmacopœia, and is essentially the same as proposed by O. Henry (1845). Many attempts had been made to isolate the active principle of digitalis before Homolle (1844) succeeded in obtaining a purer product, like the present officinal one, by a process which is officinal in France, and consists in precipitating from the cold prepared aqueous infusion, gummy and coloring matter, by subacetate of lead, removing the excess of lead by carbonate of sodium, precipitating with tannin, and treating further in a manner somewhat similar to the preceding process.

Properties.—The officinal digitalin forms a white or yellowish-white powder, or it may be obtained in porous mammillated masses or scales. It is inodorous, and has an intensely bitter taste, is soluble in alcohol, but almost insoluble in water and in ether. It dissolves slightly in dilute acids without neutralizing them; its solution in concentrated muriatic acid is yellowish; but rapidly becomes green, and after some time deposits a green powder. Its dust is irritating and sternutatory. Heated upon platinum foil it burns with a sooty flame, finally leaving no residue.

The readiness with which the active principle of digitalis as it exists in the plant is altered has been repeatedly pointed out. The properties given by both the British and United States Pharmacopœias are those mentioned by Homolle and Quevenne, and by the French Codex for a digitalin, prepared by the process of which a brief outline is given above. But the process adopted by the two Pharmacopœias is that of Henry, which yields a different product. Lefort (1864) pointed out that two kinds of digitalin are in the market, namely, *French* or *insoluble digitalin*, which is that of Homolle, and *German* or *soluble digitalin*, which is readily soluble in water, also in concentrated hydrochloric acid, the solution becoming yellow, brown, and finally a dull green; exposed to the vapor of hydrochloric acid it turns brown, while insoluble digitalin turns green. Soluble digitalin is made in Germany by processes analogous to that of Henry, and by modifications as suggested by G. F. Walz in his investigations of digitalis (1851 to 1858). Kosmann recently (1875) endeavored to explain the discrepant results as follows: The soluble active principle of digitalis has been named by various authors *digitasolin*, *digitaletin*, and *digitalin;* it is, $C_{27}H_{45}O_{15}$, a compound of one molecule of digitalretin and two of glucose, and is readily altered even in the plant by saline and acid bodies, and converted into glucose and *insoluble digitalin* (*digitaletin* of Walz), which is $C_{21}H_{33}O_9$, and represents one molecule each of digitalretin and glucose. Both digitalins are very bitter and energetic medicinal agents. By the further action of hot dilute acids insoluble digitalin is split into glucose and *digitalretin* (*paradigitaletin*), $C_{15}H_{25}O_5$, which is slightly bitter, is soluble in alcohol, slightly in ether, but insoluble in water and alkalies. The continued action of dilute acids results in the production of *dehydrated digitalretin*, $C_{15}H_{21}O_3$, which is resin-like, insoluble in water, soluble in alcohol, ether, and ammonia water, and has an acrid taste; it has likewise been called *paradigitalein.* Kosmann considers Nativelle's *crystallized digitalin* as being intermediate in composition between insoluble digitalin and digitalretin.

Nativelle's process (1874) is as follows: 1000 grams of powdered digitalis leaves are macerated for 24 hours in a solution of 250 grams of acetate of lead in 1000 grams of water, then displaced with 50 per cent. alcohol, the percolate treated with 40 grams of sodium bicarbonate, and distilled and evaporated to 2000 grams; when cool it is mixed with 2000 grams of water, and after several days decanted. The precipitate is drained, pressed, mixed with 1000 grams of 80 per cent. alcohol, and heated to boiling; 10 grams of neutral lead acetate are added, the boiling continued for a few minutes, and when cool the liquid is filtered. The filtrate is mixed with 50 grams powdered wood-charcoal, and distilled, the charcoal exposed to expel the alcohol, drained, dried, and percolated with chloroform. The impure digitalin left on evaporation is dissolved in 100 grams of 90 per cent. alcohol, the solution mixed with a concentrated solution of 1 gram of lead acetate and with 10 grams of granular animal charcoal, boiled for a few minutes, cooled, filtered and distilled. The granular crystals are drained, dissolved in 10 grams of hot alcohol; 5 grams of ether and 15 grams of water are added, and the whole well shaken together. The ether removes a colored fixed oil, and crystalline digitalin is deposited, which, if necessary, is again subjected to the same process of purification. It crystallizes from hot alcohol in the form of white slender brilliant needles.

Physiological Action and Medical Uses.—Comparative experiments and observations have rendered it probable that not only is digitalin a compound substance, but that in the nature of its action it does not differ from that of the other active components of digitalis, or digitalis itself (vid. Digitalis). The extremely variable proportion of digitalin in the preparations sold under that name prevents it from being a reliable medicine. The average *dose* is one-fiftieth of a grain.

DIGITALIS, *U. S.*—DIGITALIS.

Digitalis folia, Br.; *Folia digitalis*, P. G.—*Digitalis leaves, Foxglove leaves*, E.; *Feuilles de digitale pourprée* (*de grande digitale*), Fr.; *Fingerhutkraut*, G.

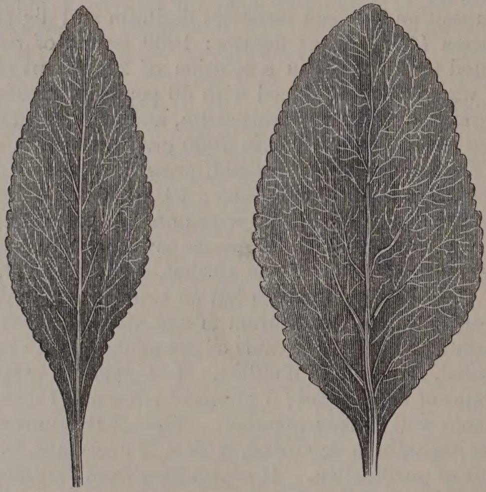
The leaves of Digitalis purpurea, *Lin.* (D. tomentosa, *Link* and *Hoffm.*). Woodville, Med. Bot., plate 24; Bentley and Trimen, Med. Plants, 195.

Nat. Ord.—Scrophulariaceæ.

Origin.—Foxglove is a biennial plant, indigenous to Southern and Central Europe, particularly in the western section, and grows wild as far north as Norway, likewise in Madeira and the Azores. It is found on the edges of woodlands and thickets, in rather sandy soil, and is generally absent from calcareous districts. It is well known as an ornamental garden plant. The stem is two to five feet high, has alternate leaves, and a long terminal raceme of handsome purplish-crimson and tubular bell-shaped flowers, producing an ovoid capsule with numerous small seeds. The leaves should be collected from wild plants when about two-thirds of the flowers are expanded. F. Schneider (1869) found the radical leaves collected in September of the first year to be very efficacious.

Description.—The radical leaves are 6 to 12 inches long, ovate or oblong-ovate, rather obtuse, at the base contracted into a winged petiole 4 to 6 inches long. The margin is rather irregularly doubly crenate, the upper surface is wrinkled, dull green, and soft, downy; the lower surface is of a grayish color, densely pubescent, and prominently reticulate; the midrib is broad towards the base, and of a slight purplish tint. The stem leaves are gradually reduced in size, and upon shorter petioles, the uppermost being sessile, oblong lanceolate, and obscurely crenate. The dried leaves have a faint tea-like odor and a bitter rather disagreeable taste. In cultivation the plant usually becomess less hairy, and the radical leaves of the first year's growth are usually narrower and more oblong lanceolate in outline.

Fig. 58.



Digitalis purpurea, *Lin.*—Leaf of the first and of the second year's growth.

Constituents.—*Digitalin* is the medicinally active principle of the leaves (see page 500), and is supposed to be contained also in the seeds of digitalis; obtained from the latter, Delffs found it to have the composition $C_{17}H_{30}O_7$, and to be colorless, crystalline, readily soluble in alcohol, ether, or chloroform, and not colored by concentrated mineral acids. Schmiedeberg has recently (1875) obtained *digitoxin*, another active principle, from the leaves previously exhausted by water; it is entirely insoluble in water, benzol, or carbon bisulphide, very sparingly soluble in ether, slowly in chloroform, and readily in alcohol; its composition is $C_{31}H_{33}O_7$. It is not a glucoside, but acids convert it into *toxiresin*, which, like digitoxin, has a powerful action on the heart. Schmiedeberg examined also a commercial digitalin made from the seeds, and found in it *digitonin*, *digitalin* (Kosmann's insoluble digitalin?), and *digitalein*. The latter is soluble in chloroform, which does not dissolve digitonin, otherwise the two substances resemble each other; these bodies are readily altered under various circumstances, and their relation to each other and to the active principle or principles naturally contained in the plant must be left to further careful investigation. Duffield (1868) obtained by the officinal process 0.8 to 0.9 per cent. of digitalin from European and American digitalis leaves.

W. Engelhardt (1862) obtained a physiologically active volatile alkaloid from the leaves; it was also noticed by F. F. Mayer in the leaves, but not in the extract of digitalis. An acrid principle, *scaptin*, was obtained by Radig (1835) in a very impure state, and purer by Walz (1858) as *digitalacrin*. Walz (1852) separated *digitalosmin*, a pearly acrid stearopten of the odor of digitalis. Morin's (1845) *antirrhinic acid* likewise possesses some odor. The *digitoleic acid* of Kosmann and *digitaloic acid* of Walz are volatile and fatty and probably identical.

The other constituents of digitalis are not of medicinal or pharmaceutical importance.

Adulterations and Substitutions are said to have occasionally occurred; but the physical characters of digitalis leaves are so marked, that they cannot easily be confounded with other leaves, even if they are in a broken condition; the rugose upper surface, the crenate margin, and the densely pubescent lower surface, with its well-defined meshes of white prominent veins, are not met with in any other officinal leaf. As accidental impurities have been mentioned, the nearly smooth leaves of *Digitalis ochroleuca*, Jacq., the stellately hairy and mucilaginous leaves of species of *Verbascum*, and the nearly entire, obscurely reticulate, and upon the upper side rough leaves of *Conyza squarrosa*, Lin., and *Symphytum officinale*, Lin.

Off. Prep.—Digitalinum, *U. S.*, *Br.;* Extr. digitalis, Extr. digitalis fluid., *U. S.;* Infusum digitalis, Tinctura digitalis, *U. S.*, *Br.*

Physiological Action. *On Plants and Animals.*—Plants watered with an infusion of digitalis wither and die. Fish placed in a weak infusion of the plant die in spasm, with the ventricle of the heart contracted. Digitalin used hypodermically in frogs occasions a tetanoid rigidity of the muscles and an irregular tonic contraction of the left ventricle of the heart, with slowness and unsteadiness of its rhythm. The auricle does not seem to participate in this action of the ventricle, but becomes distended as the capacity of the ventricle diminishes. At the same time the pulse-rate declines, and the blood-pressure increases. But if the dose of digitalis has been directly poisonous, the pulse-rate rises, and the blood-pressure diminishes. Toxical doses of digitalis given to birds, dogs, and other animals, occasion active intestinal irritation, with watery or bloody dejections. Carnivorous animals are, more readily than the herbivorous, poisoned by this agent.

The action of poisonous doses of digitalis and its preparations upon the circulatory system, as illustrated by experiments upon animals, consists of first an increase usually both of the rate and force of the pulse, while the action of the heart is strong and abrupt and sometimes accompanied by a murmur. But sometimes the primary operation reduces the number of the pulsations while augmenting their force. There is no evidence that the volume of the pulse is increased; on the contrary, it denotes the circulation of a diminished amount of blood. Indeed, experimental investigation has demonstrated that large doses of digitalin produce a marked contraction and even a complete closure of the capillary vessels, a condition which necessarily involves an increased blood-pressure in the larger arteries. At the same time the heart's diastole is lengthened, it may be to fourfold the normal duration; and this it is that causes the characteristic retardation or infrequency of the pulse. The mechanism by which this effect is produced is ascribed to a primary stimulation and a subsequent paralysis of the inhibitory nerve of the organ, and irritation of the motor nerves. After a lethal dose of digitalin the heart is found in diastole, and will not contract under the strongest galvanic stimulus. Respiration follows the circulation in its changes, becoming infrequent when the pulse is slow, and hurried when the pulse is rapid. The temperature of the body is not materially affected, nor uniformly in the same manner. The intrinsic diuretic action of digitalis seems to have been asserted by nearly all the earlier experimenters, but more prolonged and accurate observations prove that no such operation belongs to it.

On Man.—The symptoms produced by digitalis have been described in substantially the same terms by nearly all observers. The following, recorded by Koppe, is the most recent and complete in its details: In about an hour after taking two milligrammes ($\frac{1}{33}$ gr.) of *digitoxin* he began to experience malaise, depression, faintness, nausea, and repugnance to food; in three or four hours the pulse fell from 80 to a point varying between 30 and 58; nausea was intense and indescribably distressing, and only momentarily relieved by a profuse vomiting of dark green bile, and later of yellow bile; the pulse was intermittent, the features pale and collapsed. In seven or eight hours prostration was so extreme that without assistance it was impossible to stand; vision was so confused by an indefiniteness of outline that familiar objects and persons were not recognized, but the latter were known by their voices, and the whole field of vision was yellow. During the night bilious vomiting recurred at intervals, and was excited even by iced champagne. The following day the same symptoms continued; the pulse was 54 and intermittent, with a sense of præcordial sinking, and the sphygmographic tracing showed diminished force of the pulse with inequality. The second night was disturbed with restlessness and nightmare. On the third day small quantities of water were retained, but the vision and the pulse remained as before. It was not until the fourth day that the experimenter was able to walk leaning on a friend's arm, and that the disorder of vision gradually subsided; sleep, which now was refreshing, and an almost voracious appetite, enabled him speedily to renew his strength. In other cases in which digitalis or digitalin has been taken in excessive doses, the symptoms were essentially the same as these.

As regards the heart, digitalis and its preparations in small doses primarily increase the pulse-rate and tension, and, if continued, lower the rate without diminishing the tension. It is an error to suppose that the increased force of the arterial blood-current, as measured by the dynamometer, denotes an increased volume of that current; on the contrary, the arteries and the heart both experience tonic contraction under the influence of digitalis, and the supply of arterial blood is everywhere diminished. That digitalis does not give a real increase of power to the heart is shown by the fact that, when the pulse-rate is slowest, a comparatively slight muscular exertion, such as changing the recumbent for the erect posture, will sometimes cause the pulse to rise from the lowest point reached under the influence of the medicine to one far above the normal rate. The tendency to rigid muscular contraction does not affect all the heart muscles in an equal degree, but chiefly those of the left ventricle. It is this power which, in certain cases of positive or relative debility of that ventricle, renders the medicine a valuable remedy, while its action is maintained within certain bounds; but beyond these it tends to obstruct the cardiac circulation, and, by suddenly preventing the free passage of blood through the heart, to cause death by syncope.

Digitalis is totally devoid of diuretic properties. The cases which led to a belief in its possessing them were those in which a diminished secretion of urine was produced by obstructive heart disease with positive or relative debility of that organ. In a healthy state of the heart digitalis diminishes the amount of urine secreted, as well as the proportion of solid excrementitious matter contained in it. There is no reason to suppose that by its direct operation it stimulates any one of the functions. It certainly, in doses which exhibit its physiological operation, depresses the entire nervous system, impairs the digestion, diminishes urination, lowers the animal temperature, retards the respiration, and may for the time annihilate the activity of the genital organs. Its diuretic action, which is the strongest ground of its claim to worth as a medicine, appears then to be altogether indirect.

Medical Uses.—As was just stated, the diuretic virtues of digitalis are the most conspicuous; and long before its mode of action had been experimentally investigated, it was established as the most efficient remedy for *dropsy* depending upon diseases of the heart, or upon that form of renal disease which consists of congestion and tubal obstruction. On closer examination of the former affections, those which produced dropsy by hindering the cardiac circulation, more particularly valvular obstruction, and notably stenosis of the mitral valve, and weakness of the heart-muscle, were found to be most readily relieved by this medicine. By rendering the action of the heart more tranquil and regular, and producing contraction of the capillary arteries, the venous congestions which directly occasion dropsy are removed, and the absorption of the effused liquid necessarily follows. The mechanism of this effect is, not improbably, as follows: "The contraction of the capillaries causes a greater quantity of blood to accumulate in the arteries, the difference of pressure between the arteries and veins will increase in favor of the former, and the blood will rush through the capillaries at a greater pace, and, owing to the pressure within the veins being lessened, the dropsical effusions will return to the venous system, and at the same time the watery constituents of the blood will increase, and cause great diuresis." (Ackermann.) On the other hand, dropsy depending upon a congested state of the kidneys, and due to the prevented escape of water through those emunctories, is apt to be cured by digitalis, which then probably acts by contracting the renal capillaries, thereby lessening the engorgement which prevented their normal secretion from taking place. In general dropsy of whatever form, debility of the circulation, whether it be due to cardiac embarrassment or to renal obstruction, is the essential condition for securing the diuretic operation of digitalis.

Certain heart lesions which give rise to dropsy also occasion various other phenomena, for which in the same manner digitalis offers the surest hope of relief. *Dilatation*, slight muscular *degeneration*, and *mitral obstruction* and *insufficiency* are those whose effects are most favorably influenced by digitalis, which renders the irregular heart rhythmical in its movements, and gives a tonic contractility to the flaccid muscle. But this very power is not without its danger if the weakness of the heart is excessive, especially through fatty degeneration. To slow the heart when its muscular structure is greatly impaired is to add to its embarrassment. To slow it when its muscle is hypertrophied is to counteract the conservative agency by which the hypertrophy was established; as in cases of aortic obstruction or insufficiency, or of both united. So long as the heart's movements are not arhythmical, or do not tend to become so during excitement of the organ, there is no indication for the use of digitalis. Whenever the rhythm of the heart is perverted, and at the same time the arterial system is deficient in blood while the veins are overloaded with it, as shown by the feeble and usually irregular pulse, the dropsical limbs, the difficult breathing, the discolored face, and perhaps bloody expectoration and scanty urine, digitalis is clearly indicated; but its administration must be cautiously adjusted and its operation watched.

The false and absurd theory, according to which the treatment of *fever* should consist of means tending directly and solely to reduce the pulse-rate, has been illustrated by the use of digitalis in *typhoid fever.* Even its advocates have not shown that it abridges the disease or lessens its mortality, while it is abundantly demonstrated to impair the digestion, reduce the strength, and even to occasion sudden death. The use of digitalis in other forms of fever is equally unsatisfactory, and justifies the judgment of Traube, that the true field of action for digitalis is not fever. The recent use of digitalis in fever is only a revival of the old application of it by Rasori to the treatment of *inflammations;* the latter has also been employed by some who were perhaps ignorant of the history of its vogue and of its condemnation. The results of its revival have been to prove that digitalis does not in the least modify favorably any acute inflammation, and especially pueumonia, pleurisy, and pericarditis; but that, on the contrary, it exposes the patient to the risk of sudden death. The only inflammatory affection in which it may be advantageously used is chronic *bronchitis*, with profuse secretion, which is often confounded with consumption. There is no doubt that in this disease it has been found to lessen the pulmonary congestion and secretion, and thereby the dyspnœa, sweating, and wasting of strength which they cause. There is good reason for believing that certain forms of *hemorrhage* may be controlled by digitalis, more particularly uterine hemorrhage, whether due to congestion, vascular relaxation, or to organic diseases of the uterus. Its utility in *pulmonary hemorrhage* is less demonstrable. The mode of action of digitalis in these cases may be presumed to be analogous to that of ergot, viz., by causing contraction of the arteries. The same mode of action may be attributed to the medicine in the case of *delirium tremens*, in which it is reputed to be highly efficient if given in large doses, such as half a fluidounce of the tincture, and even as much as twenty-eight fluidrachms. More frequently, however, doses of one or two fluidrachms, repeated every three or four hours, have been employed. It would appear that there is something in this affection which insures a singular toleration of the medicine. But the necessity of using it at all, and thereby incurring a risk which experience has shown to be occasionally a fatal one, is not apparent in relation to a disease which nearly always recovers under judicious hygienic treatment, when the patient's constitution is sound. The anaphrodisiac virtue of digitalis has been found useful in preventing *erections of the penis* due to local irritation, and also nocturnal *seminal emissions*, and other effects of genital excitement.

Digitalis has been used as a local application to promote the resolution of *enlarged glands*, and also in infusion or tincture applied to the abdomen, especially in cases of *renal dropsy*. In the former case iodine is preferable, and in the latter the medicine should rather be given internally.

Administration.—Digitalis is given in doses of one or two grains twice or thrice daily, until its effects begin to appear, when it should be at once suspended. The infusion or the tincture is preferable, and of these the former is by far the most efficient. Poisonous effects are to be met by wine, opium, and strong coffee. Tannin is recommended as a chemical antidote. If a poisonous dose has been recently swallowed, ipecacuanha, mustard, and other prompt emetics should be administered.

DIOSCOREA.—WILD YAM.

The rhizome of Dioscorea villosa, *Lin.* *Nat. Ord.*—Dioscoreaceæ.

Origin.—Wild yam is a diœcious climbing perennial, growing in thickets in moist localities of the United States south to Florida and west to the Mississippi.

The leaves are alternate, opposite or whorled, broadly ovate-cordate, acuminate, nine to eleven-ribbed, nearly smooth above, downy and paler beneath. The fruit is a triangular-winged capsule growing in pendulous bunches.

Description.—The rhizome is horizontal, about ½ inch thick, somewhat flattened above, repeatedly forked or branched and bent, 6 inches or more in length, on the lower side with distant simple wiry rootlets from 2 to 4 inches long. The rhizome is externally of a pale yellowish-brown color, and breaks with some difficulty, showing internally a compact white tissue with numerous scattered yellowish wood bundles. It is inodorous, and has a taste at first insipid, and afterwards strongly acrid. In Virginia it is known as *rheumatism root.*

Constituents.—Wild yam contains much starch. The acrid principle has not been isolated; it appears to be gradually altered on boiling the rhizome with water.

Other Species.—Most species of dioscorea which are indigenous and cultivated in the East and West Indies, and in other tropical countries, have large farinaceous edible tubers, which are known as *yam*, E., G.; *igname*, Fr. The following are the most important: D. ALATA, *Lin.*, *White negro yam;* D. TRIPHYLLA, *Lin.*, *Buck yam;* D. TRIFIDA, *Lin.*, *Indian yam;* D. BULBIFERA, *Lin.*, *Ceylon white yam;* and D. SATIVA, *Lin.*, *Common yam.*

Medical Action and Uses.—Time has not added to our knowledge of the medicinal qualities of wild yam more than it has done in the case of many other indigenous plants which were long ago reputed to be valuable medicines; we are, therefore, compelled to repeat, without addition or modification, the old-time statement that, according to Riddell, "a decoction of it is eminently beneficial in bilious colic," and that Dr. Neville "places much reliance on the tincture as an expectorant, and also that it acts as a diaphoretic, and in large doses as an emetic." If these statements are correct, it may be assumed that dioscorea has some of the qualities of ipecacuanha. The resin precipitated by water from the tincture is said to produce analogous effects to those just enumerated.

DIOSPYROS, *U. S.*—PERSIMMON.

Fruits de plaqueminier de Virginie, Fr.; *Persimmonfrüchte*, *Dattelpflaumen*, G.

The unripe fruit of Diospyros Virginiana, *Lin.* *Nat. Ord.*—Ebenaceæ.

Origin.—The persimmon tree is indigenous to the United States, and grows in woodlands, in low grounds, and along streams from the New England States west to Illinois, and in the Southern States. It attains a height of 50 to 60 feet, is irregularly branched, has nearly smooth, subcoriaceous, ovate-oblong leaves, and produces in May and June axillary and solitary fertile flowers with 8 stamens and clustered sterile flowers with 16 stamens. The fruit ripens in November, but should be collected not later than October, while green.

Description.—The fruit is a globular berry about an inch in diameter, with a short foot-stalk, and the permanent four-lobed calyx at the base, green, smooth, and 4 to 6-celled, each cell containing a single flat ovate-oblong seed. The unripe persimmon has a pleasant but weak odor, and contains a viscid juice of a very astringent taste, which is retained when carefully dried, but becomes acidulous sweet after the fruit has been exposed to the frost.

Constituents.—B. R. Smith (1846) found the unripe fruit to contain tannin, malic acid, and sugar. J. E. Bryan (1860) detected also pectin, and regards the tannin as distinct from the tannin of galls. Charropin (1873), however, considers it identical with the latter, and isolated also a yellow coloring matter, which is insoluble in water but readily soluble in ether.

The ripe fruit is edible. Mixed with flour, a pleasant bread or cake is made of it. When kneaded with half its measure of wheat-bran, and well baked in an oven, a bread is obtained, which, in the Southern States, is preserved for making *persimmon beer*, by fermenting it with some hops. Such beer is also made from the fresh fruit, and by distillation alcohol may be obtained.

The larger fruit of *Diospyros embryopteris*, Pers., is very astringent in its unripe state, and used in India like persimmon.

Medical Action and Uses.—The unripe fruit, and also the inner bark, are astringent and bitter, and are used, like other products of the same nature, in the treatment of chronic and subacute *diarrhœa*, *leucorrhœa*, *sore throat*, and *uterine hemorrhage*. It is also sometimes used as a tonic and febrifuge. The most convenient preparation is an infusion, or a vinous tincture, which may be made by percolation with an ounce of the dried unripe fruit or bark to half a pint or less of the menstruum. It may be prescribed in doses of from half an ounce to two fluidounces.

DIRCA.—LEATHERWOOD.

Dirca palustris, *Lin.* *Nat. Ord.*—Thymelaceæ.

Description.—The leatherwood, also called *moosewood*, *ropebark*, and, in New England, *wicopy*, grows in rich damp woods from South Carolina northward to Canada, and is a much-branched shrub about four feet high, with the branches apparently jointed, and with soft white and brittle wood. The smooth yellowish-brown or brown-gray bark is very fibrous, and remarkably tough, hence the common names. The leaves are alternate, about three inches long, subsessile, oval-obovate, acute at each end, pale green and slightly hairy beneath. The flowers precede the leaves, are in clusters of two to four, have a light-yellow, tubular funnel-shaped, four-toothed calyx, eight slender stamens, and ripen an oval, one-seeded, reddish drupaceous fruit, which is about one-quarter inch in diameter. All parts of it, but the bark in a greater degree, have a nauseous and acrid taste, and contain an unknown acrid principle, which appears to be freely soluble in alcohol, but slightly soluble in water.

Allied Plants.—Besides the different species of daphne, the following deserves to be briefly noticed, as possessing similar virtues :—

LAGETTA LINTEAREA, *Lam.*, s. Daphne lagetta, *Sm.* *Lacetree.*—A small tree of Jamaica and other West Indian islands, with small white nearly sessile flowers, ever-green shining ovate-cordate leaves, and a brownish or ash-colored bark, the liber of which is readily separable into twenty or more transverse bast layers, having the appearance of delicate lace.

Medical Action and Uses.—The berries are emetic and poisonous. The fresh bark applied to the skin causes redness and vesication and sores which are very difficult to heal. When chewed it excites free salivation and causes pain and soreness of the mouth, qualities which have led to its being used as a masticatory in *toothache*. These qualities are very analogous to those of mezereon.

DRACONTIUM, *U. S.*—DRACONTIUM.

Skunk-cabbage root, E.; *Racine de pothos fétide*, Fr.; *Stinkende Drachenwurzel*, G.

The rhizome and roots of Dracontium fœtidum, *Lin.*, s. Ictodes fœtidus, *Bigelow*, s. Symplocarpus fœtidus, *Salisbury*, s. Pothos fœtida, *Mich.*

Nat. Ord.—Araceæ.

Origin.—Skunk-cabbage, skunk-weed, or polecat-weed, is a common North American perennial, growing in bogs and moist grounds, and flowering in April and the early part of May. The spathe, which precedes the leaves, is hoodedshellform, pointed, rather fleshy, of a variegated purplish-brown and yellow color, and incloses a short oval spadix which is densely tesselated with fleshy flowers, and enlarges finally to a spongy mass, superficially covering the globular seeds. The leaves are radical, one and a half to two feet long, on short petioles, smooth, ovate, and heart-shaped. All parts have a very fetid odor, which on bruising is more decided.

Description.—The rhizome, which should be collected early in the spring, is tuberous, truncate above and below, three to four inches long and about two inches in diameter, of a gray-brown color, the upper half beset with numerous long fleshy rootlets, which in drying become much shrivelled and longitudinally wrinkled, and are of a lighter color and weaker taste than the rhizome. The latter is white internally or gray when old, has the fibro-vascular bundles scattered, and possesses a very acrid and biting taste which is gradually lost when long kept.

Constituents.—The root was analyzed by J. M. Turner (1836), who did not succeed in isolating the acrid principle which appears to be altered by heat, and who obtained from it a volatile fatty matter, a little volatile oil, resin, wax, fixed oil, sugar, gum, and starch.

Medical Action and Uses.—Dracontium when chewed produces irritation of the mouth, and applied to a freshly blistered surface, it augments the secretion. Internally it occasions vertigo, nausea, and frequently vomiting. Its fetid smell probably suggested its employment as an antispasmodic; and reports are not wanting of its having cured *hysteria* and spasmodic *asthma*, and even chronic bronchitis, chronic rheumatism, and dropsy. But it has no substantial claim to be retained even in the secondary list of a Pharmacopœia which contains many more efficient remedies for such diseases. The *dose* is from ten to twenty grains of the recently dried root. An infusion, made with an ounce of the dried root to a pint of water, may be prescribed in doses of one or two tablespoonfuls. A saturated tincture made in the same manner may be given in the dose of one or two teaspoonfuls.

DULCAMARA, *U. S.*, *Br.*—BITTERSWEET.

Stipites dulcamaræ, P. G.—*Tiges de douce-amère* (*de morelle grimpante*), Fr.; *Bittersüss-Stengel*, G.

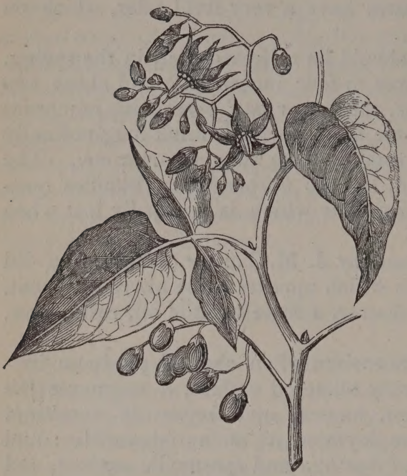
The young branches of Solanum dulcamara, *Lin.* (s. Dulcamara flexuosa, *Moench*). Woodville, Med. Bot., plate 33; Bentley and Trimen, Med. Plants, 190.

Nat. Ord.—Solanaceæ.

Origin.—The bittersweet or woody night-shade is a somewhat shrubby and climbing plant, which grows throughout the greater part of Europe, in Northern Africa, and from Asia Minor east to northwestern India and to China. It is naturalized in North America, and in many places is abundant. It grows around dwellings, in hedges and thickets on moist banks. The stem, when supported by shrubs, is sometimes 15 to 20 feet long, woody at the base, and divided into many flexuose branches dying back during the winter; the leaves are alternate petiolate and slighly pubescent beneath, the lower ones ovate with a heart-shaped base, the upper halbert-shaped, or with two ear-like lobes at the base; the flowers are in small cymes, and have a deeply five-lobed purple, sometimes whitish corolla. The berries are oval, red, and contain many minutely pitted seeds.

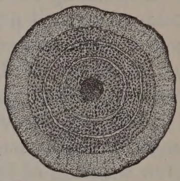
Description.—The branches which are one or two years old are collected in the autumn after having shed their leaves, or in the spring before the leaves appear. They are one-quarter of an inch and less thick, cylindrical or somewhat angular, longitudinally striate or furrowed, and more or less warty. The corky layer is pale-greenish or yellowish-brown, separates easily, and covers a dark-green bark, which is lighter-green in the bast layer. The greenish afterwards yellowish wood is porous, striate by the fine medullary rays, and consists of one or two annual rings; the whitish pith has been usually absorbed. The odor is unpleasant, somewhat narcotic, weak in the dried stalks; the taste is bitter, afterwards sweet. Bittersweet is generally met with in the market cut into short sections.

Fig. 59.



Solanum dulcamara, *Lin.*

Fig. 60.



Transverse Section of Branch.

Constituents.—The bittersweet principle has been variously named *picroglycion*, *dulcarin*, and *dulcamarin*. Desfosses (1821) separated from the drug *solania*, an alkaloid previously discovered by him in *Solanum nigrum*, and he, as well as Pelletier, regarded the picroglycion as solania, mixed with glucose. Winckler (1841), Moitéssier (1856), and others, considered the alkaloid of dulcamara as distinct from the solania of potatoes; but since the discovery of the glucoside nature of solania in 1859, the supposed solania from bittersweet does not appear to have been again examined.

Wittstein (1852) isolated from bittersweet *dulcamarina*, an alkaloid having a resinous appearance, and the odor and taste of the plant. E. Geissler (1875) obtained this product, but recognized it as a mixture. He obtained *dulcamarin*, $C_{22}H_{34}O_{10}$, by digesting the aqueous infusion of bittersweet with granular animal charcoal, washing the latter, and exhausting it with alcohol, evaporating, dissolving in water, precipitating with ammonia, and the filtrate therefrom with subacetate of lead, digesting the washed precipitate with alcohol, and decomposing it with sulphuretted hydrogen. It forms a yellowish powder of a strongly-bitter and then sweet taste, is soluble in alcohol and water, insoluble in ether, chloroform, benzol, carbon bisulphide, and petroleum-benzin, and is decomposed by diluted acids into sugar and brown tasteless *dulcamaretin*.

The other constituents, gummy, resinous, and waxy matters, are not of medicinal importance.

Admixtures.—The cut stems of Humulus lupulus, *Lin.*, and Lonicera periclymenum, *Lin.*, are said to be occasionally mixed with dulcamara in Europe; they have none of the characteristics of the latter.

Off. Prep.—Decoctum dulcamaræ, Extr. dulcamaræ, Extr. dulcamaræ fluid., *U. S.;* Infusum dulcamaræ, *Br.*

Physiological Action. *On Animals.*—The extract introduced into the stomach of rabbits occasions a remarkable degree of apathy, but not true sleep, with great flaccidity of the muscles, but no paralysis. The sensibility to pain as well as to contact is blunted; the pulse and respiration rate are reduced; the temperature is raised; the pupils are not altered; the ears and the lips become cyanosed; the head is bowed downwards, and moves laterally to and fro; and death takes place in convulsions. The stomach presents an intensely dark-red color from the congestion of its bloodvessels, while the intestinal mucous membrane is pale. The large veins of the thorax and abdomen are distended with dark blood.

On Man.—In large doses dulcamara is stated by some reporters to cause dryness, heat, and constriction and stinging in the throat, thirst, and sometimes diarrhœa. Feeble persons, it is said, are apt to experience twitching of the eyelids and lips with tremulousness of the limbs; the head is heavy and giddy, and, as in the lower animals, a cyanotic hue of the face and hands may be observed, and sometimes an erythematous eruption of the skin, with a tendency to diaphoresis. The action of dulcamara upon the human heart is not definitely determined, but it probably renders the circulation slower and more languid. It is proper to state that Dr. John Harley experimented upon man with the expressed juice, and also with the tincture, in small and in large doses, without any appreciable physiological effect.

Medical Uses.—The so-called scientific therapeutists of the present day are disposed to deny any curative virtues to dulcamara, because they are unable to explain those it is alleged to possess, according to their notions of its mode of action. Such a reason may, in a logical sense, be called impertinent. The claims of dulcamara rest on the same grounds as those of opium, mercury, and cinchona, the ground of clinical experience. It was long used as a popular remedy, and subsequently by physicians, for *cutaneous eruptions*, both internally and externally, and especially for psoriasis and other scaly diseases of the skin, and also for acne, impetigo, chronic eczema, and ecthyma. It is said to be most apt to cure those diseases when they occur in persons of a strumous habit. It has had considerable repute as a remedy for chronic muscular *rheumatism*, and also in chronic *bronchitis*, *whooping cough*, and other chronic pulmonary affections in which cough is a prominent symptom.

Dulcamara is best used in the decoction (Decoctum dulcamaræ) which is made from the fresh stems. The fluid extract may also be employed. It must be long continued to produce curative effects.

ECBALII FRUCTUS, *Br.*—SQUIRTING CUCUMBER FRUIT.

Cucumis asininus, Cucumis agrestis.—*Wild cucumber*, E.; *Concombre sauvage* (*purgatif, d'ane*), Fr.; *Springgurke, Esels-Kürbis, Spritzgurke*, G.

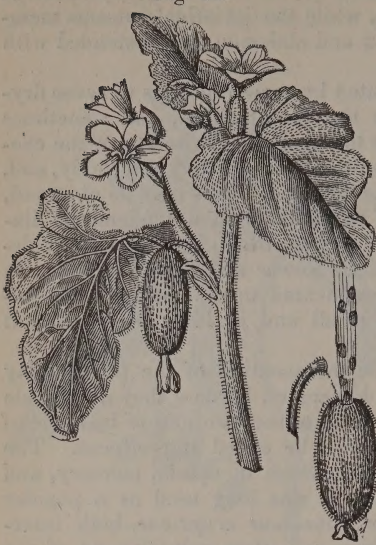
The fruit of the squirting cucumber, Ecbalium officinarum, *Richard*, s. Ecbalium agreste, *Reichenb.*, s. Elaterium cordifolium, *Moench*, s. Momordica elaterium, *Linn.* Step. and Church, Med. Bot., plate 34; Bentley and Trimen, Med. Plants, 115.

Nat. Ord.—Cucurbitaceæ.

Origin.—The plant is a common weed in dry and waste places in Southern Europe and eastward thence to Persia. It has a perennial, fleshy, white root, a trailing, succulent, bristly stem 1 to 3 feet long, alternate, bristly, bluntly-triangular and cordate leaves, and unisexual monœcious flowers, with deeply five-lobed, yellow and veined corollas. The plant is cultivated to a small extent for medicinal purposes in Germany, France, and at Mitcham and Hitchin, in England; the seeds being sown about March, the seedlings planted out in June, and the nearly ripe fruit collected in August or early in September.

Description.—The fruit is nodding from the recurved stalk, two inches or less in length, about one inch thick, oblong, and somewhat tapering above, pale green, beset with fleshy prickles, three-celled, and containing a bitter watery juice, in which the numerous oblong, compressed, polished, light-brown seeds are immersed. When mature, the fruit becomes yellowish, and separates suddenly

Fig. 61.



Ecbalium officinarum, *Rich.*

from the stalk, at the same time violently expelling the juice and seeds from the orifice formed at the base. The fruit is collected with the stalk when almost ripe for preparing elaterium.

Constituents.—The analyses of Braconnot, Paris, Marquart, Landerer, and Koehler indicate the presence of resinous, albuminous, and gummy matters, but, besides *elaterin*, no compound of importance (see *Elaterium*).

Walz (1859) obtained from the entire plant collected with the root the following principles, which are stated to be present likewise in elaterium :—

Prophetin, also found in the fruit of *Cucumis prophetarum*, Lin.; yellowish powder, slightly soluble in water, more in alcohol, freely in ether; precipitated by tannin; is a glucoside. *Ecbalin* or *elateric acid*, resin-like, bitter and acrid, soluble in alkalies, alcohol, ether, and in twenty parts of water. *Hydroelaterin*, amorphous, soluble in water, alcohol, ether, and alkalies; is not a glucoside. *Elaterid*, very bitter, insoluble in water and ether, soluble in alcohol and alkalies, also in concentrated acids.

Pharmaceutical Use.—For the preparation of Elaterium.

ELATERIUM, *U. S.*, *Br.*—ELATERIUM.

Élaterium, Fr.; *Elaterium*, G.

A substance deposited by the juice of the squirting cucumber fruit.

Preparation.—Take of Squirting Cucumber Fruit very nearly ripe one pound. Cut the fruit lengthwise, and lightly press out the juice. Strain it through a hair sieve, and set it aside to deposit. Carefully pour off the supernatant liquor; pour the sediment on a linen filter, and dry it on porous tiles with a gentle heat. The decanted fluid may deposit a second portion of sediment, which can be dried in the same way. *Br.*

This is essentially the process recommended by Dr. Clutterbuck (1820), except that he directs the surface of the fruit to be moistened with cold water, thus preventing the juice from adhering, and the split fruit to be rinsed in cold water, for recovering the juice adhering to the inside. With an increased pressure a larger amount of juice and of deposit is obtained; but the latter is then of inferior quality. The deposited elaterium may be dried with a very moderate heat; but exposure to the sunshine should be avoided. Clutterbuck obtained only six grains of elaterium from forty specimens of squirting cucumber; with slight pressure, forty pounds of the fruit will generally yield half an ounce, and in warm, dry seasons, even three-quarters of an ounce of elaterium.

Description.—It is in light, friable, flat, or slightly incurved, cake-like fragments, frequently marked on their surfaces with the impression of the linen or paper on which they were dried. When fresh it has a pale-green color, changing by age to gray, and then often containing minute sparkling crystals on the surface. It breaks with a fine granular fracture, has a slight tea-like odor, and an acrid and bitter taste. It does not effervesce with acids; a cooled decoction of it is not colored blue, or is but slightly tinged by solution of iodine, showing the nearly complete absence of starch. It yields half its weight to boiling rectified spirit, and this solution, on being concentrated and added to warm solution of potassa, deposits on cooling not less than twenty per cent. of elaterin in colorless crystals. *Br.*

Constituents.—The principal constituent is *elaterin*, $C_{20}H_{28}O_5$, of which Morries (1831) obtained between 15 and 26 per cent.; Flückiger and Hanbury (1874) 27.6 and 33.6; Walz (1859) even 50 per cent. It may be obtained by Morries' process, which is the one given in the above test of the British Pharmacopœia. It is not unlikely, however, that in this way a portion of the principle may be lost, for Buchheim (1872) observed that solid potassa, added to a hot alcoholic solution of elaterin, changes the latter to an acid body which is soluble in water, and inert, since 1.0 gram produced no effect. According to him, elaterin is the anhydrid of elateric acid, and converted into the latter by heat alone; hence the importance of avoiding heat in the preparation of elaterium. The best method of obtaining elaterin is to exhaust elaterium with chloroform, from which solution white crystals will be immediately deposited on the addition of ether. (*Pharmacographia.*) Elaterin is in colorless, shining, hexagonal scales or prisms, with an acrid and extremely bitter taste, soluble in alcohol, amylic alcohol, carbon bisulphide or chloroform; also in hot olive oil, insoluble in petroleum benzin. It is not a glucoside, and is not precipitated by tannin. It was observed by Marquart (1833), Walz (1859), and Köhler (1869), that the amount of elaterin diminished very considerably in the fruit as the season advances. According to Power (1875) elaterin is not changed by chlorinated alkalies; nor is its alcoholic solution precipitated either by tannin or barium chloride. Nitric acid produces, after several hours, a pinkish tinge; but when heated, at once a red coloration. With sulphuric acid it is instantly colored deep red, the color changing to deep brown, and ultimately to light green on the addition of a fragment of potassium bichromate.

Elaterium contains pectin, and, according to Walz, *prophetin* and some other principles (see page 512).

Physiological Action.—Elaterium, however it may be given to dogs and rabbits, does not vomit or purge them, but destroys them with tetanoid phenomena. In some other animals the subcutaneous use of elaterium produces profound and fatal exhaustion. In man its internal use causes more or less vomiting, severe griping, and profuse watery stools, with a sense of great exhaustion.

Medical Uses.—Elaterium is used as a purgative in those cases only in which a drastic operation, with profuse serous discharges, is desired. Hence it may be prescribed with great effect to relieve the brain or the lungs threatened with the dangers of *congestion*, provided no contraindication exists in the patient's debility or in disease of the digestive canal. It was one of the most renowned of the ancient remedies for *dropsy*, and in recent times it has shown its power by evacuating serous collections which other purgatives and all diuretics failed to remove. It is, however, most frequently used in abdominal dropsy.

The variable strength of elaterium suggests caution in its use. One-sixteenth of a grain may be given in a pill made with extract of hyoscyamus or confection of roses, and repeated every hour until the effects begin to appear. Elaterin is more active in solution with alcohol. The *dose* is the same as that of elaterium.

ELEMI, *Br.*, *P. G.*—ELEMI.

Resina (s. Gummi) Elemi.—*Élémi*, *Resine élémi*, Fr.; *Elemi*, G.

A concrete resinous exudation, the botanical source of which is undetermined, but is probably Canarium commune, *Lin.*; *Rumph. Amb.*, vol. ii., plate 47. Chiefly imported from Manila. *Br.*

Obtained from an undetermined plant growing in Yucatan. *P. G.*

Origin.—The name of Elemi has been given to various resinous products which have from time to time appeared in commerce, and which, it is believed, are all derived from trees of the Nat. Ord. Burseraceæ. The British Pharmacopœia refers Manila elemi to *Canarium commune*, Lin., a tall tree indigenous to the Moluccas, and to other parts of tropical Asia; while Blanco (1845) states that it is obtained from *Icica abilo*, a tree scarcely known; nor is the mode of obtaining it known. It is a product of the Philippine Islands.

Description.—Manila elemi is in soft, granular, transparent masses when fresh; but is generally met with in the shops in solid pieces, which are externally pale lemon-yellow and clear; internally opaque, nearly white, and mixed with chips and other impurities. It breaks with a dull granular fracture, and readily fuses to a transparent liquid. Moistened with alcohol, it disintegrates, and shows a large number of small acicular crystals. It has a strong aromatic, somewhat terebinthinate odor, and a warm, aromatic, and acrid taste.

Constituents.—Flückiger and Hanbury (*Pharmacographia*) obtained from the drug 10 per cent. of a colorless, neutral, fragrant, and strongly dextrogyre, volatile oil. An oil of elemi obtained by H. St. Claire Deville (1849) had a strong rotatory power to the left, and the composition $C_{10}H_{16}$.

On treating elemi with alcohol, Maujean (1823) obtained a soluble amorphous resin, which Baup (1851) named *breïn*, and succeeded in crystallizing by the very slow evaporation of its alcoholic solution. Maujean's insoluble resin was by Bonastre (1824) crystallized from its solution in boiling strong alcohol; it is Baup's *amyrin*, and, like brein, is readily soluble in ether, and insoluble in water. The same author obtained also *bryoidin* and *breïdin*, both fusible, the former having a bitter and acrid taste; it is easily soluble in alcohol, ether, volatile and fixed oils, slightly in cold water, but crystallizes from boiling water, from alkaline solutions, or from dilute acetic acid in silky threads or in mosslike masses. *Breïdin* is likewise crystalline, readily soluble in alcohol, less in water or ether. E. Buri (1876) gives to amyrin the formula $(C_5H_8)_5.2H_2O$. He found it to be soluble in ether, chloroform, and carbon bisulphide; to be fusible at 177° C. (350.6° F.), and to sublime when carefully heated in thin layers. The mother liquors of amyrin yielded him (1878) *elemic acid* $(C_5H_8)_7O_4$, the potassium salt of which crystallizes from its strong alkaline solution in needles.

Varieties.—The following resinous products are sometimes met with as distinct varieties of elemi:—

MAURITIUS ELEMI obtained from *Colophonia mauritiana*, Comm., a large tree of Mauritius; it is at first liquid, and resembles the Manila elemi.

MEXICAN ELEMI, supposed to be obtained from *Amyris elemifera*, Royle, is in light or dark yellow, somewhat greenish masses, of a waxy lustre, translucent or opaque, friable, but readily softening in the mouth.

BRAZILIAN ELEMI, collected from *Icica icicariba*, D. C., and other species of the same genus; it forms soft yellowish-white or solid pale or greenish-yellow masses.

All these varieties have a similar though not identical odor, and disintegrate when treated with cold alcohol, with the separation of small crystals, which are probably identical with *amyrin*.

Off. Prep.—Unguentum elemi. *Br.*

Medical Action and Uses.—The qualities of elemi are analogous to those of the turpentines, and it might probably be used for the same purposes internally. It is, however, only employed as an external application, in plaster or ointment, as a dressing for *issues*, *indolent ulcers*, etc. In this country it is rarely used.

EMPLASTRA.—PLASTERS.

Emplâtres, Fr.; *Pflaster*, G.

Plasters are solid tenacious preparations intended for external use, considerably harder than cerates, so that they cannot be spread at the ordinary temperature, yet of such a composition that they will be pliable and adhesive at the temperature of the body. According to their composition they are distinguished into two classes, namely, *plasters* properly so called, the base of which consists of a fusible and insoluble lead soap, and *resinous plasters*, which owe their adhesiveness to a resin mixed with some wax or fat, and for this reason are called *ointment-plasters*, *onguents-emplâtres* by the French; they are the *rétinolés solides*, or hard resin fats of Guibourt.

The *preparation* of all plasters containing more than one ingredient is effected in a manner similar to that of the cerates, with such modifications as are necessitated by their greater firmness and higher fusing point. The simple plaster or the resin is first liquefied, care being taken to avoid too high a heat; the wax, fat, or other fusible substances are then added, and lastly oleoresins and aromatic products which would be injured by long-continued heat, and gum resins or other substances which are infusible and must be mechanically incorporated with the solidifying plaster. The latter may be accomplished in several ways, according to the nature of the substances to be added; they are either rubbed fine and to a perfectly smooth paste with some fat, volatile oil, or oleoresin, or they are finely powdered and passed through a sieve into the cooling plaster, which is then to be stirred until firm enough to prevent the mechanical admixtures from separating. If extracts are to be incorporated, they should, if possible, be prepared with strong alcohol, so as to be fusible with the other ingredients of the plaster. Most gum resins are not completely fusible or readily pulverizable, and are therefore best converted into a smooth paste in the manner indicated above. The use of some petroleum benzin during the trituration will often be found advantageous for accomplishing the object in view.

Straining is best avoided in preparing plasters. Should it be found necessary it is never to be deferred until the infusible ingredients have been added, but performed with the smallest possible bulk and with those portions of the material having the lowest fusing point. On the whole, however, it will be found more advantageous and expeditious to use only purified ingredients, so that the straining of the plaster may not be required.

For convenience in handling and dispensing, plasters are rolled into cylinders of convenient thickness. A slab or thick board is suitable for the purpose. The melted plaster is allowed to cool until it is of a soft, pliable consistence, when a convenient quantity is transferred to the slab previously moistened with water, and then kneaded with the moistened hand and rolled out to the desired thickness; when larger quantities are to be thus rolled out, a smooth and straight board will be found convenient as a roller, with its ends supported by ledges, whereby uniform thickness is secured. Plasters which contain vegetable powders or other substances soluble in water, are treated in the same manner, except that the water is replaced by olive or a similar bland and non-drying oil. The most convenient size of such rolls or sticks is, for dispensing purposes, about the thickness of a finger, or even smaller. They keep well if they are wrapped in wax or paraffin paper. The softer plasters are sometimes poured into boxes or kept in square cakes, the latter being cast in tin or paper moulds, as described under Cerates (see page 373).

Plasters are usually spread upon white sheepskin; for particular purposes chamois skin, linen, muslin, or even paper (see Charta, page 382) may be used. The leather is extended and fastened upon a smooth board, and the desired size and shape are marked upon it either by pasting strips of paper on it, or using tin frames of the requisite size and shape. Sometimes an apparatus is used, consisting of a block of hard wood with an even or somewhat convex surface, over which a sheet iron frame is fitted, cut out to the dimensions and shape of the plaster to be spread, and covering sufficient leather to serve for a margin. For rectangular plasters it is convenient to have two L-shaped pieces of sheet tin, each side of which is graduated in inches, commencing from the angle; by bringing the angle of one diagonally opposite to that of the other piece, a rectangular or square outline of any desired size may be formed. When the leather has been properly prepared, a sufficient quantity of the plaster is to be fused by a moderate heat and with frequent stirring, to avoid burning, and while still liquid is poured upon the leather, and spread by means of a warm stout pallet knife, with sufficient pressure to obtain a smooth and even surface. Various plaster spreaders, with long and short, straight and curved handles, have been constructed, the spreader generally being a solid square or triangular piece of iron, which, once heated, will remain warm for a sufficient length of time to soften such portions of the plaster as may become hard, until the whole has been evenly spread. Sometimes the spreader or blade is made hollow, for the purpose of introducing boiling water or a heater to maintain the necessary temperature. But with some practice the pallet knife will be found quite sufficient for the ordinary sizes of plaster. The consistence at which the fused mass should be poured upon the leather is of importance; if it be too thin, it will partly pass through the material and stain the outer surface; if too thick, it will congeal before it can be spread out, and require heating by means of the plaster iron, and is then apt to become too fluid. For true plasters a temperature of 50° to 55° C. (120° to 130° F.) will be found to give the proper consistence; resinous plasters containing wax or fats should be cooled to a still lower degree. So-called *porous plasters* have been used for some years past. To perforate spread plasters extemporaneously, Prof. Remington (1878) has devised a tool consisting of a brass wheel three-quarters of an inch wide, and studded with 16 punches in two alternating rows half an inch apart. The wheel revolves around a steel axle, which is connected with a handle nine inches long, by means of which the requisite pressure is obtained.

The *amount* of plaster necessary for spreading a given area will depend partly upon the nature of the plaster and partly upon the thickness to which it is spread; on an average, 10 grains will be found sufficient for one square inch of surface. To prevent the clothes from becoming soiled and to facilitate the removal of the plaster, a margin of about one-quarter inch is left around the spread surface.

In European pharmacy the term *sparadrap* is used to designate plasters which, like adhesive, court, and similar plasters, consist of adhesive substances thinly spread upon certain kinds of muslin, silk, or paper. They are prepared in various ways according to the nature of the adhesive material; *court plaster*, for instance, is made by stretching a piece of common silk smoothly between frames, and applying, by means of a brush, a solution of 1 part of gelatin in from 12 to 15 parts of water, and, after this layer has dried, repeating the operation. To make it *waterproof*, as it is termed, the other side of the silk should be previously covered with an alcoholic solution of benzoin or other resinous substance. The addition of a small quantity of glycerin to the gelatin solution renders the court plaster more pliable and prevents it from becoming too hard and dry. True plasters, to be made into sparadraps, require a different apparatus; this generally consists of a smooth board upon which rests in an upright position a kind of trough into which the melted plaster is put, and the trough is provided below with a slit through which the plaster escapes; the cambric or other material is guided by rulers while being drawn underneath the trough, which must be kept sufficiently warm to prevent the plaster from becoming too firm, and should be so constructed as to act not merely as a scraper, but likewise to press upon the material beneath sufficiently for spreading the plaster thinly but evenly. Paper sparadraps are made in the same manner (see also Charta, page 382). For a figure and description of an apparatus suitable for the purpose, see *Amer. Journ. Pharmacy*, 1869, p. 455.

When kept for a long time, plasters are apt to become brittle. With rolled plasters, the cause may be found partly in the removal of the glycerin. If not otherwise injured, they may be usually restored by fusing them carefully over a little water and incorporating with the melted mass ½ to 1 per cent. of olive oil. To restore the adhesiveness of spread plasters is often a difficult matter, and must in all cases depend upon the nature of the plaster. Heating the surface of the plaster until it becomes soft, covering the softened surface with a solution of turpentine or Canada balsam, and then laying aside the plaster for a day will usually accomplish the object. For some years past certain manufacturers have used caoutchouc to keep plasters pliable and adhesive. This can be successfully made, according to J. W. Worthington (1871), by macerating 1 ounce of finely cut caoutchouc in a pint of petroleum benzin until a thick solution is obtained, of which one part is added to 7 or 8 parts of melted plaster.

If non-resinous extracts, fixed or volatile oils, are ordered in such quantities as to interfere with the adhesive properties of the plaster, Shael (1873) recommends them to be incorporated with powdered tragacanth. If this mixture is spread upon plaster an adhesive margin is left.

EMPLASTRUM ACONITI, *U. S.*—ACONITE PLASTER.

Emplâtre d'aconit, Fr.; *Aconit-Pflaster, G.*

Preparation.—Take of Aconite Root in fine powder sixteen troyounces; Alcohol, Resin Plaster, each a sufficient quantity. Moisten the aconite root with six fluidounces of alcohol, and pack it in a conical percolator. Cover the surface with a disk of paper, and pour upon it ten fluidounces of alcohol. When the liquid begins to drop, cork the percolator, and, having closely covered it to prevent evaporation, set it aside in a moderately warm place for four days. Then remove the cork, and gradually pour on alcohol until two pints of tincture have been obtained, or the aconite root is exhausted. Distil off a pint and a half of alcohol, and evaporate the residue to a soft uniform extract by means of a water-bath. Add to this sufficient resin plaster, previously melted, to make the mixture weigh sixteen troyounces, and then mix them thoroughly. *U. S.*

This is an efficient plaster if prepared from good aconite root, which it represents weight for weight, and the alcoholic extract of which is easily and uniformly incorporated with the resin plaster.

Medical Action and Uses.—This plaster is anodyne and discutient. It may be applied over joints and other parts affected with *rheumatism*, *white swelling*, etc., and upon the seats of *neuralgic pain.*

EMPLASTRUM AMMONIACI, *U. S.*—AMMONIAC PLASTER.

Emplâtre de gomme ammoniaque, *Emplâtre fondant* (*résolutif*), Fr.; *Ammoniak-Pflaster*, G.

Preparation.—Take of Ammoniac five troyounces; Diluted Acetic Acid half a pint. Dissolve the ammoniac in the diluted acetic acid and strain; then evaporate the solution by means of a water-bath, stirring constantly, until it acquires the proper consistence. *U. S.*

The Pharmacopœia is incorrect in directing the ammoniac to be *dissolved* in the dilute acetic acid; the ammoniac can only be *emulsionized.* The finished preparation is quite adhesive, but has lost nearly all its volatile oil. It must be prepared in porcelain vessels, and during the evaporation stirred with a porcelain or glass spatula to avoid contamination with metals.

Medical Action and Uses.—It is used as a stimulant discutient over swellings which have ceased to exhibit an inflammatory tendency, such as *scrofulous joints* and *glands.* It is apt to irritate the skin and produce a papular eruption.

EMPLASTRUM AMMONIACI CUM HYDRARGYRO, *U. S.*, *Br.*—AMMONIACUM AND MERCURY PLASTER.

Plaster of ammoniac with mercury, E.; *Emplâtre de gomme ammoniaque mercuriel,* Fr.; *Quecksilber und Ammoniak-Pflaster,* G.

Preparation.—Take of Ammoniac twelve troyounces; Mercury three troyounces; Olive Oil sixty grains; Sublimed Sulphur eight grains. Heat the oil and gradually add the sulphur, stirring constantly until they unite; then add the mercury and triturate until globules of the metal cease to be visible. Boil the ammoniac with sufficient water to cover it, until they are thoroughly mixed; then strain through a hair sieve and evaporate, by means of a water-bath, until a small portion taken from the vessel hardens on cooling. Lastly, add the ammoniac, while yet hot, gradually to the mixture of oil, sulphur, and mercury, and thoroughly incorporate all the ingredients. *U. S.*

Take of Ammoniacum twelve ounces; Mercury three ounces; Olive Oil one fluidrachm; Sublimed Sulphur eight grains. Heat the oil and add the sulphur to it gradually, stirring till they unite. With the mixture triturate the mercury until globules are no longer visible; and lastly, add the ammoniacum, previously liquefied, mixing the whole carefully. *Br.*

It is obvious that the sulphur merely serves the purpose of facilitating the fine division of the mercury. In the methods selected for incorporating the ammoniac, both Pharmacopœias are at fault. The British Pharmacopœia directs it to be liquefied, but omits to state how the liquefaction is to be accomplished. The United States Pharmacopœia boils with water, regardless of the consequences. By triturating the ammoniac with petroleum benzin until a mass nearly free from grittiness is obtained, then emulsionizing with the least possible quantity of water, straining and evaporating, a satisfactory product will be obtained, which, in our opinion, would be improved by the addition of some turpentine and lead plaster.

Medical Action and Uses.—The mercury in this plaster is supposed to add to its discutient effects and to render it especially applicable to swellings of a *syphilitic* nature. The presence of a syphilitic element is not necessary to render it more efficient than the simple plaster of ammoniac. Its prolonged application sometimes excites ptyalism.

EMPLASTRUM ANTIMONII, *U. S.*—ANTIMONIAL PLASTER.

Emplastrum stibiatum s. antimoniale.—*Emplâtre (Poix) émétisée, Emplâtre antimonial,* Fr.; *Brechweinstein-Pflaster,* G.

Preparation.—Take of Tartrate of Antimony and Potassium in fine powder a troyounce; Burgundy Pitch four troyounces. Melt the pitch by means of a water-bath and strain; then add the powder, and stir them well together until the mixture thickens on cooling. *U. S.*

The finely powdered tartar emetic should not be added until the fused mass almost begins to thicken; the addition of two or four drachms of wax would improve the adhesive qualities of the plaster. It is strange that the Pharmacopœia should consider it necessary to add one-twelfth of yellow wax to Burgundy pitch to convert it into a plaster, and regard one-fourth of the non-adhesive tartar emetic as sufficient to accomplish the same purpose.

Medical Action and Uses.—This plaster is intended to render pustulation by tartar emetic uniform upon the parts to which it is applied. It is seldom used.

EMPLASTRUM ARNICÆ, *U. S.*—ARNICA PLASTER.

Emplâtre d'arnique, Fr.; *Arnicapflaster*, G.

Preparation.—Take of Alcoholic Extract of Arnica a troyounce and a half; Resin Plaster three troyounces. Add the extract to the plaster, previously melted by means of a water-bath, and mix them thoroughly. *U. S.*

The officinal formula, strictly followed, yields a good plaster.

Medical Action and Uses.—Among the remedies which are more frequently procured without the prescription of a physician than with it, this is in popular use as a remedy for a variety of *local pains* which are generally muscular. It serves to protect, support, and mildly stimulate.

EMPLASTRUM AROMATICUM, *P. G.*—SPICE PLASTER.

Emplastrum stomachicum.—*Aromatic or stomach plaster*, E.; *Emplâtre aromatique*, Fr.; *Aromatisches Pflaster, Magenpflaster*, G.

Preparation.—Take of Yellow Wax thirty-two parts; Suet twenty-four parts; Turpentine eight parts. Melt them together, and to the nearly cooled mass add of Expressed Oil of Nutmeg six parts; powdered Olibanum sixteen parts; powdered Benzoin eight parts; Oil of Peppermint and of Cloves, each one part. Mix intimately, form into rolls, and keep them in wax-paper. *P. G.*

The plaster is of a grayish-brown color and has an aromatic odor. *Spice plasters*, as generally used in the United States, are mixtures of various spices which are applied after being mixed with honey or water, and really belong to the class of cataplasms. The following formula was used by the late Dr. Parrish, Sr.: Powdered capsicum, cinnamon, and cloves, of each two ounces, rye-meal, spirits, and honey, sufficient.

Medical Uses.—This plaster is popularly used in Germany to palliate rheumatic and other local pains.

EMPLASTRUM ASSAFŒTIDÆ, *U. S.*—ASAFETIDA PLASTER.

Emplastrum asæ fœtidæ, Emplastrum fœtidum.—*Emplâtre d'ase fétide, Emplâtre fétide (antihystérique)*, Fr.; *Stinkasant-Pflaster*, G.

Preparation.—Take of Asafetida, Lead Plaster, each twelve troyounces; Galbanum, Yellow Wax, each six troyounces; Alcohol three pints. Dissolve the asafetida and galbanum in the alcohol by means of a water-bath, strain the liquid while hot, and evaporate to the consistence of honey; then add the plaster and wax, previously melted together, stir the mixture well, and evaporate to the proper consistence. *U. S.*

The direction to *dissolve* the asafetida and galbanum in alcohol cannot be followed, since the gum resins are only partially soluble in that menstruum. The intention of the Pharmacopœia is to disintegrate them, so that by straining they may be freed from the coarser impurities. The plaster is of good consistence.

Medical Action and Uses.—The local stimulation of the galbanum, and the action of the absorbed asafetida upon the nervous system, render this plaster an appropriate application to the chest in *whooping-cough*, and to the abdomen in habitual flatulent *colic*. It is recommended in *hysteria*, but can hardly act upon that disease except through the patient's imagination.

EMPLASTRUM BELLADONNÆ, *U. S.*, *Br.*—BELLADONNA PLASTER.

Emplâtre de belladonne, Fr.; *Belladonna-Pflaster*, G.

Preparation.—Take of Belladonna Root in fine powder sixteen troyounces; Alcohol, Resin Plaster, each a sufficient quantity. Moisten the belladonna root with six fluidounces of alcohol, pack it in a conical percolator, and, having covered the surface with a disk of paper, pour on ten fluidounces of alcohol. When the liquid begins to drop from the percolator, close the lower orifice with a cork, and, having closely covered the percolator, set it aside for four days. Then remove the cork, and gradually pour on alcohol until two pints of tincture have slowly passed. Distil off by means of a water-bath a pint and a half of alcohol; introduce the residue into a two-pint capsule, and evaporate on a water-bath to a soft, uniform extract; ascertain its weight, and, having added sufficient resin plaster, previously melted, to make the whole weigh sixteen troyounces, mix them thoroughly. *U. S.*

Take of extract of Belladonna, Resin Plaster, of each three ounces; Rectified Spirit six fluidounces. Rub the extract and spirit together in a mortar, and when the insoluble matter has subsided, decant the clear solution, remove the spirit by distillation or evaporation, and mix the alcoholic extract thus obtained with the resin plaster melted by the heat of a water-bath, continuing the heat until with constant stirring the plaster has acquired a suitable consistence. *Br.*

Of the two formulas, the first deserves the preference, since it will always yield a handsome preparation which may be easily managed, and which is quite efficacious if good belladonna root has been employed. It is often used in the form of sparadrap.

Medical Action and Uses.—Belladonna plaster diminishes the circulation of the blood in the part to which it is applied, and thereby, as well as by a direct action on the nerves, lessens pain. It is habitually employed to allay *neuralgic* and *rheumatic pains;* over *inflammatory swellings* in their congestive stage; and especially upon engorged *glands*, as the *mamma* and the *testicle*. Care must be taken that the skin is sound where it is applied, as the characteristic symptoms of belladonna poisoning of a high grade have resulted from a neglect of this precaution. These symptoms in a mild form, such as dilatation of the pupils, dryness of the throat, and a papular eruption on the skin, are common even when the plaster has been applied to the unbroken skin.

EMPLASTRUM CALEFACIENS, *Br.* See EMPLASTRUM PICIS CUM CANTHARIDE.

EMPLASTRUM CANTHARIDIS, *Br.* See CERATUM CANTHARIDIS.

EMPLASTRUM CERATI SAPONIS, *Br.*—SOAP CERATE PLASTER.

Emplâtre de savon saturné, Fr.; *Seifencerat-Pflaster*, G.

Preparation.—Take of Hard Soap in powder ten ounces; Yellow Wax twelve and a half ounces; Olive Oil one pint; Oxide of Lead fifteen ounces; Vinegar one gallon. Boil the vinegar and oxide of lead together, by the heat of a steam-bath, constantly stirring them until the oxide has combined with the acid; then add the soap and boil again until most of the moisture is evaporated; finally, add the wax and oil melted together, and stir the whole continuously, maintaining the heat until by the evaporation of the remaining moisture the product has acquired the proper consistence for a plaster. *Br.*

A similar preparation was formerly (1850) officinal in the United States, but has been replaced by *Ceratum Saponis*, which see. To avoid the prolonged unnecessary boiling, A. W. Gerrard (1874) proposed to substitute, for the vinegar, 18 ounces of acetic acid, which is sufficient to dissolve the oxide of lead; the acetate of lead formed reacts with the soap, forming lead plaster.

Medical Uses.—Soap cerate plaster is used for the general purposes of adhesive plaster, and for supporting and protecting enlarged joints and other swollen parts.

EMPLASTRUM FERRI, *U. S.*—IRON PLASTER.

Emplastrum roborans; Emplastrum ferratum s. martiale.—Chalybeate plaster, Strengthening plaster, E.; *Emplâtre d'oxyde rouge de fer, Emplâtre de Canet*, Fr.; *Eisenpflaster, Stärkendes Pflaster*, G.

Preparation.—Take of Subcarbonate of Iron three troyounces; Lead Plaster twenty-four troyounces; Burgundy Pitch six troyounces. To the lead plaster and Burgundy pitch, previously melted together, add the subcarbonate of iron, and stir constantly until the mixture thickens on cooling. *U. S.*

Take of Hydrated Peroxide of Iron in fine powder one ounce; Burgundy Pitch two ounces; Lead Plaster eight ounces. Add the peroxide of iron to the Burgundy pitch and lead plaster, previously melted together, and stir the mixture constantly till it stiffens on cooling. *Br.*

Both formulas yield plasters containing the same amount of iron. A. W. Gerrard (1874) proposes to omit the Burgundy pitch, which would improve the plaster. Its partial replacement by turpentine we consider still better.

Medical Action and Uses.—There is no reason for believing that the iron in this plaster exerts any special therapeutic influence. Its protective, supporting, and stimulant action renders it a useful application to parts affected with chronic muscular and articular *rheumatism*, to the chest during the decline of acute *pleurisy*, to enlarged *glands*, etc.

EMPLASTRUM GALBANI COMPOSITUM, *U. S.*—GALBANUM PLASTER.

Emplastrum galbani, Br.; *Emplastrum lithargyri (vel plumbi) compositum, Emplastrum diachylon compositum.—Compound galbanum plaster*, E.; *Emplâtre de galbanum*, Fr.; *Mutterharz-Pflaster, Gummipflaster, Zugpflaster*, G.

Preparation.—Take of Galbanum eight troyounces; Turpentine a troyounce; Burgundy Pitch three troyounces; Lead Plaster thirty-six troyounces. To the galbanum and turpentine, previously melted together and strained, add first the Burgundy pitch and then the lead plaster, melted over a gentle fire, and mix the whole together. *U. S.*

Take of Galbanum, Ammoniacum, Yellow Wax, of each one ounce; Lead Plaster eight ounces. Melt the galbanum and ammoniacum together, and strain. Then add them to the lead plaster and wax, also previously melted together, and mix the whole thoroughly. *Br.*

The addition of a little turpentine or Canada balsam, for the purpose of liquefying the gum resins ordered by the second formula, would render that part of the process easier of execution. The German *compound diachylon plaster* contains only one-eighth of its weight of gum resins.

By rubbing 30 grains of powdered saffron with sufficient alcohol to produce a pulpy mass, and mixing this intimately with four troyounces of galbanum plaster (U. S. P.), previously fused, a good substitute for *Emplastrum galbani crocatum* of the German Pharmacopœia is obtained.

EMPLASTRUM OXYCROCEUM, Ph. G., s. EMPL. GALBANI RUBRUM.—This compound galbanum plaster is frequently used by our German population; it is prepared as follows: Take of Yellow Wax, Resin, Burgundy Pitch, each six parts. Melt them together with a moderate heat, and to the strained mass add of Ammoniac powdered and Galbanum, each two parts, previously dissolved in Turpentine three parts. Then add an intimate mixture consisting of Mastic, Myrrh, Olibanum, each in powder two parts, and Saffron powdered one part, and mix the whole together (P. G.). The plaster is reddish-brown, and very tenacious.

Medical Action and Uses.—As a more stimulant application than most of the other plasters used for the same purposes it may be preferred before them in the treatment of various local affections named in the preceding articles.

EMPLASTRUM HYDRARGYRI, *U. S., Br.*—MERCURIAL PLASTER.

Emplastrum mercuriale.—Emplâtre mercuriel, Fr.; *Quecksilber-Pflaster*, G.

Preparation.—Take of Mercury six troyounces; Olive Oil, Resin, each two troyounces; Lead Plaster twelve troyounces. Melt the oil and resin together, and, when they have become cool, rub the mercury with them until globules of the metal cease to be visible. Then gradually add the lead plaster, previously melted, and mix the whole together. *U. S.*

Take of Mercury three ounces; Olive Oil one fluidrachm; Sublimed Sulphur eight grains; Lead Plaster six ounces. Heat the oil and add the sulphur to it gradually, stirring until they unite; with this mixture triturate the mercury until globules are no longer visible; then add the lead plaster, previously liquefied, and mix the whole thoroughly. *Br.*

The extinguishment of the metallic mercury is accomplished, in the first formula, by the mixture of resin and olive oil; in the second, by the little sulphur combined with the olive oil. Canada or Venice turpentine would have a similar result.

The French Codex gives a formula for EMPLASTRUM DE VIGO CUM MERCURIO, *Emplâtre mercuriel dit de Vigo*, which is occasionally used here. It is made by fusing together lead plaster 200 parts, yellow wax, and resin, each 10 parts; add thereto the following powders: olibanum, ammoniac, bdellium, and myrrh, of each 3 parts, and saffron 2 parts; also 60 parts of mercury extinguished by 10 parts of turpentine, and finally 30 parts of liquid storax, and 1 part of oil of lavender.

Medical Action and Uses.—The virtues of mercurial plaster depend upon its being not only a mechanical support to the affected parts, and a mild counter-irritant, but also upon the specific operation of its mercury, whereby it tends to promote the absorption of exudation matter, both by its direct local action and by its producing on the system a greater or less mercurial impression. Indeed, it not unfrequently occasions soreness of the gums and a degree of salivation. This property has led to its being frequently employed for the removal of *syphilitic nodes* and *glandular engorgements* produced by the same cause, including those of the *liver*. It appears also to promote the reduction of enlargements of that organ and of the *spleen*, produced by malarial disease. The Vigo plaster of the French Codex, which is a mercurial plaster containing turpentine and gum resins, has been applied as a mask to the face during the papular stage of *smallpox*, with the effect of preventing a full development of pustules, and consequently of pitting. The simpler mercurial plaster appears to have been used with equally good results. In both cases the influence of mechanical compression and of the exclusion of light should not be overlooked.

EMPLASTRUM OPII, *U. S.*, *Br.*—OPIUM PASTER.

Emplastrum opiatum, P. G.; *Emplastrum cephalicum (s. odontalgicum)*—*Empâtre d'opium, Emplâtre céphalique (temporal, odontalgique, calmant)*, Fr.; *Opiumpflaster, Hauptpflaster*, G.

Preparation.—Take of Extract of Opium a troyounce; Burgundy Pitch three troyounces; Lead Plaster twelve troyounces; Water a sufficient quantity. Mix the extract with three fluidounces of water, and evaporate, by means of a water-bath, to a fluidounce and a half. Add this to the Burgundy pitch and lead plaster, melted together by means of a water-bath, and continue the heat for a short time, stirring constantly, that the moisture may be evaporated. *U. S.*

Take of Opium in fine powder one ounce; Resin Plaster nine ounces. Melt the resin plaster by means of a water-bath; then add the opium by degrees, and mix thoroughly. *Br.*

Both formulas yield good and efficient plasters; the first being preferable, on account of the absence of the insoluble and non-adhesive constituents of opium, and for being rather stronger, as far as opium is concerned. The German Pharmacopœia gives a complex formula containing about one-half the proportion of opium ordered by the British Pharmacopœia.

Medical Uses.—This plaster is a convenient form for the local application of opium to painful parts of limited extent, *e. g.*, to the face in toothache.

EMPLASTRUM PICIS BURGUNDICÆ, *U. S.*—BURGUNDY PITCH PLASTER.

Emplastrum picatum, F. P.—*Emplâtre de poix de Bourgogne*, Fr.; *Burgunder Pech-Pflaster*, G.

Preparation.—Take of Burgundy Pitch seventy-two troyounces; Yellow Wax six troyounces. Melt them together, strain, and stir constantly until they thicken on cooling. *U. S.*

The French Codex directs one part of yellow wax to three parts of Burgundy pitch; the German Pharmacopœia nearly the same proportions with an addition of nearly one part of turpentine.

The formula of the British Pharmacopœia for *Emplastrum Picis*, or *Pitch plaster*, is as follows: Take of Burgundy Pitch twenty-six ounces; Common Frankincense thirteen ounces; Resin and Yellow Wax, each four and a half ounces; Expressed Oil of Nutmeg one ounce; Olive Oil and Water, each two fluidounces. Add the oils and water to the frankincense, Burgundy pitch, resin and wax, previously melted together; then constantly stirring, evaporate to a proper consistence. *Br.*

Medical Uses.—Burgundy pitch plaster, besides supporting parts mechanically, is useful through its stimulant and mildly counter-irritant action.

EMPLASTRUM PICIS CANADENSIS, *U. S.*—CANADA PITCH PLASTER.

Hemlock pitch plaster, Hemlock plaster, E.; *Emplâtre de poix de Canada*, Fr.; *Canadapech-Pflaster*, G.

Preparation.—Take of Canada Pitch seventy-two troyounces; Yellow Wax six troyounces. Melt them together, strain, and stir constantly until they thicken on cooling. *U. S.*

Medical Uses.—Its uses are the same as those of Burgundy pitch plaster.

EMPLASTRUM PICIS CUM CANTHARIDE, *U. S.*—PLASTER OF PITCH WITH CANTHARIDES.

Emplastrum calefaciens, Br.—*Warm or warming plaster*, E.; *Emplâtre de poix cantharidé*, Fr.; *Pechpflaster mit Canthariden*, G.

Preparation.—Take of Burgundy Pitch forty-eight troyounces; Cerate of Cantharides four troyounces. Heat the cerate as nearly as possible to 212° in a water-bath, and, having continued the heat for fifteen minutes, strain the cerate, add the pitch, and, melting them together by means of a water-bath, stir constantly until the mixture thickens on cooling. *U. S.*

Take of Cantharides in coarse powder, Expressed Oil of Nutmeg, Yellow Wax, Resin, of each four ounces; Soap Plaster three and one-quarter pounds; Resin Plaster two pounds; Boiling Water one pint. Infuse the cantharides in the boiling water for six hours, squeeze strongly through calico, and evaporate the expressed liquid by a water-bath till reduced to one-third. Then add the other ingredients and melt in a water-bath, stirring well until the whole is thoroughly mixed. *Br.*

A. W. Gerrard (1874) recommends the substitution of resin plaster for the soap plaster.

EMPLASTRUM CANTHARIDUM PERPETUUM, Ph. G., is used for similar purposes, and is prepared by melting with a gentle heat resin and yellow wax each 50 parts, turpentine 37 parts, Burgundy pitch 25 parts, and suet 20 parts, and then adding very finely powdered cantharides 18 parts and euphorbium 6 parts. It has a greenish-black color.

Medical Action and Uses.—Its use is to maintain a mild counter-irritant action greater than that of the simple pitch plaster, but less than is caused by a blister. It is often of signal advantage in chronic affections of the *joints*, chronic muscular *rheumatism*, and chronic diseases of the *chest*. Of the last, chronic *bronchitis* is often greatly benefited by its use, and next to this chronic *pleurisy*. It is of service in the treatment of chronic pulmonary engorgement due to the presence of *tubercle*, or to that *broncho-pneumonia* which so often tends to pulmonary phthisis.

EMPLASTRUM PLUMBI, *U. S.*, *Br.*—LEAD PLASTER.

Emplastrum lithargyri simplex, P. G.; *Emplastrum simplex*, F. P.; *Emplastrum diachylon simplex.—Diachylon plaster, Litharge plaster*, E.; *Emplâtre simple, Emplâtre de plomb (de litharge)*, Fr.; *Bleipflaster, Diachylon-Pflaster*, G.

Preparation.—Take of Oxide of Lead in fine powder thirty troyounces; Olive Oil fifty-six troyounces; Water a sufficient quantity. Rub the oxide of lead with half its weight of the oil; add the mixture to the remainder of the oil, contained in a suitable vessel, of a capacity equal to twice the bulk of the ingredients. Then add half a pint of boiling water, and boil the whole together until a plaster is formed; adding from time to time during the process a little boiling water, as that first added is consumed. *U. S.*

The French and German Pharmacopœias use equal parts of olive oil and lard in place of olive oil alone, which is directed by the British and United States Pharmacopœias. A much greater discrepancy, however, exists in the proportion of the fat to the litharge. The United States Pharmacopœia directs 28 parts of the fat and 15 parts of litharge. Calculated for the same amount of fat, the French and German formulas use 14, the British only 12.25 parts of litharge. The last-named amount is decidedly insufficient, and yields a plaster which is and remains sticky. The litharge should be not less than half the weight of the fat used, and, in view of its variable quality, may very properly be increased somewhat beyond that proportion as directed by the United States Pharmacopœia.

In view of the importance of this plaster as a basis for many others, it is usually prepared in larger quantities, and an expeditious and successful manipulation is therefore to be preferred to methods which may involve more labor and time. If the litharge is in fine powder there is no necessity to triturate it with the oil; but it is well to pass it through a sieve for the purpose of removing impurities and breaking up lumps, and to sift it directly into the mixture of oil and water, which may at the same time be heated. The whole is then boiled, and frequently stirred to prevent the litharge from settling to the bottom, and a little hot water is added from time to time to supply that which may have evaporated. The mixture has at first a reddish color, which gradually changes until it finally becomes white. From the time it commences to boil the mixture foams on account of the extrication of the watery vapors, and as the saponification proceeds the foaming increases. Now it requires additional attention to keep up the supply of water and to prevent the mass from becoming overheated, which would interfere with the adhesive qualities of the plaster and more or less darken its color. The temperature may be allowed to rise to about 120° C. (248° F.); but will be below that point if sufficient water be present. Without the addition of water litharge will decompose fats uniting with the fatty acids, but a much higher temperature will be required, and, in the absence of water, glycerin cannot be separated, but is decomposed. Plumbic hydrate, the hydrated oxide of lead, contains enough water for the separation of glycerin, and its combination with the acids of the oil is effected more readily and at a lower temperature. The relations are similar if the officinal directions are followed; but the saponification of the fat requires more time as plumbic hydrate is slowly formed; however with sufficient attention no secondary decomposition products are formed. To increase the saponifying action of the litharge a small quantity of acetate of lead is sometimes added, by which the oxide is more readily dissolved; the addition is, however, not necessary. Since carbonate of lead saponifies fats with greater difficulty than the oxide, the latter should be as free from the former as possible; the carbonic acid is gradually evolved as the saponification proceeds.

Lead plaster may also be obtained by precipitating a solution of soap by sugar of lead; but the plaster thus obtained soon becomes hard and dark colored. Similar objections exist against the substitution of many other fats for olive oil. As we have seen, the French and German Pharmacopœias sanction the use of equal weights of olive oil and lard.

The process is known to be finished when, after dropping a little of the plaster in cold water and kneading it between the fingers, it is found to be pliable, but not sticky. When this point has been reached the vessel is removed from the fire, and allowed to cool somewhat. The temperature may then be reduced by the addition of cold water, and the mass kneaded and rolled out, as described above (page 515), into cylinders weighing half a pound each.

Lead plaster is of a uniform grayish-white color which superficially changes to yellowish, and should be entirely free from uncombined litharge, the presence of which is easily recognized by its reddish color. Chemically it is a mixture of oleate and palmitate of lead, containing also stearate if lard has been used in its preparation.

Zinc plaster, in which oxide of zinc is substituted for litharge, has been occasionally recommended; it is most expeditiously prepared by mixing concentrated solutions of 2 parts of white Castile soap and 1 part of sulphate of zinc, digesting the mixture until the decomposition has been completed, and washing out the salt by kneading the mass under water.

Off. Prep.—Empl. assafœtidæ, *U. S.*; Empl. ferri, *U. S.*, *Br.*; Empl. galbani, *Br.*; Empl. galbani comp., *U. S.*; Empl. hydrargyri, *U. S.*, *Br.*; Empl. opii, *U. S.*; Empl. resinæ, Empl. saponis, *U. S.*, *Br.*

Medical Action and Uses.—The oxide of lead in this plaster is its only active ingredient, and hence it is used as a discutient as well as a protective. Owing to the possibility of absorption of the lead, it should not be applied to raw surfaces. It is frequently used to prevent *bed-sores* and the *abrasions* which many forms of surgical apparatus tend to produce.

EMPLASTRUM PLUMBI IODIDI, *Br.*—IODIDE OF LEAD PLASTER.

Emplâtre d'iodure de plomb, Fr.; *Jodblei-Pflaster*, G.

Preparation.—Take of Iodide of Lead one ounce; Soap Plaster and Resin Plaster, each four ounces. Add the iodide of lead in fine powder to the plasters previously melted, and mix them intimately. *Br.*

Mr. A. W. Gerrard (1874) showed that thus prepared the plaster contains very little iodide of lead, which is nearly all decomposed by the soap contained in the plaster; he suggests the following modification: Melt together 1½ ounces of resin and 16 ounces of lead plaster, and stir in 2 ounces of finely powdered iodide of lead.

Medical Action and Uses.—This is perhaps the best form in which the iodide of lead can be employed topically for promoting the resolution of indurations resulting from inflammation, and especially from articular rheumatism.

EMPLASTRUM RESINÆ, *U. S., Br.*—RESIN PLASTER.

Adhesive plaster, E.; *Emplâtre résineux* (*adhésif*), Fr.; *Heftpflaster*, G.

Preparation.—Take of Resin in fine powder six troyounces; Lead Plaster thirty-six troyounces. To the lead plaster, melted over a gentle fire, add the resin, and mix them. *U. S.*

Take of Resin four ounces; Lead Plaster two pounds; Hard Soap two ounces. To the lead plaster, previously melted with a gentle heat, add the resin and soap, first liquefied, and stir them until they are thoroughly mixed. *Br.*

This is the plaster which, spread upon muslin, forms the sparadrap commonly known as *adhesive plaster* or *sticking plaster.* A. W. Gerrard (1874) suggests that for use in summer one-fourth the quantities of soap and resin ordered in the second formula should be used; in the spring, one-half the quantity will answer; but in cold weather, the officinal proportions are preferable. The German Pharmacopœia prepares for this purpose a plaster from crude oleic acid by heating, by means of a steam bath, 18 parts of the acid with 10 parts of finely powdered litharge, and after the plaster has been formed, which is accomplished without difficulty, adding to the mass 3 parts of resin and 1 part of suet.

Good adhesive plaster should not be sticky at the ordinary temperature; when spread upon muslin, it should be pliable without cracking, and when applied to the skin, should adhere firmly.

Off. Prep.—Empl. aconiti, Empl. arnicæ, *U. S.;* Empl. belladonnæ, *U. S., Br.;* Empl. calefaciens, Empl. opii, Empl. plumbi iodidi, *Br.*

Medical Uses.—Adhesive plaster is chiefly employed for the support of mobile parts, for exerting pressure, for securing the coaptation of *wounds* and *fractures*, for maintaining *surgical dressings*, etc. It is apt to irritate delicate skins.

EMPLASTRUM SAPONIS, *U. S., Br.*—SOAP PLASTER.

Emplastrum saponatum, P. G.; *Emplastrum cum sapone*, F. P.—*Emplâtre de savon*, Fr.; *Seifenpflaster*, G.

Preparation.—Take of Soap sliced four troyounces; Lead Plaster thirty-six troyounces; Water a sufficient quantity. Rub the soap with water until brought to a semi-fluid state; then mix it with the lead plaster, previously melted, and boil to the proper consistence. *U. S.*

Take of Hard Soap six ounces; Lead Plaster two and a quarter pounds; Resin one ounce. To the lead plaster, melted by a gentle heat, add the soap and the resin, first liquefied; then, constantly stirring, evaporate to a proper consistence. *Br.*

The presence of one-seventh of soap in the second formula renders the plaster less adhesive than that of the first formula, in which the soap has been reduced to one-tenth of the whole. The soap plaster of the German Pharmacopœia contains one-fifteenth of soap, and in addition 1.1 per cent. of camphor; and that of the French Codex rather less than one-seventeenth of soap.

Off. Prep.—Ceratum saponis, *U. S.;* Empl. calefaciens, Empl. plumbi iodidi, *Br.*

Among the unofficinal plasters, more or less employed in different sections, the following deserve to be mentioned in this place:—

EMPLASTRUM CERUSSÆ, s. *Empl. album coctum.*—Litharge 10 parts, and olive oil 25 parts, are boiled together with water until the former is dissolved; carbonate of lead, 18 parts, is then added, and the boiling continued until a plaster is formed (*P. G.*). A similar composition containing a little wax and powdered orris root is known as *Mahy's plaster.*

EMPLASTRUM FUSCUM, s. *Empl. matris fuscum, Empl. nigrum s. noricum s. minii adustum s. universale.*—Finely powdered red oxide of lead 2 parts, and olive oil 2 parts, are boiled with constant stirring, until the mass assumes a dark brown color, when 1 part of yellow wax is added (*P. G.*). For some purposes, 1 per cent of camphor is added. The plaster is put up in square cakes and in boxes, and is also sold in the United States as a secret preparation under different names. It is extensively employed by the German population, and known to them as *Mutterpflaster, Universalpflaster,* etc.

LOGAN'S PLASTER.—Boil together over a slow fire olive oil 2½ pints, fresh butter 4 ounces, Castile soap 12 ounces, litharge 16 ounces avoirdupois, until the mass has a pale brown color; then add carbonate of lead 16 ounces, and continue the heat until the plaster is formed; lastly, add 2 drachms of powdered mastich.

Medical Uses.—Soap plaster is generally used to prevent *abrasions, bed-sores,* etc., and, like other plasters containing lead, it possesses some discutient powers. Owing to the thickness of the layer, as it is usually spread, it is apt to be moved from its original position, and is therefore not so efficient as adhesive plaster in preventing bed-sores.

ENEMATA.—CLYSTERS.

Clysmata, Clysteria.—Lavements, Clystères, Fr.; *Klystiere,* G.

Clysters are liquid medicines which are injected into the rectum by means of a syringe, and ordinarily consist of water or of infusions mixed with solutions of salts or holding insoluble substances in suspension. They are rarely if ever prepared by the apothecary, but are generally made at the bedside, and the introduction of formulas into the Pharmacopœia serves mainly the purpose of informing the physician of the mode of their preparation.

ENEMA ALOES, *Br.*—ENEMA OF ALOES.

Lavement aloëtique, Fr.; *Aloeklystier,* G.

Preparation.—Take of Aloes forty grains; Carbonate of Potash fifteen grains; Mucilage of Starch ten fluidounces. Mix, and rub together. *Br.*

Medical Action and Uses.—It is far from certain that the enema of aloes exerts any special influence, or any that would not be secured equally well by a solution of common salt or of a magnesium salt. Aloetic enemata, when they are intended to purge, should be large; but when they are to be retained, to destroy *ascarides* of the rectum, or to stimulate the *uterus,* they should not exceed two or three fluidounces.

ENEMA ASSAFŒTIDÆ, *Br.*—ENEMA OF ASAFŒTIDA.

Enema fœtidum s. antihystericum, Clysma tonicum.—Lavement d'ase fetide, Fr.; *Asafötida-Klystier,* G.

Preparation.—Take of Asafœtida thirty grains; Distilled Water four fluidounces. Rub the asafœtida in a mortar with the water added gradually, so as to form an emulsion. *Br.*

This is identical with a mixture of equal parts of water and milk of asafœtida.

Medical Action and Uses.—The use of asafœtida by enema is often the most eligible mode of its administration, on account of the patient's inability to swallow, as in *hysteria*, or because it acts very promptly, as in cases of *intestinal flatus*. The association of aloes with the emulsion of asafœtida forms a very useful enema in cases of *constipation* with flatulence. A mixture of the wine or tincture of aloes, and tincture of asafœtida, sufficiently diluted with water, is far better than the officinal enema made with water alone.

ENEMA MAGNESIÆ SULPHATIS, *Br.*—ENEMA OF SULPHATE OF MAGNESIA.

Enema catharticum.—*Lavement de sulfate de magnésie*, Fr.; *Bittersalz-Klystier*, G.

Preparation.—Take of Sulphate of Magnesia one ounce; Olive Oil one fluidounce; Mucilage of Starch fifteen fluidounces. Dissolve the sulphate of magnesia in the mucilage of starch, add the oil, and mix. *Br.*

Medical Action and Uses.—The oil and mucilage in this enema are worse than useless. A simple solution of Epsom or of Glauber salts is preferable. It may be used as an evacuant of a constipated bowel when a prompt operation is desired, as in cases of obstinate *constipation* or of *congestion of the brain*. For such purposes an enema should always be large.

ENEMA OPII, *Br.*—ENEMA OF OPIUM.

Enema anodynum s. sedativum.—*Lavement opiacé anodin*, Fr.; *Opium-Klystier*, G.

Preparation.—Take of Tincture of Opium half a fluidrachm; Mucilage of Starch two fluidounces. Mix. *Br.*

Medical Action and Uses.—The quantity of laudanum or of other liquid opiate in an enema must vary with the age and state of the patient, whether a local or a general narcotic effect is sought, etc. As the enema ought to be retained, the quantity of liquid in it should not exceed two ounces; and it should consist of water, which is promptly absorbed, and not of starch, which may not be absorbed at all.

ENEMA TABACI, *Br.*—ENEMA OF TOBACCO.

Lavement de tabac, Fr.; *Tabak-Klystier*, G.

Preparation.—Take of Leaf Tobacco twenty grains; Boiling Water eight fluidounces. Infuse in a covered vessel for half an hour, and strain. *Br.*

Medical Action and Uses.—The infusion of tobacco (U. S. P.) is stronger than this preparation by one-half, but is prepared in the same way, and used for the same internal purposes—that is to say, for producing nausea and muscular relaxation in cases of strangulated *hernia*, and promoting alvine evacuations in *ileus*, as well as in the various cases indicated in the article on Tobacco. Its use requires caution.

ENEMA TEREBINTHINÆ, *Br.*—ENEMA OF TURPENTINE.

Lavement térébinthiné, Fr.; *Terpentinöl-Klystier*, G.

Preparation.—Take of Oil of Turpentine one fluidounce; Mucilage of Starch fifteen fluidounces. Mix. *Br.*

Medical Action and Uses.—In the case of this enema, the proportion of the active ingredient should vary with the case in which it is used, and numerous other circumstances. It is most frequently employed to lessen *tympanitic* distension of the bowels, but is of little use, comparatively, unless the flatus is confined in the colon. It sometimes affords great relief to the suffering from *vesical calculus*. It has been used with alleged advantage in certain cases of *amenorrhœa;* and to destroy *ascarides* of the rectum. It is sometimes administered during a paroxysm of *hysteria*. When it is intended that a turpentine enema shall be retained, its bulk should be small, and it should also be made into an emulsion with yelk of egg.

EPIGÆA.—TRAILING ARBUTUS.

Ground-laurel, Gravel-plant, May-flower, E.

Epigæa repens, *Lin.* *Nat. Ord.*—Ericaceæ, Ericineæ.

Description.—The trailing arbutus is a prostrate hairy North American shrub, about a foot long, growing in sandy woods and flowering in early spring. The thin woody stem is covered with a brown bark. The evergreen leaves are alternate, about two inches long, petiolate, coriaceous, and reticulated; their shape is ovate, the margin entire, the base heart-shaped, and the apex tipped with a short point. The flowers are in small axillary clusters, rose-colored or whitish, fragrant, have a deeply five-parted bracted calyx, a salver-form corolla with the tube hairy inside, ten stamens, and produce five-lobed and five-celled capsules containing numerous seeds. The leaves are inodorous, and have a bitterish and astringent taste.

Constituents.—The leaves contain tannin, which produces a black precipitate with iron salts. Using gelatin as a precipitant, H. K. Bowman (1869) determined its amount to be 3.5 per cent. Jefferson Oxley (1872) proved the constituents to be identical with those of uva ursi, namely, *arbutin*, *urson*, and *ericolin*. Formic acid was also found, and a principle having in the behavior to tests some resemblance to gallic acid, without, however, yielding pyrogallic acid.

Medical Action and Uses.—Trailing arbutus has been compared with uva ursi and buchu; it possesses some astringency, like the former. It has been used for the relief of *strangury* and of *vesical catarrh*. A decoction is prepared with an ounce of the dried leaves and stems in a pint of water, and given in the *dose* of a wineglassful three or four times a day.

EPILOBIUM.—WILLOW-HERB.

Herbe de St. Antoine, Fr.; *Weidenröschen, Antonskraut*, G.

Epilobium angustifolium, *Lin.*, s. E. spicatum, *Lam.*
Nat. Ord.—Onagraceæ.

Origin.—A perennial herb, about four to six feet high, and growing in mountainous woodlands, occasionally also in dry and sunny localities. It is indigenous to North America, Northern Asia, and the greater portion of Europe, and flowers in July and August.

Description.—The root is long, fleshy, yellowish-white, and has a thick bark. The stem is erect, smooth, often reddish, branching above. The leaves are scattered, subsessile, from three to six inches long, lanceolate or linear-lanceolate, nearly entire, with a marginal vein, smooth, pale-green beneath. The flowers are in a long terminal spicate raceme; the calyx adheres to the long linear, four-sided ovary; the four unguiculate petals are spreading, purple-colored, or pinkish and showy. The eight stamens and the style with the long four-lobed stigma are bent downwards. All parts of the plant have a mucilaginous and astringent taste.

Constituents.—Analyzed by C. J. Biddle (1877) the usual constituents of plants were found. The astringent taste is due to a tannin which produces bluish-black precipitates with ferric salts. Gallic acid is also stated to be present.

Medical Action and Uses.—The demulcent, tonic, and astringent qualities of willow-herb are reported to render it useful in mild or subacute forms of *diarrhœa*. It may be given in decoction, and also applied externally to unhealthy ulcers, including aphthæ.

The root and young shoots are eaten by the inhabitants of subarctic regions, and in Russia and Siberia the leaves are used in the place of tea.

EPIPHEGUS.—BEECHDROP.

Cancer-root, E.; *Orobanche de Virginie*, Fr.; *Krebswurz*, G.

Epiphegus (Orobanche, *Lin.*) virginiana, *Bart.*, s. E. americanus, *Nutt.*
Nat. Ord.—Orobanchaceæ.

Origin.—A perennial parasite growing upon the roots of beech trees in North America. It is collected in autumn.

Description.—The subterraneous portion consists of a subglobular scaly tuber, half an inch and more in diameter. The stem is twelve to eighteen inches high, much branched, angular, with ovate scales at the base of the branches and flowers. The flowers are in long spicate racemes, the lower ones fertile and with a short corolla, the upper ones sterile with a long tubular and two-lipped corolla, about one-third of an inch long. The stamens are didynamous, and the superior capsule is one-celled, two-valved, and contains numerous minute seeds. All parts of the plant have a pale-purplish or yellowish-brown color, and a disagreeable, bitter, and somewhat astringent taste.

The constituents of the plant have not been investigated.

Allied Plants, belonging to the same natural order, have been medicinally employed in Europe and America. They are all parasitic, destitute of green foliage, and have a more or less bitter astringent and nauseous taste. We mention the following North American species:—

CONOPHOLIS (OROBANCHE, *Lin.*) AMERICANA, *Wallroth;* Cancer-root, Squaw-root, *E.* It is from four to seven inches high, nearly an inch thick, fleshy, yellowish or brownish, covered with pale shining imbricated scales, resembling a pine-cone. The flowers have a curved two-lipped corolla and four exserted stamens. It grows in oak-woods.

APHYLLON UNIFLORUM, *Tor. and Gr.*, s. Orobanche uniflora, *Lin.* Naked broom-rape, *E.* It grows in woodlands, has a very short, nearly subterraneous scaly stem, bearing one or several peduncles about four inches long, each with a nodding flower, having a curved tubular somewhat two-lipped corolla and included stamens. Its color is whitish or pale tawny.

Medical Action and Uses.—This plant appears to be astringent. Dried and powdered it has been given internally to control *diarrhœa*, and applied externally to fungous and unhealthy *ulcers*.

EQUISETUM.—HORSETAIL.

Prêle, Fr.; *Schachtelhalm*, G.

Equisetum arvense, *Lin.*, and Eq. hyemale, *Lin.* *Nat. Ord.*—Equisetaceæ.

Description.—Both plants are leafless, and grow in damp soil in Europe and North America.

E. ARVENSE, *common horsetail*, has a simple, smooth, fertile stem, appearing in March or April. The barren stems, which alone are used, are slender, about 2 feet long, green, jointed, about 12-furrowed, with simple or compound quadrangular branches, bearing at the joints 4 scales.

E. HYEMALE, *scouring rush* or *shave-grass*, has a simple stem about 2 feet long, round, grooved, the ridges rough, and at the joints with sheaths of about 20 narrow teeth, having a black girdle at the base and tip.

Constituents.—The scouring rush was analyzed by Diebold (1828), who found in it resin, wax, sugar, and other common vegetable principles. John obtained 13 per cent. of ash, 63 per cent. of which, or 8 per cent. of the plant, was silica. The common horsetail gave to Willing (1856) 4.07 per cent. of ash, 41.4 per cent. of which was silica.

Medical Action and Uses.—An infusion of the whole plant is reputed to be diuretic, like its European congeners, which, even from ancient times, have been recognized as possessing this virtue. If too freely used it is said to render the urine bloody.

ERGOTA, *U. S.*, *Br.*—ERGOT.

Secale cornutum, P. G.; *Secale clavatum*, *Mater secalis*, *Clavus secalinus.*—*Spurred rye*, E.; *Ergot*, *Seigle ergoté* (*noir*), *Blé cornu*, Fr.; *Mutterkorn*, *Kornmutter*, *Zapfenkorn*, G.

The sclerotium (compact mycelium or spawn) of Claviceps purpurea, *Tulasne*, replacing the grain (produced within the paleæ, *Br.*) of the common rye, Secale cereale, *Lin.* Steph. and Church, Med. Bot., plate 113.

Nat. Ord.—Fungi.

Origin.—The ergot fungus, *Claviceps purpurea*, Tul., and similar, but propably distinct organisms, are met with upon many grasses. For medicinal purposes that of rye alone is collected. In its development three distinct stages are observed. At the flowering season one or more ovaries in an ear of rye appear covered by a sweet yellowish mucus, the so-called *honey-dew of rye*, which has a disagreeable odor, and is avoided by bees, but attracts other insects, mainly ants and beetles, which were formerly considered to cause the disease of the grain. This honey-dew contains innumerable microscopic cells called *conidia*, and a sugar which reduces alkaline solutions of cupric oxide to cuprous oxide, and is a product of decomposition of the constituents of the ovary, caused by the developing *mycelium* of the fungus. This is formed by filamentous cells called *hyphæ*, with an outer layer, forming a kind of membrane, the *hymenium*, composed of short linear cells, the *basidia*, by which the oblong or oval conidia are separated. In this stage of development it was formerly considered a distinct fungus, and received various names, the best known being *Sphacelia segetum*, Léveillé, which is often used as a descriptive term for the first stage, which is completed when the hyphæ have penetrated the lower part of the ovary and the separation of the conidia ceases.

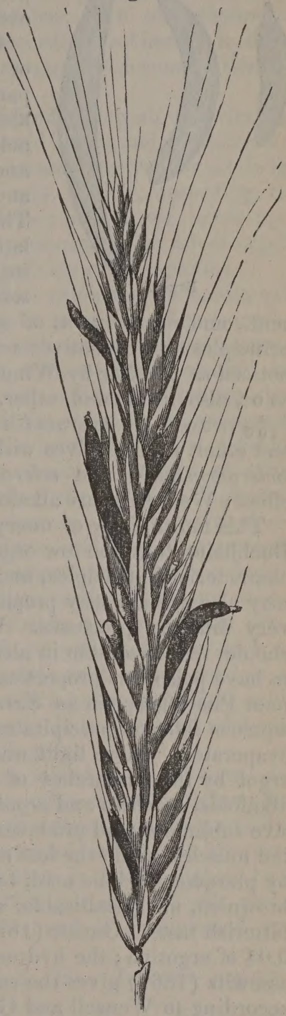
The hyphæ of the sphacelia now begin to unite at the base of the ovary into a compact body, which is purplish-black externally, and rapidly grows in length, carrying upon its apex in the form of a hood the remains of the ovary and fragments of the sphacelia tissue. Occasionally the formation of the honey-dew does not commence until some time after fructification has taken place and the fruit is partially developed; in such a case the ergot will be crowned by a stunted grain. When full grown the second stage of the fungus has been reached, which forms the officinal ergot, and was formerly regarded as a distinct fungus, named by De Candolle *Sclerotium clavus*.

After some months of rest, in the succeeding spring, small circular patches of the external layer are loosened and fold back, while, at the same time, small heads make their appearance, which, at first white, change to yellowish, reddish, and finally purple, and are upon slender, pale-purplish, curved stypes. On the surface of the head, small wart-like excrescences are formed containing the apertures of bottle-shaped cavities or conceptacles, the *perithecia*. Each one of these conceptacles contains a large number of somewhat fusiform cells or spore sacs, the *asci*, each one containing 8 filiform spores, which are discharged from the aperture of the conceptacle, agglutinated in a bundle. The formation of the spores takes place about the time of the flowering of rye, and when brought in contact with its flowers, the spores develop again the sphacelia. The spore-producing heads are nourished from the contents of tissue of the sclerotium, which at first becomes loose and spongy from the disappearance of the oil, and finally shrivels and is destroyed. This third and final stage was formerly likewise regarded as a distinct fungus, known, among other names, as *Cordiceps purpurea*, Fries, until Tulasne (1853) proved it to be merely the final stage in the development of a fungus, as described above. The production of spores may be observed by leaving the ergot in the open air, or by keeping it upon moist earth under a bell-glass; we have noticed it in a damp stoppered bottle containing some ergot.

It will be seen that the officinal ergot is merely the intermediate or dormant state of a fungus, named by the different Pharmacopœias sclerotium, *U. S.*, compact mycelium or spawn, *Br.*, and stromata sterilia (sterile beds), *P. G.*

The United States imported 75,550 lbs. of ergot during the fiscal year 1876–1877; ten years previously but 10 per cent of this quantity.

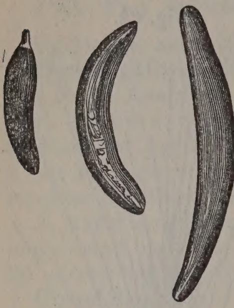
Fig. 62.



Ergotized Rye.

Description.—Ergot forms a solid, somewhat fusiform body, which is 1 to 1½ inch long, subcylindrical, or often obtusely triangular, tapering at both ends, usually somewhat curved, with three longitudinal furrows, and an easily detached, yellowish, small appendage or hood at the apex. It is externally of a purplish-black color, the surface frequently fissured transversely, internally whitish, with some purplish striæ, of a uniform texture, breaking readily with a smooth fracture. It has a peculiar heavy odor, particularly when moist, and an oily unpleasant taste. It is frequently attacked by a mite, from which it may be preserved by thoroughly drying it and keeping it in well-stopped bottles, or by putting a few drops of chloroform into the bottle containing it. When powdered it spoils after a short time, the deterioration being induced by the fixed oil becoming rancid; it should, therefore, not be kept on hand in the powdered state, except for a brief period. It appears to preserve its virtues not much over a year, and should, therefore, be annually renewed.

Fig. 63.



Ergot.

Constituents.—The separation of the constituents of ergot offers peculiar difficulties, which have been in part explained by the recent researches of Buchheim and of Dragendorff (1876); the former regards the active principle as a body somewhat resembling gelatin, and that it is formed from the gluten of the rye ovary, and readily changed by the influence of chemical agents. The latter, in connection with Podwissotzky, has isolated a number of uncrystallizable compounds, possessing more or less activity, the most important being *sclerotic acid*, present to the amount of 4 or $4\frac{1}{2}$ per cent., and *scleromucin*, of which 2 to 3 per cent. are obtained. The following principles are less active: *sclererythrin*, the red coloring matter, which was first noticed as peculiar by Winckler, is soluble in alkalies with a splendid murexid color, also in alcohol, ether, and chloroform; it is present in minute quantity ($\frac{1}{100}$ per cent.); *scleroiodin* ($\frac{1}{10}$ per cent. of ergot) is insoluble in water, alcohol, and ether, and dissolves with a violet color in potassa or strong sulphuric acid. *Sclerocrystallin* and *scleroxanthin* are crystallizable, but without medicinal effect; Wenzell's pure alkaloids (see below) are likewise regarded as nearly inert.

This multiplicity of uncrystallizable principles seems to support the views of Buchheim that the low organization of ergot prevents the formation of well-characterized principles, and that those which are formed are easily altered; it may also explain why preparations possessing some activity may be obtained by very different processes. Wiggers' *ergotin*, obtained in 1830, resembles cinchonic red, is soluble in alcohol, but insoluble in water and ether, and is said to have poisonous properties. Bonjean's *ergotin*, which is officinial in the German Pharmacopœia as *Extractum secalis cornuti*, is merely the concentrated aqueous infusion precipitated by half its weight of alcohol, and the clear filtrate evaporated. More light was apparently thrown upon the active principles of ergot by the researches of Wenzell (1864), who proved the presence of two alkaloids, *ecbolina* and *ergotina;* the former of which is precipitated by corrosive sublimate, and produces decided effects upon the brain, and contractions of the muscles, while the less active *ergotina* reduces the pulse, and is precipitated by phosphomolybdic acid, but not by corrosive sublimate. Both alkaloids are brownish, uncrystallizable, soluble in water, and have an alkaline reaction and bitterish taste. Ganser (1870) obtained from ergot 0.16 per cent. of ecbolina and 0.04 of ergotina; the hydrochlorate of the latter crystallizing in needles. Manassewitz (1867) gives the composition of ergotina as $C_{50}H_{52}N_2O_3$. The alkaloids, according to Wenzell and Ganser, exist in combination with *ergotic acid*, which is volatile, and yields crystallizable salts. Dragendorff (1876), however, regards the two alkaloids as identical, and this seems to have been proven by Blumberg (1878), who found that concentrated solution of ergotina is precipitated by corrosive sublimate, in the same way as ecbolina, and that this precipitate with the latter alkaloid is not insoluble in water. Moreover, Dragendorff denies that ecbolina, which is entirely free from the compounds mentioned above, possesses any decided physiological action. Another alkaloid, *ergotinina*, was isolated by Tanret (1875) from the fixed oil of ergot prepared with ether, by agitating it with acidulated water. Ergotinina is crystalline, but soon becomes resinous; oil of vitriol colors it violet blue; in its effects upon frogs it resembles *picrosclerotina* (producing decreased sensibility, paralysis of the extremities, and death without convulsions). This amorphous alkaloid, which is perhaps impure ergotinina, was obtained, together with *fuscosclerotic acid*, by Dragendorff and Podwissotzky in purifying sclererythrin. That water distilled from ergot, particularly in presence of an alkali, possesses an alkaline reaction, was observed by F. L. Winckler (1826); the alkaline principle was subsequently (1853) named *secalina;* but was found to be identical with *trimethylamin* (*methylamin*, according to Ludwig and Stahl). According to Ganser it does not pre-exist in ergot, but appears to be formed through the decomposition of the protein compounds.

Ergot contains between 28 and 35 per cent. of bland yellowish non-drying *fixed oil*, from which warm alcohol removes some acrid *resin* and *cholesterin;* the latter was obtained by L. Stahl (1865), and its character proven by Ludwig (1869). Schoonbroodt (1866) found in it *lactic acid*, which, according to Buchheim, often renders ergotin strongly acid. *Formic* and *acetic acids* appear also to be sometimes present. Starch is entirely absent. The ash of ergot amounts to 3 or 4 per cent., and consists almost exclusively of phosphates.

Sclerotic acid and *scleromucin* having attracted some attention as medicinal preparations, we give the process by which they may be isolated: Digest ergot, previously exhausted by ether and absolute alcohol, with water, dialyze, evaporate the dialyzate to a syrupy consistence, and treat with sufficient alcohol to obtain a mixture containing 40 to 45 per cent. alcohol, which precipitates the potassium phosphate; while more alcohol, added until the strength is increased to 75 or 80 per cent., precipitates the salts of sclerotic acid, which are soluble in dilute, but insoluble in stronger alcohol, and leave about 19 per cent. of ash. The acid is obtained in a nearly pure state by kneading the mixed sclerotates with 80 per cent. alcohol, and afterwards dissolving them in 40 per cent. alcohol; the solution is mixed with an excess of hydrochloric acid, and after several hours filtered and precipitated with absolute alcohol, whereby the ash is reduced to about 3 per cent., and consists mainly of some silica, manganium, and phosphates of iron and potassium. The acid is not a glucoside, and yields no precipitates with the reagents for alkaloids, except with phosphomolybdic acid a yellow, and with tannin a nearly colorless one. Sclerotic acid is obtained as a yellowish-brown, tasteless and inodorous substance, which has a very slight acid reaction, and is hygroscopic without being deliquescent. It is very well adapted for subcutaneous appliances, in doses of 0.03 to 0.045 gram.

The dark liquid remaining on the dialyzer, when mixed with sufficient alcohol to bring it to 45 or 60 per cent., precipitates the *scleromucin*, which while moist forms a mucilaginous solution with water, but after drying is only partially soluble, differing in this respect from sclerotic acid, which is soluble, in all proportions, before and after drying. Scleromucin is darker in color, slightly hygroscopic, gummy, inodorous and tasteless; yields 26.8 per cent. of ash, and, like sclerotic acid, contains nitrogen, is not a glucoside, and is precipitated by tannin and phosphomolybdic acid.

Off. Prep.—Extr. ergotæ fluidum (liquidum), *U. S.*, *Br.;* Infusum ergotæ, Tinct. ergotæ, *Br.;* Vinum ergotæ, *U. S.*

Physiological Action. *On Animals.*—Among the most characteristic effects of ergot given to dogs in large doses, are dilated pupils, tremulousness, staggering, paraplegia, general prostration, tonic and clonic convulsions, and death. When its action is protracted, the chief phenomena observed are these: gradual paralysis of the hinder legs, thirst, anorexia, emaciation, imperfect sight and hearing, shedding of the hair, debility and slowness of the heart, and death by exhaustion. Mixed largely with the food of pigs, it occasions redness of the eyes and ears, then coldness and gangrene of the latter and also of the tail and limbs. Death occurs usually in convulsions. The action upon birds is even more characteristic; they grow dull and languid; the comb and wattles turn cold, bluish, or ecchymotic, and are ulcerated; black blood flows from the nostrils; the plumage is shed; the pulse and respiration grow slower; and convulsions precede death. Upon pregnant animals (mammifera) the effect of ergot is, among other things, to produce abortion at an advanced period of gestation. Epidemics of abortion in cows have been traced to this cause; and veterinary surgeons employ ergot habitually to expedite languid labor. The internal lesions of animals destroyed by ergot consist of congestion and softening of the lining membrane of the digestive organs; more or less wasting of the muscles in chronic and their rigidity after acute poisoning; the latter being especially marked in the hinder limbs; the bloodvessels of the brain are apt to be congested, and in some cases, it is said, the spinal marrow is softened; the lungs are congested, and the blood is liquid and very dark.

On Man.—In doses of a drachm or two the first action of ergot is to occasion more or less vomiting and purging, but its more characteristic effects are headache, fulness of the head, vertigo, drowsiness, and dilatation of the pupils. The pulse falls from 70 to 60, or even less, in a minute, and this reduction may continue for several days, as may also the dilatation of the pupils. The respiration also becomes slower. The oil extracted from ergot, by macerating it with ether, displays even greater energy in producing the same symptoms, and, in addition, great languor and lassitude, lividity of the skin, painful rigidity of the muscles, and sometimes diuresis. These effects may continue for several days. The oil exhibits no influence upon the gravid uterus, but the residual ergot from which it had been extracted seems to possess the echolic powers of the drug unimpaired.

Ergotism, as an epidemic disease, exhibits the poisonous effects of ergoted rye upon a large scale, and in various phases, which probably depend upon the amount of the poison imbibed, as shown by experiments on animals. In one class of cases the cerebro-spinal nervous system is mainly involved, which is indicated by pain, formication and numbness of the extremities, paroxysmal flexures and extensions of the limbs, opisthotonos, violent delirium, etc., symptoms which are succeeded by exhaustion, and sometimes by strabismus, and more or less impairment of vision. In the other class of cases the nervous system is not conspicuously deranged, but the function of nutrition is impaired. A sense of muscular lassitude and a dull hue of the skin precede graver derangements of nutrition shown by the formation of gangrenous areas in various parts of the body. They begin most frequently in the thickness of a limb, and afterwards form on the superficial parts, extending from the fingers or toes upwards, causing these parts to blacken, shrivel, and harden, in a word, to become mummified, or affected with dry gangrene. The dead parts may, as in gangrene from other causes, separate so as to leave a clean wound behind. In a majority of cases, however, the attack is fatal.

In comparing the different grades of the operation of ergot in animals and in man, it is evident that the action in both cases is essentially the same, and that it is manifested mainly by the nervous, and the circulatory functions. The former exhibits debility of the general and special senses, dilated pupils, spinal paralysis, and general convulsions, usually clonic in type. The gravid uterus is thrown into tonic contractions. The circulatory and nutritive functions are shown to be deranged by the slowness of the pulse, the fall of temperature, the cyanosis of vascular parts, the discharge of dark blood, the occurrence of cutaneous eruptions, the shedding of the hair, feathers, etc., and the gangrene of various parts, but in man of the feet and hands especially.

From the preceding observations, it may be inferred that ergot acts primarily upon the nervous system; since the lower degrees of its operation interest exclusively the functions of that system, while its more prolonged action gives rise to radical changes in tissue nutrition. But all the evidence goes to show that the modifications of nervous action are consequent upon a diminished supply of arterial blood to the cerebro-spinal and the ganglionic nerve centres.

This diminished supply of blood is due partly to the sedative operation of the drug upon the heart, and partly to the contraction of the capillaries, which is demonstrable by the ophthalmoscope in the case of the human eye, and is also visible in the frog's foot, and in the membranes of the brain and spinal membranes, and in the spinal cord by the successive muscular spasm and paralysis of the voluntary and also of the intestinal and uterine muscles, and the loss of vitality, with gangrene, which have been alluded to.

Medical Uses. *In Labor.*—Rules have long been in use for the administration of ergot during labor. It may be employed: 1. In lingering labors when the child is low, the parts relaxed, the pains absent or feeble, and there is danger of delay from hemorrhage or other alarming symptoms. 2. When the pains are suspended and convulsions set in, venesection being premised. 3. In inevitable abortion. 4. When the placenta is retained by uterine inertia. 5. In post-partum hemorrhage under like circumstances. The influence of ergot upon the uterus in labor is unlike that of the natural forces; they are intermittent and rhythmical, it is constant and steady, and, as it were, tetanic. After labors with ergot the uterus remains much larger and harder than natural, and that for several days. Ergot has been accused of causing rupture of the uterus, but the evidence is incomplete when it has been administered according to established rules. Disease of the uterus, deformity of the pelvis or spine, and similar conditions forbid its use. No doubt laceration of the perineum and of the os uteri and hour-glass contraction may sometimes be attributed to its imprudent exhibition, as well as prolapse of the uterus or the rectum. Retention of the placenta is even more apt to occur. In some cases also, perhaps from an overdose of ergot, it has appeared to cause delirium, or coma, lividity of the face, muscular rigidity, etc. There is no doubt that ergot is dangerous to the child in proportion to the duration of its action, and that therefore it should not be administered until labor is near its termination. Fatal effects of the drug may occur even when it has not occasioned contraction of the uterus. Children are then born dead, with cyanosed skin and distorted limbs; and the discoloration has followed the use of the oil of ergot, which does not stimulate the uterine contractions. It follows, from these facts, that the rules above stated are justified, and that another might be added to them, viz., never to give ergot to expedite labor in larger doses than are necessary to produce that effect. In premature labor the drug appears to be more hostile to the child's life than at term, but is decidedly profitable to the mother. When the uterus is not in action, ergot does not readily excite its contractions; hence it seldom occasions abortion as a direct effect. Indeed, in certain cases when this accident is imminent from accidental uterine hemorrhage, small and repeated doses of ergot have appeared to prevent it.

Ergot has long been known as a remedy for *uterine hemorrhage* after labor, as well as for *menorrhagia*, and bleeding from *cancer* and other diseases of the uterus. In menorrhagia it seems to be most efficient when the uterus is in a flaccid condition, as shown, amongst other ways, by the persistence of uterine leucorrhœa between the menstrual periods. It doubtless acts in all these cases by contracting the uterine tissue; but that it acts directly upon the bloodvessels is proved by its efficacy in other forms of hemorrhage, *gastric*, *pulmonary*, *nasal*, *intestinal*, *urethral*, *vesical*, and *renal*, and also in *purpura hemorrhagica.* It may be employed in substance, or as fluid extract, by the mouth, or with more prompt effect by the hypodermic injection of ergotin. Full doses should be given. For hypodermic injection a solution may be prepared with 30 grains of ergotin, 13 drachms of water, and an equal proportion of glycerin. One fluidrachm, containing about one grain of ergotin, may be used hypodermically. It does not cause local irritation, and its effect upon the hemorrhage is very prompt.

The power of ergot to contract the uterus sometimes avails to expel retained *placentæ*, *polypi*, *hydatids*, etc. This action, which, under certain circumstances, may be called tonic, has been found efficient in the treatment of uterine *leucorrhœa*, and even of *amenorrhœa* due to an enfeebled and anæmic state. It is stated that ergot moderates the excessive *secretion of milk*, and may be used to prevent *mammary abscess* and the engorgement of the breasts in weaning. It is one of the most efficient remedies in *diabetes insipidus*, associated or not with belladonna. Ergot has long been used with advantage in the treatment of *paralysis of the bladder* and in *paraplegia*. Theoretically it is most appropriate to cases in which hyperæmia of the spinal cord exists, but it would be very difficult, if not impossible, to account for its efficacy in all successful cases upon this ground, particularly since it appears to have been efficacious in reflex as well as in congestive paraplegia. It should be given in full doses to insure its beneficial effects. *Incontinence of urine*, depending either upon irritability of the neck of the bladder or upon enlarged prostate, is palliated or cured, according to the nature of the primary cause. Its power of contracting the blood-vessels has been exemplified in cases of *enlarged spleen* of malarial origin, and even when it occurred as a symptom of leucocythemia. *Uterine tumors* of the fibrous and vascular sort have become reduced under its use. It is claimed, also, that *dilatation of the heart* from impaired nutrition and independent of valvular disease, is greatly benefited by this medicine. It has also been used in *whooping-cough* with apparent success; and for the relief of impaired vision arising from congestion of the *retina* and due to excessive strain of the eye in examining minute objects.

Administration.—Ergot is conveniently administered by making an infusion of one hundred and twenty grains of the drug, coarsely powdered, in about half a pint of hot water, which should be given in tablespoonful doses every ten or fifteen minutes if contraction of the distended uterus is desired, or if hemorrhage from any part is to be checked. The powder may be given in doses of from five to twenty grains at similar intervals. Bonjean's ergotin may be prescribed in doses of from one to three grains under like circumstances. Hypodermically it may be administered in warm water with the aid of glycerin. Ergotin is conveniently taken in gelatin capsules. Slerotic or sclerotinic acid may be administered hypodermically in the dose of from one-twenty-fifth to one-tenth of a grain.

ERIGERON, *U. S.*—ERIGERON.

Fleabane, Philadelphia fleabane, Scabious, E.; *Herbe d'érigeron (de vergerette) de Philadelphie*, F.; *Berufkraut*, G.

The leaves and tops of Erigeron heterophyllum, *Muhl.*, s. E. annuum, *Pers.*, s. E. strigosum, *Bigelow*, and of Erigeron Philadelphicum, *Lin.*, s. E. purpureum, *Ait.*

Nat. Ord.—Compositæ, Asteroideæ.

Origin.—Though the Pharmacopœia recognizes only two species, a third, Erigeron strigosum, *Muhl.* (s. E. integrifolium, *Big.*) inhabits similar localities, and is frequently collected with the former. The three species occur in fields and pastures, and are common weeds in many parts of Canada and the United States; all attain a height of about three feet, begin to flower in June, and are more or less hairy.

Description.—E. PHILADELPHICUM has the radical leaves spatulate, and tapering to a margined petiole, the stem leaves oblong or lanceolate, the upper ones clasping, all somewhat toothed, or the upper entire; the few flower-heads on slender peduncles; the numerous rays almost filiform, pale purple, or flesh-colored, and twice longer than the involucre; the pappus consists of a single row of capillary bristles.

E. HETEROPHYLLUM has roundish, ovate, coarsely dentate, radical leaves upon petioles about twice their length; the stem leaves are ovate-lanceolate or lanceolate, serrate in the middle, the upper ones smaller, narrowed at base, and sessile; the rays are numerous, white, tinged with purple, narrow, and less than twice the length of the involucre; the pappus is double, the outer row consisting of minute scales.

E. STRIGOSUM. The radical leaves are spatulate-lanceolate, petiolate; the stem leaves lanceolate, all nearly entire; the numerous rays white, and twice the length of the involucre; the scanty pappus is double, like the preceding.

The plants are collected in the middle of summer; they have a slight aromatic odor and a bitterish taste. They have not been analyzed with the view of isolating the bitter or diuretic principle. The volatile oil was obtained by F. L. John (1855) to the amount of half a drachm from 45 pounds of the dry herb; it is described by Procter as greenish-yellow, of a penetrating odor, a bitterish, pungent taste, of the spec. grav. 0.946, and more viscid than the oil of Er. canadense.

Medical Action and Uses.—Erigeron is a diuretic, and has been used in the treatment of *dropsies*, and of various disorders of the *urinary organs*. An infusion may be prepared with an ounce of the plant to a pint of boiling water, and given in doses of a wineglassful or more.

ERIGERON CANADENSE, *U. S.*—CANADA ERIGERON.

Canada fleabane, E.; *Herbe d'érigeron (de vergerette) de Canada*, Fr.; *Canadisches Berufkraut*, G.

The leaves and tops of Erigeron Canadense, *Lin.*

Nat. Ord.—Compositæ, Asteroideæ.

Description.—This annual is indigenous to North America, where it is met with as a common weed in fields and waste places; it is now widely diffused over the world. The stem attains a height of five or six feet, but in sterile locations is usually dwarfed, and only a few inches high; it is bristly, hairy, erect, and much branched; the leaves are lance-linear, hairy, and mostly entire; the flower heads are small and numerous, have a cylindrical involucre, many capillary ray florets, which are nearly included in the involucre, and a straw-colored bristly pappus. It flowers from July to October, and should be collected in August. It has an aromatic odor, and a bitterish, somewhat acrid and astringent taste.

The most important constituent is volatile oil (see *Oleum erigerontis*).

Off. Prep.—Extractum erigerontis canadensis fluidum, *U. S.*

Medical Action and Uses.—Canada Erigeron is a stimulant which owes its virtues to a volatile oil that is officinal. It was popularly supposed to have a special action upon the uterus (whence its name "squaw-weed"), and it has been used successfully to arrest *uterine hemorrhage*. It has also been employed to palliate *vesical irritation* and *strangury*, and cure *gonorrhœa*. An infusion may be prepared with an ounce of the plant to a pint of boiling water. *Dose*, a wineglassful. The oil has been used in the dose of five drops repeated at intervals of half an hour to arrest post-partum hemorrhage.

ERIODYCTION.—MOUNTAIN BALM.

Consumptive's weed, Bear's weed, E.

Eriodyction californicum, *Benth.* (E. glutinosum, *Benth.*), s. Wigandia californica, *Hook. and Arn.*

Nat. Ord.—Hydrophyllaceæ.

Origin.—An evergreen shrub, three to five feet high, growing thriftily among the rocks on the mountain ranges of Central California southward to Northern Mexico. It has axillary and terminal racemose clusters of showy purplish-blue flowers, with a funnel-shaped corolla and five stamens, and ovoid, semi-transparent capsules supported by the persistent five-lobed calyx, and containing about twenty seeds. The leaves are employed.

Description.—The leaves are alternate, petiolate, two to three inches long, elliptic-lanceolate, subentire or finely dentate, with the upper surface smooth, green, and varnished with a resinous exudation, and the lower surface white, hairy, and delicately reticulated by a network of veins. After bruising the leaves their balsamic odor becomes more apparent; their taste is aromatic, balsamic, and free from bitterness.

Constituents.—The leaves evidently contain *volatile oil* and *resin.* According to H. S. Wellcome (1876), the latter is transparent, amber-colored, balsamic in odor and taste, amounts to from 20 to 30 per cent. of the leaves, and consists of several distinct resins. The same resin covers also the branches.

Pharmaceutical Uses.—Wellcome has suggested the preparation from it of a fluid extract and a tincture, the latter representing four troyounces to the pint, using 75 per cent. alcohol as the menstruum. By triturating the resin with powdered French chalk, and following the officinal process for syrup of tolu, a syrup is obtained, having a delicious fruity aroma and taste, closely resembling those of the pineapple, due probably to the presence of butyric ether in the resin.

Medical Action and Uses.—Although supposed at first to possess medicinal value, it speedily ceased to attract attention. It was stated to be very serviceable in atonic bronchitis, but worse than useless in the inflammatory form of the disease; and a bold ignorance pronounced it to be a "specific for chronic lung disease, and a certain cure for consumption."

ERYNGIUM.—ERYNGO.

Button snakeroot, Corn snakeroot, Rattlesnake-master, E.

The rhizome of Eryngium yuccæfolium, *Mich.*, s. Er. aquaticum, *Lin.*

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The plant grows in pine barrens and prairies, from New Jersey westward to Wisconsin and southward to South Carolina. It has grass-like, nerved, and bristly-fringed leaves, the radical leaves being twelve to eighteen inches long, those of the stem much shorter; the white flowers are in dense ovate heads which are larger than the nearly entire leaflets of the involucre. It blooms in July and August.

Description.—Button snakeroot consists of a short root-stock, one-quarter to one-half inch long, with numerous short branches terminating with a more or less deeply cup-shaped scar. A transverse section exhibits a large whitish central pith and several short wood wedges, separated from the bark by a brown cambium line. Below the root-stalk is divided into a large number of thin nearly simple rootlets from two to three inches long, and containing a rather thick and soft whitish meditullium. Button snakeroot has a dark-brown color externally, a slight, but rather heavy aromatic odor, and a sweetish and somewhat aromatic taste, recalling that of parsnep, which is probably due to a volatile oil.

Allied Plants.—ERYNGIUM VIRGINIANUM, *Lam.*, has linear-lanceolate leaves and a spiny-toothed involucre longer than the heads of bluish flowers. It is biennial, and grows in swampy localities in the vicinity of the coast, from New Jersey southward.

ER. CAMPESTRE, *Lin.*, Eryngo, *E.;* Chardon-Roland, *Fr.;* Mannstreu, Brachdistel, *G.* A European perennial. Its root is cylindrical, about two feet long, one inch thick, with several conical heads, brown externally, and with a thick, internally white bark, covering the porous yellowish wood.

Medical Action and Uses.—Button snakeroot has an acrid and aromatic taste, and is reputed to be diaphoretic and expectorant, and emetic in large doses. In Europe E. maritimum was once celebrated for its diuretic virtues, as was also E. campestre. Both species continue to be used in the treatment of *dropsy, gravel,* and *jaundice.*

ERYTHROXYLON.—COCA LEAVES.

Feuilles de coca, Fr.; *Cocablätter,* G.

The leaves of Erythroxylon coca, *Lam.* *Nat. Ord.*—Erythroxylaceæ.

Origin.—Coca is a small shrub about four feet high, with numerous spreading purplish-brown branches. It has small, yellowish, five-petalous flowers in axillary clusters of three or four, ten hypogynous stamens, and an oblong, red and smooth drupaceous fruit containing a single albuminous seed. It is indigenous to the mountains of Peru and Bolivia, and is cultivated in some parts of Brazil and the Argentine Republic. The leaves when collected are carefully dried in the sun, to preserve their green color. About 40,000,000 pounds are annually produced.

Description.—The leaves are alternate, about two inches long, ovate or oval-oblong, rather obtuse and usually emarginate, somewhat narrowed into the short petiole, entire on the margin, rather thin, smooth, with a prominent midrib, on each side of which is a curved line running from the base to the apex. They have a slight but agreeable odor similar to that of tea, and a somewhat bitter and aromatic taste.

Constituents.—Wackenroder (1853) showed the presence, in coca leaves, of a peculiar tannin, which reacts with a green color upon iron salts, and has since been called *cocatannic acid.* Gaedeke (1855) isolated a crystalline alkaloid, which was provisionally named *erythroxylina,* and further examined by A. Niemann (1860) and W. Lossen (1865), the name being changed to *cocaina.* It is obtained from the infusion, which has been freed from tannin by acetate of lead, and rendered alkaline by soda, by agitation with ether and by evaporating the ethereal solution. When pure it is in colorless prisms of a strong alkaline reaction, has a bitterish taste, produces a transient numbness upon the tongue, dissolves in 704 parts of water, and in much less alcohol and ether. Its composition is $C_{17}H_{21}NO_4$, and on being heated with concentrated muriatic acid, it is decomposed into methylic alcohol CH_4O, benzoic acid $C_7H_6O_2$, and *ecgonina* $C_9H_{15}NO_3$, the latter having a sweetish-bitter taste, and is soluble in water, but insoluble in alcohol. Maclagan first observed the presence in coca of a volatile alkaloid, which Lossen named *hygrina;* it was obtained by the latter as a thick pale-yellow oil of a burning taste, a strong alkaline reaction, and an odor resembling that of trimethylamina. The other constituents of coca appear to be of neither pharmaceutical nor medical importance.

History.—Coca was used by the aborigines of South America long before their conquest by the Spaniards. They regarded it as a divine gift, employed it in religious ceremonies, and spoke of it as "that heavenly plant which satisfies the hungry, strengthens the weak, and makes men forget their misfortunes." The first of these reasons was sufficient to render it abominable in the sight of the fanatical invaders, who forbade its use and culture. But when they discovered that it enabled the conquered people to perform the work of their taskmasters, they winked at its diabolical origin and virtues.

Physiological Action. *On Animals.*—It seems to result from experiments that in very large doses coca produces tetanic convulsions; that in much smaller doses it causes hyperæsthesia, dilatation of the pupils, and diminution of movement, apparently from loss of co-ordination; that in intermediate doses it diminishes and then extinguishes sensibility, without destroying motility. According to Bennett, cocaine and the alkaloids of tea, coffee, guarana, and cocoa, produce identical effects, in small doses causing cerebral excitement and impaired sensibility, and in large doses an increase of these symptoms followed by tonic or clonic convulsions. He found that they at first increase and afterwards diminish the force and frequency of the heart's action; that they affect the capillaries by first contracting and then relaxing them; that they slightly lower and then raise the temperature, increase the salivary secretion, etc.

On Man.—Owing to the small quantity of coca, and that often impaired in activity, which is to be procured in countries where physiological research is practised, the conclusions in regard to its action are somewhat deficient in fulness and precision. Its principal effects are manifested in enabling those who use it to remain for a long time without food, and to endure unusual fatigue, and to preserve a cheerful temper. Some of the first historians of its use, as Von Bibra, state that it suspends the appetite for food for some hours, and at the same time greatly increases the muscular strength and endurance. When the proper quantity has been chewed, the laborer goes cheerfully to his work, and gives no heed to meal times while the influence lasts. By repeated doses abstinence from food can be maintained for three or four days. In some persons it produces an exhilarating effect. The celebrated traveller Tschudi, and more recent observers, found that when taken in infusion it conferred a singular immunity from suffering, and prevented the hemorrhages which are apt to occur in the elevated passes of the Andes, some of which are 17,000 feet high. Christison, who tested its action among the Highlands of Scotland, observed that it entirely prevented the fatigue which follows severe pedestrian exercise, and suspended hunger and thirst during its action. It had no effect upon the mental faculties beyond liberating them from the dulness and drowsiness which fatigue occasions. A native of Colombia, however, Posada-Arango, declares that coca has none of the virtues attributed to it; that the use of it by chewing is a mere distraction, like reading, to make the time pass. Bouchardat, also, considers that its virtues are merely such as belong to Chinese tea. And Scrivener reports: "I have seen hundreds of Indians during my residence in Bolivia, who have chewed coca-leaf from youth upwards, many of whom had attained their eightieth year, who showed no signs of being affected by the plant." But a very different account is given by competent witnesses of those who use the plant in excess. It is said to derange the digestion, induce habitual constipation with jaundice, loss of appetite, emaciation, and dropsy. It would seem that mental disorder is not frequent, although foreigners unaccustomed to the plant suffer from delirium and hallucinations (v. Bibra). Other reporters add that the mind is affected with imbecility, and the muscular system with weakness and trembling, and that the circulation becomes slow, feeble, and intermittent. It may safely be assumed that coca, like alcohol and tobacco, may be useful or poisonous, according to the quantity taken and the manner of using it.

So far as experiments have been undertaken, they do not agree in their physiological results. Ott found that during the use of coca for five days the solid elements of the urine diminished, while the weight of the body slightly increased. During the experiment, the urine contained oxalate of lime. Christison found that it increased the saliva, and probably lessened the secretion of the urinary solids. Gazeau, on the other hand, found that it augmented the excretion of urea and lessened the weight. According to him, its power consists in its sustained excitation of the vital functions, along with an anæsthetic power which lessens the sense of fatigue and hunger. The former conclusions are the more reasonable.

When the alkaloid *cocaïna* is given to rabbits by the stomach, it only slightly disturbs the heart's action or the respiration; but hypodermically administered even in small doses, it occasions, according to Schroff, violent tonic spasms, extreme dilatation of the pupil, and an increased pulse and respiration rate. The experiments of Bennett, on the other hand, performed on frogs and rabbits, show that its direct tendency is to cause spinal paralysis and loss of reflex action. In experiments on himself with this alkaloid, Schroff found that it quickened the pulse and occasioned an agreeable sense of lightness and activity in the mind and body, followed by some lassitude and an inclination to sleep.

In its native country, Colombia, coca is used, precisely as Chinese tea is elsewhere, as a mild stimulant and diaphoretic and an aid to digestion. These are mainly the purposes of coffee, chocolate, and guarana; and experiment has proved that the active principles of all these productions, "although unlike one another and procured from totally different sources, possess in common prominent principles, which are not only almost identical in chemical composition, but also appear similar in physiological action." (Bennett.)

Medical Uses.—Coca has been gravely proposed as a means of appeasing hunger and thirst in armies on forced marches and on voyages with insufficient food and water, the fact being overlooked that hardly enough of it has hitherto been procurable for laboratory experiments; and also that tobacco, coffee, and tea, which are abundant, have closely analogous virtues. It has also been proposed for allaying the canine hunger observed in some cases of *epilepsy* and *insanity*, and to appease the thirst in *diabetes*. Opium has generally been used to fulfil these indications. In *melancholia* it may be employed as opium and also cannabis have been, and probably with as little real advantage. It is said to have been used in South America to overcome *uterine inertia*, and to allay pain and the discharges in *cholera morbus*. It is reported to have been useful in *spermatorrhœa* and *generative debility*, but no proof exists of so improbable a statement.

Administration.—The Indian coca-chewer always carries a bag of the leaves hanging from his neck, and a small flask filled with ashes or lime. After having withdrawn the filaments from a handful of leaves, he chews them until they are reduced to a pulp; this he forms into a ball which he pierces with a splinter wetted and covered with adhering ashes. The mass has then acquired a pungent taste which excites copious salivation; a part of the saliva is ejected and a part swallowed. The ball is retained in the mouth for about an hour, and then is renewed with a fresh handful of leaves. For medicinal purposes, the most convenient form is an infusion made with about two drachms of the leaves in four fluidounces of water. Of cocaïne the *dose* is stated to be from one-eighth of a grain to one grain, in substance or as an acetate or muriate.

ESSENTIÆ.—ESSENCES.

Alcoolés concentrés, Fr.; *Essenzen*, G.

Two preparations of this class have been admitted in the British Pharmacopœia. They are simply solutions of volatile oils in alcohol, and are therefore identical with, except that they contain a much larger amount of volatile oil than, the officinal spirits. The volatile oils are in France usually termed *essences*, while the spirits containing volatile oils, but prepared by distillation, are called *alcoolats;* and those made by simple solution of volatile and non-volatile substances, are known as *alcoolés.* The *Essenzen,* popularly so called in Germany, are often strong tinctures or strong solutions of volatile oils, or mixtures of the two.

ESSENTIA ANISI, *Br.*—ESSENCE OF ANISE.

Alcoolé d'anis concentré, Fr.; *Anisessenz,* G.

Preparation.—Take of Oil of Anise one fluidounce; Rectified Spirit four fluidounces. Mix. *Br.*

Medical Action.—For medical uses *see* Spiritus anisi.

ESSENTIA MENTHÆ PIPERITÆ, *Br.*—ESSENCE OF PEPPERMINT.

Alcoolé de menthe poivrée concentré, Fr.; *Pfefferminz-Essenz,* G.

Preparation.—Take of Oil of Peppermint one fluidounce; Rectified Spirit four fluidounces. Mix. *Br.*

Medical Action.—For medical uses *see* Spiritus menthæ piperitæ.

EUCALYPTUS.—EUCALYPTUS LEAVES.

Feuilles de l'eucalyptus, Fr.; *Eucalyptus-Blätter,* G.

The leaves of Eucalyptus globulus, *Labill.* Bentley and Trimen, Med. Plants, 109.

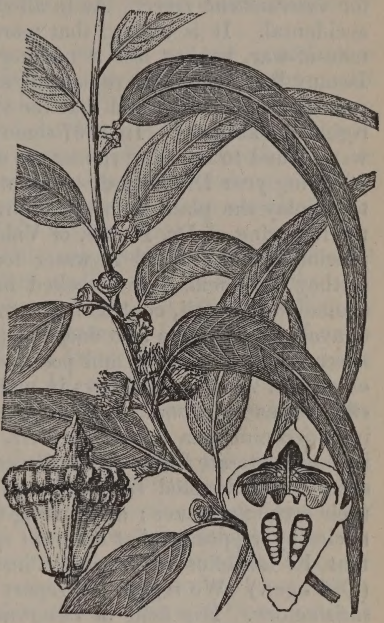
Nat. Ord.—Myrtaceæ.

Origin.—This is the *blue gum-tree* of Tasmania, which was discovered by Labillardière in 1792. It grows on moist slopes of wooded hills in the southern half of that island, and in Victoria on the main-land of Australia; it was introduced into Europe in 1856, and has since then been very extensively planted in the southern part of Europe, in Northern Africa, in the Southern United States, and in California. It is a rapid grower, and attains a height of 200 and occasionally even of over 300 feet. The flowers are upon short and broad axillary peduncles, either solitary or in clusters of 2 or 3. The buds are covered with a whitish bloom, and consist of a top-shaped, ribbed, and warty calyx-tube covered by a so-called operculum, which is composed of the united petals, is hemispherical in shape and prolonged into a cone, and separates entire like a lid from the calyx-tube. The flowers are hermaphrodite, with numerous stamens inserted on a disk, a short style, and a 4- or 5-celled ovary united with the calyx-tube.

Description.—The leaves of young plants are opposite, shortly petiolate, broadly oval or oblong, rather obtuse, heart-shaped at base, and of a pale bluish-green color. They are not employed medicinally. Older trees have the leaves alternate, petiolate, falcate, lanceolate, or oval lanceolate; oblique at the base, very entire, and above gradually tapering to the acute apex. They have a length of 6 to 12 inches, are thick, leathery, and of a pale yellowish-green color, contain numerous pellucid oil-glands, and have, besides the prominent mid-rib, two lateral veins near the margin. The leaves have a peculiar strong balsamic odor, and an aromatic, bitterish, pungent taste, followed by a sensation of coolness.

Constituents.—Hartzer (1876) obtained from the leaves tannin, cerylic, or an allied alcohol, a crystallizable fatty acid—the sodium salt of which is soluble in ether—and three resins, one of which has acid properties, and yields with sulphuric acid a carmine-colored copulated acid, becoming violet with ether. E. S. Wayne (1876) likewise isolated an acid resin, which he found to be crystallizable and to give a brown-red reaction with ferric chloride. The most important constituent, however, is the dextrogyre volatile oil, which was examined by Cloëz (1870) and by Faust and Homeyer (1874). Cloëz regarded the oil as being chiefly composed of *eucalyptol*, $C_{12}H_{20}O$, boiling at 178° C. (352.4° F.), and yielding with phosphoric anhydrid two compounds, $C_{12}H_{18}$, of which *eucalyptene* boils at 165° C. (329° F.) and *eucalyptolene* at above 300° C. (572° F.). Faust and Homeyer, however, obtained from the oil about 60 per cent. of a *terpene*, $C_{10}H_{16}$, boiling between 172° and 175° C. (342.6° and 347° F.), 30 per cent. of *cymol*, $C_{10}H_{14}$, the remainder being a *terpene* boiling at 150° C. (302° F.), and an oxygenated compound, probably $C_{10}H_{16}O$, which they named *eucalyptol*, Cloëz's compound of the same name being a mixture of the first two hydrocarbons, which rapidly combine with oxygen.

Fig. 64.



Eucalyptus globulus, *Labill.*—A flowering branch, an unexpanded flower and longitudinal section of same.

Physiological Action. *On Animals.*—The real action of this medicine is yet to be determined, for the reported results of experiments are the reverse of harmonious. While one observer states that the oil and the extract do not appear to occasion any special phenomena, unless they, perhaps, increase the appetite, another declares that, in pigeons and rabbits, the former gives rise to general excitation, and in excessive doses may prove fatal by paralyzing the excito-motor function, like bromide of potassium, rendering respiration irregular and intermittent, and at last suspending it before the heart ceases to beat. According to Siegen, it depresses the temperature even more than quinia; for twenty grains of the oil caused a rabbit's temperature to fall 3° F., and one hundred and twenty drops caused the evening temperature of a healthy man to fall nearly 1° F.

On Man.—When the oil is taken internally it excites a sense of warmth in the fauces and stomach, with increased salivation, and subsequent eructations of gas; but in doses of from fifteen to twenty grains it is readily tolerated. It is apt to cause some fulness of the head and vascular excitement. It seems to be eliminated through the lungs. It does not impart to the urine a peculiar odor, unless given in tincture and in large doses, and no resinous matter is detected in the urine by nitric acid, as is the case when copaiva is taken. According to Guibert, it eliminates an enormous proportion of urea. We are informed also by him that in doses of twenty drops the oil causes general stimulation, a feeling of lightness, and an irresistible desire to keep moving, together with a remarkable suppleness of the back and limbs. The spirits are raised, and the mind is clear and active; the appetite is increased, and sometimes aphrodisiac effects are observed. To use this author's words, "there is a true medicinal intoxication," which is not followed by a corresponding depression. In doses relatively or absolutely excessive, there is more or less general muscular paresis, without mental depression, and easily dissipated by coffee or alcohol. It is theoretically held to promote the capillary circulation by dilating the capillaries, and thereby rendering the pulse more frequent. Applied to the raw skin it causes burning pain.

Medical Uses.—Eucalyptus has been very extensively used as a remedy for *intermittent fever.* As in all similar cases, the discovery of its virtues was accidental. It is alleged that more than forty years ago the crew of a French man-of-war, having lost a number of men with "pernicious fever," put into Botany Bay, where the remaining sick were treated with eucalyptus, and rapidly recovered. It is also said that the virtues of the tree were well known to the aboriginal inhabitants. In 1867 some peasants of the Spanish province of Valencia were found to be using the leaves of the plant to cure fever and ague. In the following year Dr. Brunel, of Montevideo, was led by reports of this experience to employ the plant in hospital practice, and especially by such statements as the following of Dr. Ramel, of Valencia: "I assure you that four leaves of this precious plant infused in water form an excellent febrifuge. The sick as soon as they find themselves attacked hasten to procure these leaves, and in no instance do they fail, contrasting strongly with cinchona, which not only is often unavailing, but often also does not prevent a relapse." The report of Dr. Brunel is scarcely less glowing and positive. In 1871 Dr. Keeler, an official physician of certain Austrian railways in malarious districts, affirmed that it was quite as efficient as cinchona. Others have attributed to it marvellous results in cases in which cinchona failed. Others, still, conclude that it is peculiarly curative in the inveterate forms of the disease. There were not wanting, however, physicians who doubted the published reports, some of them upon the ground of their own experience; and among these, one, at least, accounts for the discrepancies by supposing that different species of eucalyptus had been employed, and that E. latifolius is generally insufficient, while E. longifolius seldom fails. (Oeffinger.) We regard the report of Burdel as probably the most accurate and satisfactory. His field of observation was in one of the most marshy departments of France, La Sologne, where periodical fevers are exceptionally rife and grave. He put the alleged remedy to a prolonged and thorough test, and concluded that it possessed little or no curative power over intermittent fever. Out of 123 cases only 11 were cured without relapse, and these were, moreover, treated in a hospital; and it is well known that intermittent fever patients, on being removed from a malarial locality, are very apt to recover without any medicinal treatment at all. And still further, it was observed that, among those whose paroxysms ceased under the use of this medicine, there was no diminution of the malarial cachexia such as usually takes place under the treatment by quinia. On the whole, there does not appear to be any substantial reason for believing that a substitute for cinchona has been found in eucalyptus.

It has been alleged that this tree has a special power of destroying malaria in the localities where it grows; but as the statement still lacks confirmation, it is unnecessary to refute the causes assigned for this effect, viz., "that its dead leaves, etc., raise the soil; that it energetically absorbs the soil-water in consequence of its very rapid growth and the multitude of stomata that stud its leaves; and finally, that it protects the soil against the extreme solar heat so favorable to the generation of animalculæ." (Gubler.) These reasons would be equally valid as proofs of its power to generate malaria.

As a summary of the virtues claimed for this medicine, the following may be cited: "Not being an irritant it may be liberally used in all cases of hospital gangrene and other gangrenous affections, of fetid suppuration such as occurs in glanders, syphilis, abscesses connected with dead bone, etc. It may be used with advantage to prevent animal and vegetable putrefaction, and hence as a deodorizer of hospital wards. Internally, it may be given in all cases of ulcer of the stomach or bowels, in septicæmia, typhoid fever, scarlatina, pulmonary gangrene, fetid bronchitis, etc." And as a rationale of its mode of action we are told that if a person is kept under the influence of its oil, the blood drawn from his veins will not undergo putrefaction. "At all events the hæmatoglobulin is expelled from the globules and becomes oxidized externally to them, and the anatomical element is, as it were, embalmed." It is somewhat difficult of conception that the sick of any disease should profit by the mummification of their blood-corpuscles.

Undoubtedly eucalyptus, and especially its oil, tend to restrain putrefactive fermentation, as all aromatics have done since the beginning of history; and very possibly these new agents may excel the old in this respect. Certain it is that the oil is a most efficient deodorizer, and, having a very agreeable odor of its own, is capable of substituting a pleasant for an offensive smell, while its stimulant operation upon diseased tissues assists them in recovering a natural mode of action. It has been inhaled with great advantage in an atomized solution in cases of *gangrene of the lung* and of *fetid bronchitis.*

Its astringent and balsamic qualities naturally suggested its use in the topical treatment of various affections in which other medicines of like qualities had been found useful, especially in alcoholic tincture. Indeed, it cannot be doubted that the alcohol had a potent influence in the treatment by tincture of eucalyptus of slight *hemorrhages, mucous profluvia, leucorrhœa, gonorrhœa,* indolent and irritable *ulcers, spongy gums,* etc. In certain of these affections, especially in *ulcers,* the fresh bruised leaves deprived of their nerves have been found to cause sufficient stimulation to promote a cure.

It is said that smoking the dried leaves of eucalyptus in a pipe or cigar is, with the exception of hypodermic injections of morphia, the most efficient means of calming irritation and procuring sleep in cases of *cardiac* and *aneurismal asthma,* particularly in cases of pressure on the vagus or its branches by thoracic aneurisms. (Maclean.) When the patient is too ill to inhale actively, he may be kept in an atmosphere filled with the smoke of the burning leaves. The tincture of eucalyptus is said to remove the fishy flavor and smell from *cod-liver oil* when added in the proportion of one part to one hundred. The leaves are strown among woollen clothing to protect it from *moths.*

Administration.—The leaves may be applied fresh and bruised, or mixed with poultices. They may be given internally in doses of five grains or more, but efficient doses of them are too bulky for convenient use in this manner. The extract is very apt to derange digestion and occasion diarrhœa. The *dose* of the oil may be stated at from two to five drops. The tincture is the most agreeable form of the medicine; it may be prescribed in doses of fifteen or more minims.

EUPATORIUM, *U. S.*—THOROUGHWORT.

Herba eupatorii perfoliati.—Boneset, Indian sage, E.; *Herbe d'eupatoire perfoliée, Herbe à fièvre, Herbe parfaite,* Fr.; *Durchwachsener Wasserhanf,* G.

The leaves and tops of Eupatorium perfoliatum, *Lin.*, s. E. connatum, *Mich.*, gathered after flowering has commenced.

Nat. Ord.—Compositæ, Asteroideæ.

Description.—Thoroughwort inhabits damp soil and low swampy grounds in Canada and the United States. It is a hairy perennial, with an erect stout stem 2 to 4 feet high, and much branched at the summit; the leaves are opposite, tapering, lanceolate, 4 to 6 inches long, united at the base, with the margin crenately serrate, rugosely veined, rough above and minutely resinous dotted beneath. The flowers are in dense level-topped corymbs; the heads have an oblong involucre consisting of lance-linear scales, and contain 10 to 15 tubular white florets with a bristly pappus in a single row. Its flowers appear in July, and it continues to bloom until September. The leaves and the flowering tops with the small branches are collected in July. It has a rather weak aromatic odor, and a somewhat astringent and persistently bitter taste.

Constituents.—Boneset contains a minute quantity of volatile oil, some tannin, and a bitter principle which has not been isolated. The analyses of W. Peterson (1851) and M. H. Bickley (1854) elicited, besides those mentioned, the usual common constituents of herbs.

Off. Prep.—Infusum eupatorii, *U. S.*

Allied Species.—Most of the numerous species of eupatorium and of some allied genera appear to possess similar properties, and are occasionally employed in regular or domestic practice. The following may be mentioned:—

EUP. TEUCRIFOLIUM, *Willd.*, s. E. verbenæfolium, *Mich.*, s. E. pubescens, *Pers.*, grows from Massachusetts to Louisiana, and is characterized by lance- or oblong-ovate leaves, which are truncate below, coarsely toothed towards the base, and are alternate on the branches. It is popularly known as *wild horehound*, like the nearly allied *Eup. rotundifolium*, Lin., which is found in similar localities, and is mainly distinguished by its roundish-ovate and slightly heart-shaped leaves.

E. FŒNICULACEUM, *Willd.*, called *dog-fennel*, is a common weed in fields and damp places, from Virginia to Florida, with the leaves pinnately dissected into filiform segments. The juice is used for relieving pain from the bites of insects.

E. INCARNATUM, *Walt.*, of the Southern United States from Texas to North Carolina, has triangular ovate, long-petioled leaves, and is used in Texas under the name of *mata* for flavoring tobacco.

E. PURPUREUM, *Lin.*, is common in low grounds, with a tall, simple, purplish-colored or spotted stem, ovate or lanceolate petiolate leaves in whorls of 3 to 6 and dense corymbs of mostly purplish flowers. It is known as *trumpet weed* and *gravel root*, the root being popularly used in various ailments of the urinary organs.

E. CANNABINUM, *Lin.*, or *water-hemp*, is indigenous to Europe; the leaves resemble hemp leaves, but are mostly trifoliate; the root and leaves have diuretic, and in larger doses, emetic properties.

E. AYAPANA, *Vent.*, of Brazil, has dark green leathery leaves, with purplish veins and a coumarin-like odor. It is an aromatic tonic.

MIKANIA GUACO, *H. B.*, a native of Colombia and the West Indies, is an aromatic, bitter, climbing herb, 20 feet long, with the leaves ovate-elliptic and rusty tomentose beneath; it was at one time highly lauded as a remedy in cholera and in hydrophobia. Its medicinal properties are probably not superior to those of *Mik. scandens*, Lin., of the United States, which has nearly triangular heart-shaped leaves. The genus Mikania is closely allied to eupatorium, not only botanically, but also in its sensible properties.

Medical Action and Uses.—Eupatorium resembles chamomile in its effects. It is a stimulant tonic in small, and a laxative in large doses, and an emetic or diaphoretic in warm infusion. Like all such plants, it is used to prevent or to break the chill in *intermittent fever* of a mild type. A hot infusion is a popular and efficient remedy in the forming stage of *muscular rheumatism*, *sore throat*, *bronchitis*, and even *influenza*. Its power of relieving pain in the limbs in the last-named disease entitled it to the popular name of boneset. In atonic *dyspepsia* its effects resemble those of other bitter tonics. The *dose* of the powder is stated to be twenty or thirty grains. The officinal infusion is the most convenient form for administering the medicine.

EUPHORBIA COROLLATA, *U. S.*—LARGE-FLOWERING SPURGE.

Wild ipecac, Wild hippo, E.; *Racine d'euphorbe à grandes fleurs,* F.; *Grossblüthige Wolfsmilch-Wurzel,* G.

The root of Euphorbia corollata, *Lin.* *Nat. Ord.*—Euphorbiaceæ.

Origin.—A smooth, perennial plant, which is met with in low, sandy, and dry soil from Canada to Florida, and west to Mississippi, and is abundant in many localities, chiefly of the Southern and Western States. It produces a slender, nearly simple stem two to three feet high, which has the leaves, excepting the floral ones, alternate, linear-oblong, and obtuse. The flowers are in umbels of five to seven rays, each one being again two or three-forked, and are conspicuous for the showy white appendages to the involucre, which have the appearance of petals, and bear a greenish gland at the base. The smooth capsule separates at maturity into three carpels, each containing a single ash-colored seed. It flowers in the latter part of summer and in autumn, when the root should be collected. This, like the next root, appears to be rarely met with in the market; we have received instead of it the roots of Gillenia stipulacea, Triosteum perfoliatum, and of other plants.

Description.—The root is 1½ to 2 feet long, and, when full grown, about an inch thick, cylindrical, and little branched; is externally of a dark-brown, or, when old, of a blackish color; has underneath the thin corky layer, a thickish white bark, which incloses a spongy, porous, whitish wood, radially striate by many medullary rays. In the dry state it is longitudinally wrinkled, and breaks with a short, nearly smooth fracture. It is inodorous, and has a sweetish, afterwards warm taste.

Constituents.—The emetic principle of this root is still unknown. It is probably similar to the next.

Medical Action and Uses.—Large-flowering spurge is reputed to possess emeto-cathartic properties, and its contused root will vesicate the skin. Hence it cannot be a safe agent in cases of gastro-intestinal irritation, and there seems to be no sufficient reason for its encumbering even the secondary list of the Pharmacopœia. *Dose,* as an emetic, twenty grains; as a cathartic, ten grains; as a diaphoretic, five grains.

EUPHORBIA IPECACUANHA, *U. S.*—IPECACUANHA SPURGE.

Carolina ipecac, Carolina hippo, E.; *Racine d'euphorbe vomitive,* Fr.; *Brechwolfsmilch-Wurzel,* G.

The root of Euphorbia ipecacuanha, *Lin.* *Nat. Ord.*—Euphorbiaceæ.

Origin.—A smooth, perennial, herbaceous plant, of a dull-green or dark-purplish color, growing in barren, sandy soil, at a limited distance from the sea-shore from Connecticut southward to Georgia. It produces several ascending or often diffusely spreading stems, which fork from near the base, and have opposite, obovate or oblong, obtuse, and entire, nearly sessile leaves. The flowers are inconspicuous, long-peduncled, and appear singly from the forks or the axils of the upper leaves. The nearly smooth capsule contains in each of its three cells one white, somewhat dotted seed. It flowers during the spring months.

Description.—The root resembles the preceding in general characters, but is thinner, has externally a gray or yellowish-brown corky layer, which is never blackish or dark-colored, and shows internally a yellowish, porous wood. Odor and taste are similar to the preceding. Barton believed it to be equally efficacious throughout the year.

Constituents.—The latest analyses by Petzelt (1873), and Dilg (1875), failed to add much of importance to the older one of Bigelow, except that the abundant presence of starch was proven. Petzelt regards the resinous portions as containing the emetic principle. The root may possibly contain a glucoside, since Dilg did not get a reaction for glucose until the decoction had been boiled with an acid. *Euphorbon* was found among the products extracted by petroleum benzin.

All species of Euphorbia contain a milky juice, and appear to be endowed with cathartic and emetic, frequently very acrid properties; many are occasionally employed medicinally. *E. hypericifolia* and *maculata*, Lin., are known in some parts of the United States as *spotted eyebright*, the oblique leaves being often marked with a red or brown spot; they have been used in some affections of the eye, and internally in diarrhœa, amenorrhœa, etc.

Medical Uses.—Ipecacuanha spurge does not differ essentially from the other officinal species. It may be used under the same conditions and in similar doses.

EUPHORBIUM.—EUPHORBIUM.

Euphorbe, Gomme-résine d'euphorbe, Fr.; *Euphorbium*, G.

The gum resin obtained from Euphorbia resinifera, *Berg.* Bentley and Trimen, Med. Plants, 240.

Nat. Ord.—Euphorbiaceæ.

Origin.—The plant is indigenous to the lower slopes of the Atlas Mountains of Morocco. It has an ascending, cactus-like, fleshy, quadrangular stem with spreading branches, and, instead of leaves, is furnished with divergent, spinescent stipules, situated in pairs on the angles; the flowers are in pedunculate cymes of three, or rarely more. On wounding the branches a milk-juice exudes, which hardens upon the plant, usually encrusting the spines. While it is being collected, the mouth and nostrils are protected by a cloth from the irritating effects of the dust.

Description.—Euphorbium is seen in roundish, somewhat three-cornered, cylindrical, or irregular pieces varying considerably in size, the largest measuring nearly an inch. The shape is influenced by the portion of the plant around which the exudation is hardened, and most pieces are observed with one or more holes, and inclosing fragments of the spines, flowers, or fruit. Euphorbium is brownish-yellow, somewhat translucent, brittle, nearly inodorous; but the dust excites violent sneezing, and, if inhaled, acts as an acrid poison. The taste is at first slight, afterwards burning and acrid. When heated it gives off a faint odor, suggesting that of benzoin, afterwards fuses and burns with a bright, sooty flame.

Constituents.—The older analyses by Braconnot, Brandes, and others, seem to indicate that euphorbium varies to some extent; the *resin*, readily soluble in cold alcohol, and possessing an extremely burning taste, varied between 37 and 44 per cent.; Flückiger (1868) obtained 38 per cent. of it, and ascertained its composition to be $C_{20}H_{32}O_4$. The sparingly soluble, crystallizable resin of Bonastre and others was named *euphorbon* by Flückiger, who obtained 22 per cent., and gave it the formula $C_{26}H_{44}O_2$. It is soluble in ether, benzol, amylic alcohol, chloroform, acetone, glacial acetic acid, and hot alcohol, but requires about 60 parts of alcohol for solution at the ordinary temperature. When the last traces of the acrid resin have been destroyed by boiling in a weak solution of potassium permanganate, it is entirely tasteless. If its alcoholic solution is allowed to evaporate until it forms a thin film, and this is moistened with strong sulphuric acid, the slow addition of a little strong nitric acid produces a fine violet color, a reaction which is also observed with lactucerin. Flückiger obtained also 12 per cent. of *malates*, chiefly of calcium and sodium; 10 per cent. of *mineral compounds*, and 18 per cent. of *gum*, which is precipitated by acetate of lead, also by silicate of sodium and borax.

Physiological Action.—The extremely acrid qualities of euphorbium were known to the ancients, for both Pliny and Dioscorides describe the mode of collecting the juice so as to prevent its irritating emanations from affecting the face or hands. They also speak of its taste as persistently hot and acrid, drying the throat. Its dry powder does not affect the sound skin usually, but it irritates the mucous membranes, and causes the eyes to weep and grow red, the nose to run with watery and even bloody mucus, and saliva to flow abundantly from the mouth. To prevent these effects, says Pereira, some drug grinders employ masks with glass eyes, others apply a wet sponge to the nose and face, while others cover the face with crape. Individuals who have been exposed for some time to the influence of this dust, suffer with headache, giddiness, and ultimately become delirious. I was informed, he adds, of an Irish laborer who was made temporarily insane by it, and who, during the fit, insisted on saying his prayers at the tail of the mill-horse. In a case which fell under his notice, a man grew suddenly delirious, and presently became insensible and fell in a fit. His face was red and swollen, his pulse frequent and full, and his skin very hot. On being bled, his consciousness returned, and he complained of great headache. Internally it causes great thirst, dryness of the throat, colic, vomiting, and purging, and in excessive doses besides these symptoms cold sweats, syncope, thready pulse, and even inflammation and gangrene of the bowels.

Medical Uses.—Although euphorbium was anciently and even in comparatively modern times used as a drastic purgative in *dropsy*, yet the extreme harshness of its operation led to its being associated with milder drugs for the same purpose, and at the present day it is never given internally. It was also at one time applied as a local stimulant in certain cases of *paralysis*, and more recently as a *sternutatory* when mitigated with inert or mild powders. As a local irritant, it has been used in the same cases for which mezereon is employed; and particularly in plasters intended to prolong *suppuration*, as in cases of obstinate *sciatica*. In ointments it was applied to *ulcers* maintained by necrosed bone. Plasters containing it have also been used in the treatment of chronic swellings of the *joints* induced by scrofula, gout, or rheumatism.

ERYTHROPHLŒUM.—SASSY BARK.

Mancona bark, *Saucy bark*, E.; *Écorce de mançône*, Fr.; *Mancona-Rinde*, G.

The bark of Erythrophlœum guineense, *Don.* (E. judiciale, *Procter*); s. Fillæa suaveolens, *Guill.* and *Per.*

Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—Sassy bark comes from a large tree with bi-pinnate coriaceous leaves, terminal compound spicate racemes of decandrous flowers, and flat legumes with three or four lenticular seeds. The tree grows in Central and Western Africa, and the bark is used by the natives as an ordeal and an arrow poison.

Description.—The bark is seen in flat or curved pieces of irregular size, covered externally with an uneven fissured corky layer, or deprived of the same, of a dull red-brown color. It is hard, brittle, of a fibrous texture, internally with pale yellowish-brown spots, inodorous, of an astringent taste, and when powdered excites violent sneezing.

Constituents.—Sassy bark contains tannin and a red derivative of it, and yields its active principle to water and alcohol (Procter, 1852). Gallois and Hardy (1876) isolated the poisonous constituent by treating the aqueous extract of the alcoholic extract of the bark with an alkali, and exhausting the mixture with acetic ether. This alkaloid, *erythrophleïna*, is colorless, crystalline, soluble in water, alcohol, amylic alcohol, and acetic ether, but nearly or entirely insoluble in ether, chloroform, and benzol. With sulphuric acid and potassium permanganate a violet coloration is obtained, less intense than the one produced by strychnia, and soon changing to dirty brown. The solutions of its salts are precipitated by the usual reagents for alkaloids, including bichromate of potassium, which yields a yellowish precipitate.

Erythrophlœum couminga or *koumanga* is also a large tree, all parts of which are poisonous, containing an alkaloid which is closely related to erythrophleïna, if not identical with it.

Physiological Action. *On Animals.*—The first systematic experiments with sassy bark were made in Philadelphia, in 1859, by Drs. S. Weir Mitchell and W. A. Hammond. The most conspicuous effect was a general muscular resolution, such that the animal would remain quiescent in whatever position he was placed, even until death in some instances, without exhibiting any evidence of suffering. Indeed, a degree of anæsthesia was observed. If disturbed, the animal speedily recovered his activity and sought to escape, although his efforts were marked by a certain languor and difficulty which brought him to rest again almost immediately. When a fatal dose was administered, the head fell and was caught up again, and at last reposed upon the fore paws; vomiting usually took place, the pupils contracted, the heart became slow and irregular, the respiration quick and labored, and at length death occurred with general convulsions and sudden dilatation of the pupils. Upon examination, the membranes of the brain were found to be highly congested, but there were no other peculiar changes. In 1876 was published an account of experiments with casca bark performed by Drs. Bruxton and Pye, and which agree with the statement above given; for these authors say, "In cats and dogs it causes restlessness and nausea succeeded by violent and repeated vomiting. The respiration is very much quickened. The first symptom of any affection of the locomotor organs in cats is a peculiar jerk of the hind limbs, as if something were sticking to the feet, and the animal was trying to shake it off while walking; then the gait becomes staggering, and the animal ceases to be able to stand. Death generally occurs during a convulsion of an emprosthotonic character, apparently connected with an attempt to vomit. Consciousness seems to be preserved to the last."

In 1876 MM. Gallois and Hardy discovered in sassy bark and leaves an alkaloid with which they experimented and obtained the following results. It is a heart-poison. Two milligrammes injected under the skin of a frog arrest the heart in systole in from five to eight minutes; the voluntary muscular movement and irritability remaining unimpaired for several hours. In warm-blooded animals the alkaloid excites convulsive shocks and extreme dyspnœa as consequences of the disorder in the circulation of the blood, *i. e.*, of the heart's arrest. After the animal's death this organ is found distended with blood. During the progress of the poisoning the pulse is alternately accelerated and retarded; in the latter state it becomes fuller, in the former small and feeble. Although the heart muscle is the first to die, the voluntary muscles are, nevertheless, in their turn paralyzed. In these experiments no mention is made of paralysis as a symptom of the poisoning, nor yet of vomiting or diarrhœa.

On Man.—The accounts which were long ago received of the effects produced by the sassy ordeal agree in certain points but not in others. In most of them the production of vomiting appears to be the capital phenomenon, for upon its occurrence or non-occurrence the accused was held to be innocent or guilty. "It is supposed that the fetish goes down with the water into the man's stomach, and looks about in his heart for the guilt; that if he discovers the prisoner to be innocent, he comes back with the draught which is vomited up again; but if he finds the alleged guilt, he remains in the stomach with the water to inflict merited chastisement upon the culprit." According to another account the accused, after the trial, "is obliged to move his arms and legs, to show that he has not lost the use of them;" and Santas, who first analyzed this bark, states that the sufferer "loses the power of contracting the muscles throughout the body, he is incapable of standing or walking, and the head rolls heavily about the breast and shoulders." Rev. J. L. Wilson, an American missionary, who published his observations on Western Africa in 1854, describes under the name of "nkazya" an ordeal poison, of which he says: "If it act as a diuretic it is a mark of innocence; but if as a narcotic, causing dizziness or vertigo, it is a sure sign of guilt. Small sticks are laid down about eighteen inches or two feet apart, and the suspected person, after he has swallowed the draught, is required to walk over them. If he has no vertigo this is an easy task, but if his brain is affected, he imagines they rise up before him like great logs, and he is then apt to step awkwardly and fall down, whence he is at once concluded to be guilty." In the article *Akazga* the effects of that poison are described almost in the same words, except that tetanic spasm is substituted for vertigo, in the description. But, on the whole, sassy and akazga seem to be antagonistic; the one is a relaxing the other a tetanizing poison.

According to Drs. Brunton and Pye, the vomiting produced by sassy occurs, whether it be given internally or hypodermically, but purging only in the former case. The paralysis it causes they explain as being due not to a direct action upon the muscles, or the motor nerves, or the spinal cord itself, but to the contraction of the bloodvessels which lessens the supply of blood to these parts. It acts directly upon the ends of the vagus nerve in the heart, and also upon the nerve itself, and much in the same manner as digitalis. But the final slowing of the heart produced by large doses of casca is due to the action of the drug upon the ganglionic apparatus contained in the heart itself. It has "a most extraordinary power of contracting the bloodvessels," not as digitalis has by stimulating the vaso-motor centre in the medulla-oblongata, but by acting either on the bloodvessels themselves, the vaso-motor nerves, or the vaso-motor centre not contained in the medulla. It appears to act as a diuretic by contracting the arteries, and so increasing the blood pressure. It will be noticed that in the description of "nkazya" by Wilson, given above, diuresis is mentioned as one of its effects.

Medical Uses.—When, in 1859, the essay referred to was published, it had an appendix describing the medicinal applications of sassy. It is said to be astringent, narcotic, acrid, cholagogue, and diaphoretic, and to be used successfully in the treatment of *periodical fevers*, *colic*, *diarrhœa*, and *dysentery*. A summary of cases of the last-named disease treated by the medicine appears to demonstrate its possession of marked curative virtues. It was given in tincture and also in extract. While these clinical reports point in one direction, physiological reasons are now given for using the medicine in *cardiac dropsy*, especially when it depends on mitral obstruction, and in cases of *hemorrhage* due to flaccidity of the capillaries.

EUONYMUS, *U. S.*—WAHOO.

Cortex euonymi.—Spindle tree, Burning bush, E.; *Écorce de fusain (de bonnet de prêtre)*, Fr.; *Spindelbaum-Rinde*, G.

The bark of Euonymus atropurpureus, *Jacq.* *Nat. Ord.*—Celastraceæ.

Origin.—The wahoo is a shrub 6 to 10 or even 14 feet high, and is found in shady woods of the northern and middle section of the United States east of the Mississippi. As an ornamental shrub, it is of a strikingly handsome appearance in autumn from its copious crimson, smooth, four-lobed capsules, which are pendulous on long peduncles. Its branches are slightly quadrangular; the leaves opposite, petioled, elliptic-ovate, serrate, and pointed; the flowers are dark purple, in loose cymes of three to six, and appear in June. The root-bark is preferred.

Description.—It comes in curved or quilled fragments varying in thickness between $\frac{1}{16}$ and $\frac{1}{8}$ inch. It is externally of a light ash-gray color, mottled with larger or smaller patches of dark brown or blackish; the corky layer is detached in very thin and small scales. The inner surface, to which fragments of the white wood are often adhering, is brownish-white and smooth. When dry the bark breaks, both transversely and longitudinally, with a nearly smooth fracture, exhibiting a whitish tissue which in the inner layers has a distinct tangential arrangement. The bark attracts moisture in a damp atmosphere, thereby losing its brittleness, is nearly inodorous, and has a sweetish, afterwards bitterish, and somewhat acrid taste.

Constituents.—W. P. Clothier (1861) isolated bitter, yellow, acicular crystals from the tincture prepared with diluted alcohol by agitating it with chloroform. The same principle is probably contained in the so-called *euonymin* of the eclectics, which is obtained by precipitating a concentrated tincture of the bark with water. W. T. Wenzell (1862), however, obtained by treatment of the tincture with chloroform a dark-yellow substance, from which ether dissolved a golden-yellow resin; the insoluble portion was dissolved by alcohol, a resin precipitated by acetate of lead, and the lead removed from the filtrate; on evaporation uncrystallizable *euonymin* was left having an intensely bitter taste. It is a neutral principle soluble in ether (?), alcohol, and water, and precipitated by subacetate of lead and phosphomolybdic acid. Wenzell obtained also *asparagin*, *euonic acid*, which crystallizes in needles and is precipitated by subacetate of lead; tartaric, malic, and citric acids; several resins, starch, pectin, and other common vegetable principles. The dried bark left 14.75 per cent. of ash, about half of which consisted of silica.

Allied Drugs.—EUONYMUS AMERICANUS, *Lin.*, *strawberry bush*, is a low, usually trailing shrub, with crimson warty capsules and orange-red roots.

EUON. EUROPÆUS, *Lin.*, is 8 to 20 feet high, occasionally cultivated in gardens, has greenish-yellow flowers, and pale-red capsules, the arillus being orange-red. All parts of it are emetic and purgative; the fruit made into an ointment has been used for the destruction of pediculi. Riederer (1833) believed the bitter taste to be due to an alkaloid, *euonymin*, which he did not succeed in obtaining pure. Grundner (1847) regarded it as a mixture of resin with bitter extractive. The arillus yields by pressure an orange-colored oil which has a bitter taste. The orange-red coloring matter, which is quite prevalent in this natural order, seems to deserve careful investigation.

Medical Action and Uses.—Wahoo is reported, but not upon sufficient authority, to be a "tonic, hydragogue cathartic, diuretic, and antiperiodic." Certain physicians practising in malarial localities are apt to see a cholagogue in every purgative, and this one is no exception to the rule. A decoction or an infusion, made with an ounce of the bark to a pint of water, may be given in the *dose* of a wineglassful.

EUPHRASIA.—EYEBRIGHT.

Euphraise, Fr.; *Augentrost*, G.

Euphrasia officinalis, *Lin.* *Nat. Ord.*—Scrophulariaceæ.

Description.—An annual plant about 6 inches high, indigenous to the greater part of Europe, and in North America to the White Mountains and from the great lakes northward. It has opposite, shortly-petiolate, ovate, or lanceolate leaves, which are about one-third inch long, and have four or five teeth on each side; the upper (floral) leaves are alternate, nearly rhomboid, and bristly-toothed. The axillary flowers have a four-cleft calyx and a white or lilac two-lipped corolla with a yellow throat, four ascending stamens, and an oblong, many-ovuled ovary. When fresh the plant has a faint balsamic odor, which is almost completely lost on drying; the taste is somewhat saline, bitter, and scarcely astringent.

Constituents.—Examined by J. B. Enz (1859), the fresh plant was found to contain 62 per cent. of moisture and 10.8 per cent. of cellulose, the remainder being tannin, a little volatile oil, an acrid and bitter principle, several organic acids, mannite, glucose, and other common principles. The tannin precipitates ferric salts dark green, and lead salts of a bright green color.

Medical Action and Uses.—The name euphrasia, signifying cheerfulness, was anciently as well as in more recent times given to this plant, which was supposed to render the vision clearer, and to cure various inflammatory affections of the eyes. Its English name *eyebright* may be due to this circumstance; but some maintain that its use in such disorders was prompted by the doctrine of signatures, for a yellow spot upon its flower suggests the pupil of the eye. Its utility, when applied as a fomentation or decoction in *ophthalmia*, was probably due to its astringency. A vinous decoction of it was esteemed in *toothache;* a closely allied species also used for this affection was for that reason called *odontitis*. Internally, eyebright was also given, as a distilled water or a tincture, for *chronic catarrhs*.

EXTRACTA.—EXTRACTS.

Extraits, Fr.; *Extrakte*, G.

Extracts are preparations which are obtained by removing from crude drugs a solution of their medicinal principles, and evaporating it to the consistence of a soft solid or to dryness. The medicinal principles may be removed either by expressing the crude drugs while fresh and juicy, or by exhausting the dried and powdered drugs with water, alcohol and water, alcohol, or ether, whereby the *inspissated juices* or the *aqueous*, *hydro-alcoholic*, *alcoholic*, or *ethereal extracts* are obtained; the latter contain all the fixed and volatile oils, together with the resin, which may have been contained in the drug, and usually remain liquid after the solvent has been completely evaporated, for which reason the Pharmacopœia has separated them as *oleoresinæ* (which see).

INSPISSATED JUICES.—The United States Pharmacopœia has admitted four inspissated juices, which, however, with the exception of one (Ext. taraxaci), can be prepared by the pharmacist in exceptional cases only, because the plants are not indigenous or grow spontaneously only in a few localities; they might very properly be dismissed or replaced by aqueous extracts which may be prepared by the pharmacist. The expressed juices of herbaceous plants contain, besides the medicinal principles, chlorophyll in suspension and albuminous and mucilaginous matters in solution. Of these, the chlorophyll separates on heating the liquid to about 55° C. (130° F.); the albumen is not coagulated until the temperature reaches about 94° C. (200° F.), and the solubility of the gum and mucilage is not affected by heat; but these principles may be removed by alcohol, in which they are insoluble. The different Pharmacopœias have adopted different processes for the purification of the expressed juices; that of Germany endeavors to obtain the extracts as free as possible from inert principles, and purifies by heat and by alcohol; those of France and the United States direct the juice to be coagulated by heat, but the gum is not precipitated; and that of Great Britain aims only at the separation of the albumen, and reincorporates with the extract the previously removed chlorophyll. The inspissated juices of the latter are of a green color and of a firm pilular consistence; those of the other Pharmacopœias are brown in color, and cannot be made into pills without the addition of some vegetable powder. Provided the material has been of the same quality, an inspissated juice made according to the German Pharmacopœia ought to be stronger, and if made by the British Pharmacopœia weaker, than is obtainable by the United States process.

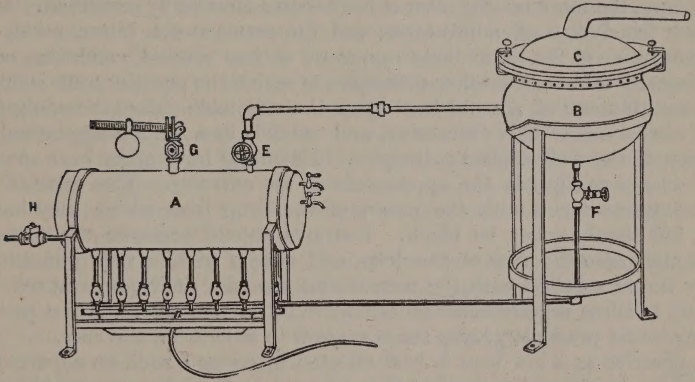
To obtain the juice, the vegetable should have been recently collected, well washed with water to free it from extraneous matter, and the superfluous water drained off. It is then cut into pieces of convenient size, and bruised in a stone mortar by means of a pestle made of hard wood until reduced to a smooth pulpy mass. If not succulent enough, a little water may be sprinkled over it during this operation. The mass is then inclosed in canvas bags, strongly expressed, again mixed with water, and expressed a second time, whereby that portion of the juice remaining in the pulp is obtained. The mixed liquids are then heated to the boiling point (to 80° C.=176° F., P. G.) to coagulate the albumen, which incloses also the chlorophyll, and is removed by straining, after which the clear liquid is evaporated to the proper consistence. The German Pharmacopœia directs the strained liquor to be evaporated until reduced in weight to 10 per cent. of the weight of the plant, when an equal weight of alcohol is added to precipitate gummy matter; the mixture is set aside until the insoluble matter has subsided, it is then strained, and the retained liquid obtained by the addition of a little diluted alcohol; the alcohol is partly distilled off, and the remaining liquor evaporated as before. The British Pharmacopœia directs the heating of the expressed juice to 130° F., whereby the chlorophyll separates from the liquid, and is collected upon a calico strainer. The strained liquor is now heated to 200° F. to coagulate the albumen, again strained, and evaporated to the consistence of a thin syrup, to which the chlorophyll, previously separated, is added, and well mixed by assiduous stirring. Evaporation to the proper consistence will complete the extract. If the part of the plant employed does not contain chlorophyll, its removal and subsequent readmixture are obviously omitted from the process, and, if starch is present, some of it will pass through the press-cloth, and the expressed juice must be allowed to subside and then be decanted from the deposited fecula.

Aqueous Extracts were formerly usually made by boiling the drug with water, expressing the watery solution, and evaporating. The Pharmacopœias have very properly discontinued this process almost altogether, and have in nearly all cases substituted infusion or percolation with water. Prolonged boiling with water will often render inert constituents (starch, etc.) soluble in water, and thus increase the amount of extract to the injury of its quality. In other cases, however, it may not only injure the quality, but also decrease the yield of the extract, as in the case of krameria, the tannin of which is either partly destroyed or becomes insoluble through combination with other constituents. Some Pharmacopœias exhaust the comminuted drugs by hot infusion or digestion; but cold infusion or percolation appears to produce not only unobjectionable aqueous extracts, but they are in some cases at least superior in appearance to those made by hot infusion or digestion. When infusion is directed, the properly comminuted drug is mixed with sufficient water to cover it, and, in case the material be light, it is submerged by putting a perforated cover with sufficient weights upon it to keep it covered by the water. After due maceration or digestion, a concentrated solution of the principles is at once obtained by expression, and a second maceration and expression will practically exhaust the drug. If a large quantity of water be used in the beginning, a second maceration may be avoided or becomes unprofitable, but a longer continued evaporation is necessary.

For the proper treatment of the material by percolating with water we refer to the remarks on Percolation (see Extracta fluida).

Alcoholic Extracts.—Whether made with strong or diluted alcohol, the powdered material is most conveniently exhausted by percolation, which process is fully described under the head of Extracta fluida. For some extracts, alcohol and diluted alcohol are used; in such cases the former is always used first, and, by the addition of the latter, an amount of percolate obtained equal to that of the alcohol employed, and kept separate from the percolate with the weaker alcohol. The two liquids are separately distilled and evaporated to the consistence of syrup, then mixed while warm, and the mixture well stirred and evaporated to the proper consistence. The stronger alcoholic solution requires sometimes to be evaporated at a low temperature, and spontaneous evaporation in a warm place is then usually directed. The alcohol which is lost in this operation may be recovered by using a shallow pharmaceutical still, which may be placed in a water-bath, and the head of which is provided on the inside with a gutter; the tincture to be concentrated is put into a porcelain evaporating dish; this is placed in the still and the moderate heat of a water-bath applied, when the alcohol will slowly evaporate, condense upon the inside of the cooled head, collect in the gutter below, and be discharged through the neck. Besides recovering the alcohol, this arrangement has also the advantage of keeping the liquid free from dust and other accidental impurities. For uses on a small scale, Prof. Parrish has somewhat modified the steam evaporating pan and still, and constructed an apparatus which is shown in the annexed cut. *A* is a boiler made of thick copper, which may be heated either by a furnace or by several Bunsen burners. Water is supplied through the valve *H*; *G* is a safety valve; *E* is the valve for regulating the supply of steam, which is carried off through the exhaust valve *F*. The evaporating pan, made of well-tinned copper, is coupled together with the steam-jacket *B*, upon the flanges of which is fitted the head *C*, and secured by means of clamps, the joint being made steam-tight by placing a coil of lamp-wick or loose cord between the flanges. If used for distillation, *C* is connected with a condenser; if for evaporation only, *C* is removed. By proper regulation at *E* and *F*, either a very moderate heat may be applied to the pan or the temperature may be raised above the boiling point of water.

Fig. 65.



Steam-boiler with Still.

Hydro-alcoholic Extracts, in the preparation of which both alcohol and water are used, are now almost obsolete, and the one still officinal in the United States Pharmacopœia should be discontinued in its present form. The operation is similar to that of making alcoholic extracts by using alcohol of different strengths;

the alcoholic and aqueous solutions are evaporated separately to a syrupy consistence, then well mixed, and evaporated to the proper consistence.

Ethereal Extracts.—All the ethereal extracts of the United States Pharmacopœia will be found under *Oleoresinæ*, where also the necessary apparatuses and operations are described. Ext. mezerei æthereum, *Br. Ph.*, is the ethereal extract of an alcoholic extract, the latter being prepared from the drug and afterwards exhausted by ether.

Evaporation of the Solutions.—This is an important operation in the preparation of extracts for which the Pharmacopœia gives, besides some special directions, the general one "to evaporate as quickly as possible in a broad shallow vessel, by means of a water-bath, and, towards the end of the process, to stir constantly with a spatula." All plants contain one or more principles which, though originally colorless, are very easily altered under the influence of air and heat, acquiring a yellow or brown color. It is not known whether the so-called *colorless extractive* is alike in all plants; nor is its composition known or the nature of changes produced under the conditions mentioned, except that the heat of boiling water and the prolonged action of oxygen will convert it ultimately into a blackened insoluble substance, to which the name *apotheme* has been given, and which appears to be allied to *humin*. Extractive is almost insoluble in absolute alcohol and ether, but dissolves freely in weaker alcohol and water, and is removed from its solutions by animal charcoal and hydrate of aluminium, the more readily after it has become colored by oxidation. It is with difficulty freed from all admixtures, and the terms sweet, bitter, acrid, etc. extractives refer to the same body in a more or less altered condition, combined or intimately mixed with other principles to which the peculiar taste is due. The injurious influence of air and heat upon the vegetable juices is mainly confined to the alterations of this extractive, and extends in a limited degree only to the majority of the well-defined principles. Its effects have often been much overrated, except as regards the appearance of the extracts. The color of the different extracts varies with the nature of the drug from which they have been made, but should never be black. Extracts should preserve the taste, and to some extent also the odor of the drug, and should yield a nearly clear or moderately turbid solution with the menstruum used in their preparation. Not to come up to these requirements is indicative of carelessness, and the presence of empyreumatic products proves the operation to have been slovenly.

Evaporation at a low heat is best effected *in vacuo;* such an apparatus, however, is too costly and complicated to be used in the laboratory of the pharmacist. The use of a water-bath is well adapted for preserving a low temperature, and if a shallow dish is used and a current of air conducted over the surface of the liquid, rapid evaporation will be effected and all danger of injuring the product avoided.

Fig. 66.

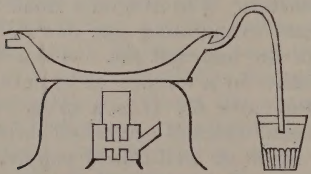
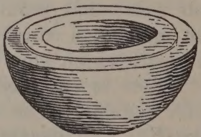


Fig. 67.



Water-baths.

The vessels used for this part of the process are of great importance for the quality of the extract. Metallic vessels should, as a general rule, be avoided, since the tannin and free acids or acidulous salts contained in many drugs would, by the prolonged necessary contact, contaminate the extract with iron or copper.

Tin is less liable to be thus attacked, and is therefore, in most cases, unobjectionable. The most suitable vessels for the purpose are porcelain dishes or well-enameled iron pans, with a rounded bottom, which may also be used for recovering the alcohol at a low heat, in the manner described above.

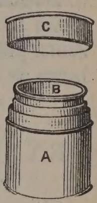
For the reasons stated, the use of metallic spatulas for stirring the extracts during evaporation is generally inadmissible: the proper material is porcelain or wood. Various mechanical contrivances have been constructed with the view of saving the manual labor and constant attendance in stirring, and they serve a good purpose.

Consistence of Extracts.—The Pharmacopœia recognizes two degrees of consistence, namely, dry and powdered, and a consistence proper for forming pills. The latter is practically unattainable in the majority of cases, unless some dry substance is added, like the chlorophyll, to the inspissated juices of the British Pharmacopœia. The nearest degree of consistence attainable with some extracts is such that they may be formed into pills, which, however, do not retain their globular shape. Others, like Extr. gentianæ, taraxaci, etc., are even too soft for that purpose, while some, like Extr. jalapæ, rhei, etc., gradually become quite tough or hard. Extracts which do not contain any fixed oil or hygroscopic constituents, may be evaporated and, after cooling, reduced to powder. On being warmed, all extracts become softer, and, if pulverulent at the ordinary temperature, acquire sufficient pliability to be rolled into pills.

Preservation.—The consistence of extracts nearly neutralizes any injurious effect which contact with the atmosphere might otherwise exert, and the most ordinary care will therefore suffice to keep them unaltered for a considerable time. The Pharmacopœia directs the sprinkling upon the softer extracts of a small quantity of alcohol; but this is entirely unnecessary for those which are to some degree hygroscopic, and of little permanent utility for those which have a tendency to become tough. The difficulty may generally be avoided, by spreading a few drops of glycerin over the surface, or, as has been proposed, by working into the warm extract half its weight of glycerin and dispensing fifty per cent. more than prescribed.

The ordinary extracts are kept in jars of queensware, or, preferably, of porcelain, with a cover of the same material. Small quantities may be kept in wide-mouthed vials, with a very narrow shoulder, or in an ordinary tie-over jar, inclosed in a tin box, just large enough to receive it, and provided with a well-fitting cover.

Fig. 68.



Jar in Tin Box.

Powdered extracts, if not hygroscopic, are kept in a jar or bottle. For convenience in dispensing, the German Pharmacopœia directs the reduction of a portion of the different narcotic extracts to powder by warming the extract in a porcelain dish, incorporating an equal weight of dextrin, drying the mixture at a temperature of 40° to 50° C. (104° to 122° F.), rubbing it to powder, and adding sufficient dextrin to make the weight of the powder double that of the extract employed. 2 grains of this powder represent 1 grain of the extract.

Yield and Composition.—Considering the variable condition of the drugs, as influenced by climate, soil, time of collection, etc., the yield cannot be uniform, even if the same process be scrupulously followed. Recently dried herbs usually yield more extract than the same herb in the fresh state, or kept on hand for some months. For similar reasons, the composition of the extracts must vary as much as the drugs from which they are prepared. Certain extracts, when kept on hand for some time, form throughout their mass acicular crystals of potassium nitrate, the acid being probably formed through the gradual oxidation of some nitrogenized, probably albuminous principle.

EXTRACTUM ACONITI, *U. S.*, *Br.*—EXTRACT OF ACONITE.

Extractum foliorum (vel herbæ) aconiti.—Extract of aconite leaves, E.; *Extrait de feuilles d'aconit*, Fr.; *Eisenhutblätter-Extrakt*, G.

Preparation.—Take of Aconite Leaves recently dried and in fine powder twelve troyounces; Alcohol a pint; Diluted Alcohol a sufficient quantity. Introduce the powder, previously mixed with one-third of the alcohol, into a conical percolator, and pour upon it the remainder of the alcohol. When the liquid has all been absorbed by the powder, pour on diluted alcohol until a pint of tincture has been obtained. Set this aside in a warm place, and allow it to evaporate spontaneously until reduced to three fluidounces. Continue the percolation with diluted alcohol until two pints more of tincture have passed, or until the powder is exhausted; then evaporate, by means of a water-bath, at a temperature not exceeding 160° F., to the consistence of syrup, and add the three fluidounces of tincture first obtained. Lastly, continue the evaporation at a temperature not exceeding 120° F., until the whole is reduced to the proper consistence. *U. S.*

Take of the Fresh Leaves and Flowering Tops of Aconite one hundred and twelve pounds. Bruise in a stone mortar and press out the juice; heat it gradually to 130° F. and separate the green coloring matter by a calico filter. Heat the strained liquor to 200° F. to coagulate the albumen, and again filter. Evaporate the filtrate by a water-bath to the consistence of a thin syrup; then add to it the green coloring matter previously separated, and, stirring the whole together assiduously, continue the evaporation at a temperature not exceeding 140° F. until the extract is of a suitable consistence for forming pills. *Br.*

The two processes yield brown-green extracts, which are probably of very nearly the same strength; the first contains the chlorophyll and resinous matter of the leaves to the exclusion of the gummy constituents which are present in the latter. It should be remembered that the *Extr. aconiti* of the German Pharmacopœia is prepared from aconite root by exhausting it with alcohol, specific gravity .892, and is about 6 to 8 times stronger than the extract prepared from the herb.

Medical Uses.—This extract may be given in the dose of from half a grain to a grain, gradually increased if necessary. An alcoholic extract of the root, prepared in the same manner, may be prescribed in doses one-third as large as those just indicated.

EXTRACTUM ALOES BARBADENSIS, *Br.*—EXTRACT OF BARBADOES ALOES.

Extrait d'aloès de Barbades, Fr.; *Barbadoes Aloe-Extrakt*, G.

Preparation.—Take of Barbadoes Aloes in small fragments one pound; Boiling Distilled Water one gallon. Add the aloes to the water, and stir well until they are thoroughly mixed. Set aside for twelve hours, then pour off the clear liquor, strain the remainder, and evaporate the mixed liquors by a water-bath or a current of warm air to dryness. *Br.*

Medical Uses.—There does not appear to be any advantage in this extract over aloes itself. Its *dose* is the same, or from two to six grains.

EXTRACTUM ALOES SOCOTRINÆ, *Br.*—EXTRACT OF SOCOTRINE ALOES.

Extrait d'aloès sucotrin, Fr.; *Socotora Aloe-Extrakt*, G.

Preparation.—Take of Socotrine Aloes in small fragments one pound; Boiling Distilled Water one gallon. Add the aloes to the water, and stir well until they are thoroughly mixed. Set aside for twelve hours; then pour off the clear liquor, strain the remainder, and evaporate the mixed liquors by a water-bath or a current of warm air to dryness. *Br.*

The two extracts of aloes are yellowish-brown powders, which yield turbid solutions with water. The introduction of *purified aloes* into the U. S. Pharmacopœia renders an extract scarcely necessary. The extract of the German Pharmacopœia is made by maceration with *cold* water; the latter recognizes also an *Extractum aloes acido sulphurico correctum*, which is obtained by diffusing 8 parts of the extract in 32 parts of distilled water, adding gradually 1 part of sulphuric acid, and evaporating to dryness.

Medical Uses.—It may be given for the same purposes as the extract of Barbadoes aloes, or as aloes itself, and in the same *dose*, from two to six grains.

EXTRACTUM ANTHEMIDIS, *Br.*—EXTRACT OF CHAMOMILE.

Extractum chamomillæ Romanæ.—*Extrait de camomille romaine*, Fr.; *Römisch-Kamillen-Extrakt*, G.

Preparation.—Take of Chamomile Flowers one pound; Oil of Chamomile fifteen minims; Distilled Water one gallon. Boil the chamomile with the water until the volume is reduced to one-half, then strain, press, and filter. Evaporate the liquor by a water-bath until the extract is of a suitable consistence for forming pills, adding the oil of chamomile at the end of the process. *Br.*

It is a dark-brown extract, having the odor and bitter taste of chamomile. It would seem not to be very difficult to work out a better process, in which the long boiling should be avoided.

Medical Uses.—It is, like extract of gentian, a convenient excipient for tonic medicines given in the pilular form, especially quinia and the salts of iron. It is by itself a mild stomachic tonic. *Dose*, from two to ten grains.

EXTRACTUM ARNICÆ, *U. S.*—EXTRACT OF ARNICA.

Extractum arnicæ alcoholicum.—*Extrait d'arnique*, Fr.; *Arnika-Extrakt*, *Wohlverleih-Extrakt*, G.

Preparation.—Take of Arnica in moderately coarse powder twenty-four troyounces; Alcohol four pints; Water two pints; Diluted Alcohol a sufficient quantity. Mix the alcohol and water, and moisten the powder with a pint of the mixture; then pack it firmly in a cylindrical percolator, and gradually pour on the remainder of the mixture. Continue the percolation with diluted alcohol until six pints of tincture have passed. Lastly, evaporate, by means of a water-bath, to the proper consistence. *U. S.*

The yield is about 30 per cent. of the weight of the flowers. The extract is of a brown color, slight odor, and bitter and acrid taste.

Medical Uses.—It is seldom, if ever, prescribed internally, although its *dose* is stated to be from five to ten grains. Its chief use is in making arnica plaster.

EXTRACTUM BELLADONNÆ, *U. S.*, *Br.*—EXTRACT OF BELLADONNA.

Extrait de belladone, Fr.; *Tollkirschen-Extrakt*, G.

Preparation.—Take of Belladonna Leaves, fresh, twelve troyounces. Bruise the leaves in a stone mortar, sprinkling on them a little water, and express the juice; then, having heated this to the boiling point, strain, and evaporate to the proper consistence. *U. S.*

Take of the fresh Leaves and young Branches of Belladonna one hundred and twelve pounds. Bruise in a stone mortar, and press out the juice; heat it gradually to 130° F., and separate the green coloring matter by a calico filter. Heat the strained liquor to 200° F., to coagulate the albumen, and again filter. Evaporate the filtrate by a water-bath to the consistence of a thin syrup; then add to it the green coloring matter previously separated, and, stirring the whole together assiduously, continue the evaporation at a temperature not exceeding 140° F., until the extract is of a suitable consistence for forming pills. *Br.*

The first formula yields a brown, and the second a greenish-brown extract; the yield of the former is about $3\frac{1}{2}$ per cent.

Medical Uses.—A number of local applications of this, as of all other narcotic extracts, exists. Softened with water, or mixed with oil, it enters into many magistral formulæ for the relief of local pains, especially those of a *neuralgic* sort. A more elegant form for this purpose is belladonna plaster. Its relaxing and anodyne operations combined are used in spasm of muscles surrounding canals, as the *ureter*, *bladder*, *urethra*, *os uteri*, *vagina*, and *rectum*, when irritation excites their contraction. In these several cases the extract softened may be rubbed in as near as possible to the seat of pain; or it may be introduced in a suppository into the vagina or rectum. When applied to the prepuce in phimosis and in paraphimosis, it sometimes reduces the engorgement and stricture. Rubbed on the forehead or eyelids it was formerly much used to *dilate the pupil;* but the more cleanly solution of atropia is to be preferred. It may be used internally for all the purposes to which belladonna is appropriate. Extract of belladonna is of uncertain strength, and its dose is therefore variable. A quarter of a grain may be given three times a day, and the quantity gradually increased, until the state of the pupil denotes the degree of its action.

EXTRACTUM BELLADONNÆ ALCOHOLICUM, *U. S.*—ALCOHOLIC EXTRACT OF BELLADONNA.

Extrait de belladone alcoholique, Fr.; *Spirituöses Tollkirschen-Extrakt*, G.

Preparation.—Take of Belladonna Leaves in fine powder twenty-four troyounces; Alcohol four pints; Water two pints; Diluted Alcohol a sufficient quantity. Mix the alcohol and water, and moisten the powder with a pint of the mixture; then pack it firmly in a conical percolator, and gradually pour upon it the remainder of the mixture. Continue the percolation with diluted alcohol until six pints of tincture have passed. Lastly, evaporate, by means of a water-bath, to the proper consistence. *U. S.*

The yield is about 22 per cent. of greenish-brown extract having the bitter taste of belladonna.

Medical Uses.—The uses and the dose of this preparation are essentially the same as those of the simple extract of belladonna.

EXTRACTUM CALUMBÆ, *Br.*—EXTRACT OF CALUMBA.

Extractum colombo, P. G.—*Extrait de colombo*, Fr.; *Kolombo-Extrakt*, G.

Preparation.—Take of Calumba Root, cut small, one pound; Distilled Water four pints. Macerate the calumba with two pints of the water for twelve hours, strain and press. Macerate again with the same quantity of water, strain and press as before. Mix and filter the liquors, and evaporate them by the heat of a water-bath until the extract is of a suitable consistence for forming pills. *Br.*

The yellowish-brown extract contains the mucilaginous and bitter principles of calumba.

Medical Uses.—This preparation, which in its action differs but little from the extracts of colombo and gentian, may be prescribed in the *dose* of from two to ten grains.

EXTRACTUM CANNABIS AMERICANÆ, *U. S.*—
EXTRACT OF AMERICAN HEMP.

Extrait de chanvre américain, Fr.; *Amerikanischer Hanf-Extrakt*, G.

Preparation.—Take of American Hemp in moderately fine powder twelve troyounces; Alcohol a sufficient quantity. Moisten the hemp with six fluidounces of alcohol, pack it in a conical percolator, cover the surface with a disk of paper, and pour on six fluidounces of alcohol. When the liquid begins to drop from the percolator, close the lower orifice with a cork, and, having closely covered the percolator to prevent evaporation, set it aside in a moderately warm place for four days. Then, having removed the cork, gradually pour alcohol upon the surface until two pints of tincture have been obtained, or until the hemp is exhausted. Lastly, by means of a water-bath, evaporate to the proper consistence. *U. S.*

Medical Uses.—The *dose* of this extract is as variable as that of Indian hemp, and it should be administered with the same precautions.

EXTRACTUM CANNABIS INDICÆ, *U. S.*, *Br.*—EXTRACT OF INDIAN HEMP.

Extrait de chanvre indien, Fr.; *Indischer Hanf-Extrakt*, G.

Preparation.—Take of Indian Hemp in moderately fine powder twelve troyounces; Alcohol a sufficient quantity. Moisten the hemp with six fluidounces of alcohol, pack it in a conical percolator, cover the surface with a disk of paper, and pour on six fluidounces of alcohol. When the liquid begins to drop from the percolator, close the lower orifice with a cork, and, having closely covered the percolator, to prevent evaporation, set it aside in a moderately warm place for four days. Then, having removed the cork, gradually pour alcohol upon the surface until two pints of tincture have been obtained, or until the hemp is exhausted. Lastly, by means of a water-bath, evaporate to the proper consistence. *U. S.*

Take of Indian Hemp in coarse powder one pound; Rectified Spirit four pints. Macerate the hemp in the spirit for seven days, and press out the tincture. Distil off the greater part of the spirit, and evaporate what remains by a water-bath to the consistence of a soft extract. *Br.*

The extract is of a blackish-green color, having a slight but heavy narcotic odor and a bitter taste. Nitric acid converts it into an orange-red resin, which after washing with water has the color of gamboge. (Procter, 1864.)

Medical Action and Uses.—This extract varies so greatly in activity that its dose cannot be definitely fixed. Half a grain of a specimen not before tested should be given at first, and gradually the dose should be increased until its sensible effects are produced.

EXTRACTUM CARNIS, *P. G.*—EXTRACT OF MEAT.

Extractum carnis Liebig.—Extrait de viande de Liebig, Fr.; *Liebig's Fleischextract*, G.

Preparation.—In 1854 Liebig published a formula for preparing a *broth for invalids* as follows: Half a pound of fresh meat is finely chopped and macerated for one hour with one pound of cold distilled water, to which four drops of hydrochloric acid and from thirty to sixty grains of table-salt are added. The mass is then displaced on a colander, a little water being added, until one pound of percolate has been obtained. The clear liquid has a red color, and contains the albuminoids of the meat in solution. In 1859 the Bavarian Pharmacopœia adopted a process for extract of meat, in which chopped meat was exhausted with hot water, and the expressed liquid, carefully freed from fat and albumen, was evaporated.

Since then factories have been established in different parts of South America, Australia, and the United States, where cattle are abundant and cheap. In the majority of these establishments Liebig's process appears to be followed, perhaps with some slight modification. At Fray-Bentos, on the river Uruguay, where a factory was conducted under the direction of Liebig, the extract, according to F. Müller (1868), is prepared as follows: The freshly slaughtered meat is allowed to cool for twenty-four hours, and then ground into a pulpy mass by passing it between iron rollers furnished with small projections. The pulp is stirred with water for about an hour, strained through sieves, the fat carefully removed, and the liquid evaporated in steam-pans, a current of air being continuously passed over the surface. At a certain state of concentration the liquid is filtered, and the evaporation continued until the extract is transferred to well glazed stoneware jars which are carefully covered.

Properties.—Thus prepared, extract of meat is of a brown color, and has a pleasant odor suggestive of roasted meat. It is completely soluble in water, yielding a clear solution, which, on the addition of a little table-salt, has the flavor of beef-broth. When dried at the temperature of 110° C. (230° F.), 100 parts of the extract should lose not over 22 parts of moisture, and after incineration not less than 18 parts of ashes should be left, containing only a small quantity of sodium chloride. If 100 parts of the extract are digested with alcohol, and the liquid filtered and evaporated, not less than 56 parts of extract should be obtained. (P. G.) The figures given by Liebig himself as indicating the limits of variation in extract of meat prepared by his process are for *moisture* 16 to 22 per cent.; *ash* 18 to 22 per cent.; *extractive*, soluble in 80 per cent. alcohol, 56 to 66 per cent. The absence of chloride of sodium in meat-juice is proven by precipitating first the salts of inosic acid by an equal bulk of alcohol, and then adding five volumes of alcohol, when the mixture will separate into two layers, the lower of which, about one-twentieth of the whole, on evaporation at a low temperature will yield prisms of the chloride of potassium, containing not a trace of sodium salt.

The amount of nitrogen in extract of meat is sometimes as low as 4 per cent.; but if made of good beef usually between 9 and 10 per cent., and depends chiefly on the presence of *creatin*, *creatinin*, *globulin*, and *urea*. The solution in water of the extract usually yields a slight precipitate with tannin, which, according to Eichhorn (1867), is due to the presence of a nitrogenated body, which somewhat resembles gelatin, but is not identical with it. Werner (1868), however, states that, if in preparing the extract the temperature of 60° C. (140° F.) be not exceeded, the aqueous solution will give no reaction for gelatin. It would seem, therefore, best to evaporate the liquid under reduced pressure. It is well known, however, that some extracts of meat which have appeared in our market have contained large quantities of gelatin. (See paper by A. E. Ebert in *Proc. Amer. Pharm. Association*, 1871, p. 512.)

Other extracts of meat, liquid as well as solid, have from time to time claimed attention. In 1873 Prof. Leube recommended an extract, in which the meat fibrin is also utilized by being emulsionized. Mirus recommends its preparation by the following process: 250 grams of meat, free from fat and bones, and chopped fine, are introduced into a strong bottle and agitated with 250 grams of water containing 2 per cent. of muriatic acid, until all lumps have disappeared, when the bottle is corked and the stopper wired. Five or six of such bottles are boiled in a high pot for fifteen hours; each bottle is then well agitated, and the boiling continued for fifteen hours more. The preparation may also be made in a suitable steam boiler by placing the meat in a covered porcelain vessel, and boiling for the length of time indicated. The object is to alter the muscular fibres under pressure and under the conditions stated, until they are as nearly disintegrated as possible. In the liquid state the preparation soon spoils, unless preserved by Appert's method; it may, however, be evaporated in a steam-bath to dryness, when it will keep well in closed bottles, and should, when prescribed, be softened by the addition of warm water.

Physiological Action and Medical Uses.—It appears to be too often overlooked that Liebig, to whom is due the vogue of beef-tea during the last quarter of a century, expressly declared it to be incapable of promoting nutrition, and that it is to be classed as nervous food along with tea, coffee, and alcohol, and even as inferior to the last. The very small proportion of two and a half per cent. of albumen which it contains, according to some modes of preparation, is altogether eliminated in Liebig's extract, and the gelatin almost completely, leaving the organic alkaloids and acids and the salts. That these act as temporary nervous stimulants there can be no doubt; but the popular impression is that beef-tea is a substitute for food, and hence it often happens that the patient is plied with it inordinately, with the result of provoking vomiting or diarrhœa. That it often occasions the latter when habitually used as a substitute for food, to repair fatigue, or to fortify the body or mind for an unusual exertion, is probably within the experience of many physicians. It is, however, rather indirectly than directly injurious by being used as a nutrient, a function which it has no claim to perform. On the other hand, it has not that poisonous operation which science, falsely so called, attributed to it through Kemmerich in 1868. He arrived at the singular conclusion that concentrated cold extract of horse-flesh injected into the stomach of dogs, in small doses, increases the number and strength of the heart's pulsations, but that in large doses it kills, with all the appearances of cardiac paralysis. This remarkable result he attributes to the potash salts of the meat!

The stimulant and non-nutritious qualities of beef-tea render it peculiarly fitted for the treatment of the greater number of acute *febrile diseases*. Nature protests against the use of food in them, by the repugnance of the patients to taking it, and by the aggravation of the fever which it induces. During the augment and acme of these affections, food in a literal sense heaps fuel on the fire; but in many of them the animal mechanism must be kept in such active movement as to enable it to resist the disintegrating tendencies of the disease, and afterwards to throw off the effete accumulations. This, beef-tea aids in accomplishing, in the same manner as alcohol. When that end is attained, and when the fever has declined, the preparation holds only a secondary place in the treatment, the first being occupied by true nutrients, which are better prepared by culinary skill than by chemical science. Feeding by the rectum with beef-tea is, if possible, of even more temporary utility than when this preparation is given by the stomach. Pancreatic emulsion is more efficient. It is highly recommended in various affections of the stomach when the mucous coating requires to be protected from irritation in convalescence from typhus, etc., and may be combined with broth or with Liebig's extract of meat; or milk and powdered cracker may be used alternately with it. It has been employed with marked advantage in cases of *fatty diarrhœa* due to obstruction of the pancreatic secretion, and in the *wasting diseases* of children induced by artificial feeding. It also promotes the digestion and assimilation of *cod-liver oil.*

EXTRACTUM CINCHONÆ, *U. S.*—EXTRACT OF CINCHONA.

Extractum Chinæ.—Extract of calisaya bark, E.; *Extrait de quinquina jaune*, Fr.; *China-Extrakt*, G.

Preparation.—Take of Yellow Cinchona in fine powder twelve troyounces; Alcohol three pints; Water a sufficient quantity. Mix the powder with twenty fluidounces of the alcohol, and allow the mixture to stand for four days; then introduce it into a conical glass percolator, and gradually pour upon it the remainder of the alcohol. When the liquid ceases to pass, pour upon the residue sufficient water to keep its surface covered, until three pints of tincture have passed. Set this portion aside, and continue the percolation until six pints of infusion are obtained. Distil off the alcohol from the tincture, and evaporate the infusion until the liquids respectively are brought to the consistence of thin honey; then mix them, and, by means of a water-bath, evaporate to the proper consistence. *U. S.*

If the percolation has been properly conducted, there appears to be little necessity of obtaining such a large amount of aqueous infusion after the bark has been exhausted by alcohol. The extract is of a reddish-brown color, has the persistently bitter taste of cinchona, and, on keeping, becomes dry. The German Pharmacopœia recognizes an *Extractum Chinæ frigide paratum*, which is obtained by evaporating the cold aqueous infusion of pale cinchona bark.

Medical Uses.—Extract of cinchona, since it possesses all the virtues of Peruvian bark, would for many purposes be preferable to quinia, were it less bulky. The *dose* is from ten to thirty grains.

EXTRACTUM COLCHICI, *Br.*—EXTRACT OF COLCHICUM.

Extrait de colchique, Fr.; *Zeitlosen-Extrakt*, G.

Preparation.—Take of Fresh Colchicum Corms deprived of their coats seven pounds. Crush the corms, press out the juice; allow the feculence to subside, and heat the clear liquor to 212° F.; then strain through flannel, and evaporate by a water-bath at a temperature not exceeding 160° F., until the extract is of a suitable consistence for forming pills. *Br.*

This is a brown extract, having a bitter taste, and yielding with water a rather turbid solution.

EXTRACTUM COLCHICI ACETICUM, *U. S.*, *Br.*—ACETIC EXTRACT OF COLCHICUM.

Extrait de colchique acétique, Fr.; *Zeitlosen-Essigextrakt*, G.

Preparation.—Take of Colchicum Root in moderately fine powder twelve troyounces; Acetic Acid four fluidounces; Water a sufficient quantity. To the acetic acid add a pint of water, and mix the resulting liquid with the colchicum root. Transfer the mixture to a conical glass percolator, and pour water gradually upon it, until the liquid passes with little or no taste. Lastly, evaporate the liquid, in a porcelain vessel, by means of a water-bath, to the proper consistence. *U. S.*

The formula of the British Pharmacopœia is the same as for the preceding extract, the only difference consisting in the addition of 6 fluidounces of acetic acid to the bruised colchicum tubers before the juice is expressed.

The extract resembles the preceding in all respects, except that it is softer and has the distinct odor of acetic acid.

Medical Uses.—These extracts are convenient forms of colchicum for prescription in pill, especially for those purgative pills which gouty patients commonly require. The *dose* of either is from one-half grain to two grains.

EXTRACTUM COLOCYNTHIDIS, *U. S.*, *P. G.*—EXTRACT OF COLOCYNTH.

Extractum colocynthidis alcoholicum.—*Extrait de coloquinte*, Fr.; *Koloquinten-Extrakt*, G.

Preparation.—Take of Colocynth forty-eight troyounces; Diluted Alcohol a sufficient quantity. Dry the colocynth, and, having removed the seeds, and reduced it to coarse powder by grinding or bruising, macerate it in eight pints of diluted alcohol for four days, with occasional stirring; then express strongly, and strain through flannel. Pack the residue, previously broken up with the hands, firmly in a cylindrical percolator, cover it with the strainer, and pour diluted alcohol upon it, until the tincture and expressed liquid, taken together, measure sixteen pints. Mix the tincture with the expressed liquid, and, having recovered from the mixture ten pints of alcohol by distillation, evaporate the residue to dryness by means of a water-bath. Lastly, reduce the dry mass to powder, and keep it in a well-stopped bottle. The extract obtained by this process weighs about seven troyounces. *U. S.*

The yield mentioned by the Pharmacopœia has reference to the peeled fruit containing the seeds, which, however, must be removed before percolation. When made on a large scale, the removal of the seeds is a tedious operation, if not impossible. For this reason the colocynth is ground, care being taken not to crush the seeds, which would load the extract with much oily matter. Dr. Squibb (1867) obtained from very dry colocynth 20.6 per cent. of extract; the general yield from the commercial article is about 14 to 14.5 per cent. After completely removing the seeds, Procter (1867) had left, from 48 troyounces of colocynth, only 12 troyounces of pulp, which yielded 3¼ troyounces of extract, equal to 6.8 per cent. G. H. C. Klie (1878) obtained 16 troyounces of pulp, and not over 6 troyounces, or 12.5 per cent., of extract.

Medical Uses.—It is seldom used alone, but is an ingredient of the compound extract.

EXTRACTUM COLOCYNTHIDIS COMPOSITUM, *U. S.*, *Br.*—COMPOUND EXTRACT OF COLOCYNTH.

Extrait de coloquinte composé, Fr.; *Zusammengesetztes Koloquinten-Extrakt*, G.

Preparation.—Take of Extract of Colocynth in fine powder three troyounces and a half; Purified Aloes in fine powder twelve troyounces; Resin of Scammony in fine powder three troyounces; Cardamom in fine powder a troyounce and a half; Soap in fine powder three troyounces. Mix the powders thoroughly, and keep the mixture in a well-stopped bottle. *U. S.*

Take of Colocynth Pulp six ounces; Extract of Socotrine Aloes twelve ounces; Resin of Scammony four ounces; Hard Soap in powder three ounces; Cardamom Seeds in fine powder one ounce; Proof Spirit one gallon. Macerate the colocynth in the spirit for four days; press out the tincture and distil off the spirit; then add the aloes, scammony, and soap, and evaporate by a water-bath until the extract is of a suitable consistence for forming pills; adding the cardamoms towards the end of the process. *Br.*

The first formula is preferable, as it directs the use of a definite amount of the extract of colocynth, instead of the extract obtained from a definite weight of colocynth pulp, which may vary considerably (see page 567). By mixing the ingredients in the state of fine powder, a preparation uniform in appearance cannot be obtained. But by fusing them together with the assistance of a little alcohol, and by subsequently drying and powdering, an unobjectionable compound extract is produced. It is not hygroscopic, and is, therefore, most conveniently kept in the state of powder.

Medical Uses.—As an efficient and safe purgative this compound, when well prepared, is not excelled by any other in cases of habitual *constipation* produced by torpor of the bowels. Calomel or rhubarb can be added to it to meet special indications; or, if disposed to gripe, extract of hyoscyamus will help to correct this tendency. The *dose* is from five to twenty grains.

EXTRACTUM CONII, *U. S.*, *Br.*—EXTRACT OF CONIUM.

Extract of hemlock, E.; *Extrait de ciguë*, Fr.; *Schierlings-Extrakt*, G.

Preparation.—Take of Conium Leaves fresh twelve troyounces. Bruise the leaves in a stone mortar, sprinkling on them a little water, and express the juice; then, having heated this to the boiling point, filter it, and evaporate to the proper consistence, either in a vacuum with the aid of heat, or in shallow vessels, at the ordinary temperature, by means of a current of air directed over the surface of the liquid. *U. S.*

The extract of the British Pharmacopœia is prepared from the fresh leaves and young branches of conium in precisely the same manner as the corresponding inspissated juices of aconite and belladonna.

This and the following extract might well be dispensed with. If a solid extract is desirable, it should be made from the nearly ripe fruit. The inspissated juice is about 5 per cent. of the weight of the recent herb.

Medical Uses.—As usually sold this extract is often inert. Two grains may be given, as a commencing dose, several times a day, and the quantity gradually increased until its proper operation begins to be seen.

EXTRACTUM CONII ALCOHOLICUM, *U. S.*—ALCOHOLIC EXTRACT OF CONIUM.

Alcoholic extract of hemlock, E.; *Extrait alcoolique de ciguë*, Fr.; *Spirituöses Schierlings-Extrakt*, G.

Preparation.—Take of Conium Leaves recently dried and in fine powder twelve troyounces; Alcohol a pint; Diluted Alcohol a sufficient quantity. Introduce the powder, previously mixed with one-third of the alcohol, into a conical percolator, and pour upon it the remainder of the alcohol. When the liquid has all been absorbed by the powder, pour diluted alcohol upon it until a pint of tincture has been obtained. Set this aside in a warm place, and allow it to evaporate spontaneously until reduced to three fluidounces. Continue the percolation with diluted alcohol until two pints more of tincture have passed, or until the powder is exhausted; then evaporate this liquid by means of a water-bath, at a temperature not exceeding 160° F., to the consistence of syrup. To this add the three fluidounces of tincture first obtained, and continue the evaporation, at a temperature not exceeding 120° F., until the whole is reduced to the proper consistence. *U. S.*

The yield is in the neighborhood of 20 per cent. of the dried leaves.

Medical Uses.—The primary *dose* of about two grains may be gradually increased until its operation becomes manifest.

EXTRACTUM DIGITALIS, *U. S.*, *Ph. G.*—EXTRACT OF DIGITALIS.

Extractum digitalis alcoholicum.—*Extrait alcoolique de digitale*, Fr.; *Fingerhut-Extrakt*, G.

Preparation.—Take of Digitalis recently dried and in fine powder twelve troyounces; Alcohol a pint; Diluted Alcohol a sufficient quantity. Introduce the powder, previously mixed with one-third of the alcohol, into a percolator, and pour upon it the remainder of the alcohol. When the liquid has all been absorbed by the powder, pour diluted alcohol upon it until a pint of tincture has been obtained. Set this aside in a warm place, and allow it to evaporate spontaneously until reduced to three fluidounces. Continue the percolation with diluted alcohol until two pints more of tincture have passed, or until the powder is exhausted; then evaporate this liquid, by means of a water-bath, at a temperature not exceeding 160° F., to the consistence of syrup. To this add the three fluidounces of tincture first obtained, and continue the evaporation, at a temperature not exceeding 120° F., until the whole is reduced to the proper consistence. *U. S.*

This is a greenish-brown extract, 22 to 25 parts of which represent 100 parts of the leaves. The inspissated juice, prepared according to the German Pharmacopœia (see page 556), is brown, and its weight is equal to that of 3 to 4 parts of the fresh leaves and branches employed.

Medical Uses.—This preparation is rarely used, and probably is less reliable than others of digitalis. *Dose*, one-fourth of a grain, and gradually increased.

EXTRACTUM DULCAMARÆ, *U. S.*, *P. G.*—EXTRACT OF BITTERSWEET.

Extrait de douce-amère, Fr.; *Bittersüss-Extrakt*, G.

Preparation.—Take of Bittersweet in moderately fine powder twelve troyounces; Diluted Alcohol a sufficient quantity. Moisten the bittersweet with four fluidounces of diluted alcohol, pack it in a conical percolator, and pour diluted alcohol gradually upon it until the tincture passes but slightly imbued with the properties of the bittersweet. Distil off the alcohol from the tincture until reduced to one-half; then strain, and, by means of a water-bath, evaporate to the proper consistence. *U. S.*

The German Pharmacopœia exhausts bittersweet by hot aqueous infusion. In both cases a brown extract, weighing about 20 per cent. of the twigs employed, is obtained.

Medical Uses.—This extract, which, when fresh, probably contains all the virtues of dulcamara, may be given in the *dose* of five or ten grains, and rapidly increased.

EXTRACTUM GENTIANÆ, *U. S.*, *Br.*—EXTRACT OF GENTIAN.

Extrait de gentiane, Fr.; *Enzian-Extrakt*, G.

Preparation.—Take of Gentian in moderately coarse powder twelve troyounces; Water a sufficient quantity. Moisten the gentian with four fluidounces of water, pack it in a conical percolator, and gradually pour water upon it until the infusion passes but slightly imbued with the properties of the gentian. Boil the liquid to three-fourths of its bulk; then strain, and, by means of a water-bath, evaporate to the proper consistence. *U. S.*

Take of Gentian Root sliced one pound; Boiling Distilled Water one gallon. Infuse the gentian in the water for two hours; boil for fifteen minutes; pour off, press, and strain. Then evaporate the liquor by a water-bath until the extract is of a suitable consistence for forming pills. *Br.*

Cold water is preferable for exhausting gentian, since it dissolves all of the bitter principle without taking up the whole of the pectin compounds, which enter into solution in hot water. An extract prepared with the latter has a gelatinous appearance, though not in the same degree as if made by prolonged boiling with water. The yield by the first process approaches 30 per cent. of the weight of the dry root, and the yellowish-brown extract yields with water a nearly clear solution.

Medical Uses.—This extract contains all the virtues of gentian in a form convenient for administration. It is, however, most generally used as an excipient for other tonics, and especially for iron and quinia. The *dose* is from three to ten grains.

EXTRACTUM GLYCYRRHIZÆ, *U. S.*—LIQUORICE.

Succus liquiritiæ, P. G.; *Extractum liquiritiæ.—Licorice, Extract of liquorice*, E.; *Extrait de réglisse*, Fr.; *Lakriz, Lakrizensaft*, G.

The extract of the root of Glycyrrhiza glabra, *Lin.*

Preparation.—Liquorice is prepared for commercial purposes in the southern portion of Europe, and in this country. The fresh root is mostly employed, but the dried root will likewise answer the purpose. The root is crushed to a pulpy mass or broken into a coarse powder, and then boiled with water over a naked fire, or by steam. The liquor is expressed, allowed to settle, and decanted, or for the common qualities together with the fine pulpy matter evaporated by boiling and continued stirring until the mass has attained the proper consistence to be rolled out into sticks of a certain weight, a portion of olive oil being used to prevent it from adhering to the hands and the table. The sticks are made of an adopted length and thickness, stamped with the initials or name of the manufacturer, or of the town where the factory is located, and finally dried. The root of *Glyc. echinata* is likewise used in the manufacture of liquorice.

On exhausting the root with cold or hot water, hygroscopic extracts are obtained; but on treating the root now with steam Delondre (1856) observed that a considerable amount of matter was dissolved, which, on evaporating the solution, was friable, without attracting moisture, and had a sweet taste without acridity. It is this substance, consisting of altered glycyrrhizin, together with the starch contained in the root, which gives firmness to the commercial extract. From 1,000,000 to 1,250,000 pounds of liquorice are annually imported into the United States, and a considerable quantity is manufactured here.

Description.—Liquorice appears in commerce packed in boxes between layers of laurel leaves (*Laurus nobilis*, Lin.) to prevent the sticks from adhering; in Southern Russia oak leaves are used for the same purpose. Besides the liquorice of American manufacture, two principal varieties are distinguished in our commerce, the *Sicilian* and *Calabrian* or *Spanish*. The former is in thin sticks, one-quarter to three-eighths of an inch in diameter, of a dull-black color, frequently of an empyreumatic taste, and generally very impure. The latter variety is in larger sticks, about an inch in diameter, six or seven inches long, black, and somewhat glossy externally, slightly flexible, except at a low temperature, and breaking with a sharp conchoidal and shining fracture; some small cavities may usually be found in the interior. The products of the different manufacturers of this liquorice differ from one another not only in the size of the stick, but often by marked differences in their odor and taste; while some specimens are almost purely sweet, others are persistently acrid and empyreumatic. For medicinal purposes, liquorice should be almost devoid ot acridity.

Placed in cold water, a portion of the liquorice is dissolved, but the residue retains the shape of the sticks, and if a little ammonia be now added to the water, Rump (1855) observed the liquid to become again colored and again to acquire a sweet taste from dissolving fresh portions of glycyrrhizin. The amount soluble in cold water varies very considerably, and reaches in the best brands about 70 per cent. of the dried liquorice, but the percentage is usually a little less than this.

Under the name of *Italian liquorice* an impure article in thin sticks is met with, and the so-called *refined liquorice* of the shops is in still thinner cylindrical and glossy pieces, likewise impure, and readily attacked by insects. *Pontefract cakes* are small liquorice lozenges, which are much used in England.

Impurities and Adulterations.—Fragments of vegetable tissue are generally present to some extent; shreds of copper are sometimes also met with, and result from careless scraping of the evaporating pans. The fraudulent additions usually consist of farinaceous matters, gum, glucose, and mineral compounds. The latter are estimated in the ash, which for good well-dried liquorice should not exceed 6 or 7 per cent.; starch may sometimes be seen in little lumps in the interior of the sticks, and if not altered by heat may be recognized by the microscope. Gum added fraudulently is usually detected in the cold aqueous solution by the precipitate which takes place on the addition of an equal bulk of alcohol, and grape-sugar will cause the solution of liquorice in cold water to be of a lighter color.

Corigliano and *Barracco* are among the brands most esteemed in the United States; *Solazzi* juice is highly valued in England.

Constituents.—Liquorice contains glycyrrhizin, free (soluble in ammonia) and in combination with ammonia (soluble in cold water); also starch, principally modified by long boiling, a portion of sugar, and a little acrid resinous matter.

Other extracts of liquorice:

EXTRACTUM GLYCYRRHIZÆ DEPURATUM s. SUCCUS LIQUIRITIÆ DEPURATUS, *Purified liquorice*, is recognized by several European Pharmacopœias, and has been proposed in the United States as a substitute for the powdered liquorice when ordered in liquid preparations. It is made by alternately placing layers of washed straw and liquorice into a suitable vessel, and covering the material with cold water. As the water becomes saturated it is withdrawn through a faucet below, and replaced by fresh water until color and a sweet taste are no longer imparted to it. The perfectly clear liquids are then evaporated to the consistence of an extract, which should yield a clear solution with water. For convenience in dispensing, a concentrated solution of definite strength is often kept on hand. To remove the resinous matter, which imparts a disagreeable acrid taste, Ungewitter (1875) suggests the digesting of the stick liquorice in strong alcohol, and afterwards exhausting it with cold water.

EXTRACTUM GLYCYRRHIZÆ, *Br.*, EXTRACTUM LIQUIRITIÆ RADICIS, *P. G.*—The extracts of liquorice root of the two pharmacopœias are alike and practically identical with that of the French Codex, except that the latter exhausts the root by displacement with distilled water at a temperature of 15° to 20° C. (59° to 68° F.); the following is the formula:—

Take of Liquorice Root in coarse powder one pound; Distilled Water four pints. Macerate the liquorice root with two pints of the water for twelve hours, strain and press; again macerate the pressed marc with the remainder of the water for six hours, strain and press. Mix the strained liquors, heat them to 100° C. (212° F.), and strain through flannel; then evaporate by a water-bath until the extract is of a suitable consistence for forming pills. *Br.*

The yield is about 16 per cent. The extract resembles the preceding *purified* extract of liquorice, but is of a lighter color, and of a sweet and purer taste.

Off. Prep.—Confectio sennæ, Decoct. aloes comp., *Br.;* Mistura glycyrrh. comp., *U. S.;* Mistura sennæ comp., *Br.;* Pil. ferri iodidi, *U. S.;* Tinct. aloes, *U. S.*, *Br.;* Tinct. rhei et sennæ, Troch. cubebæ, Troch. glycyrrh. et opii, *U. S.;* Troch. opii, *Br.*

Medical Uses.—Extract of liquorice is a lenitive and demulcent, which also excites the secretions of the fauces, and perhaps of the larynx. It is chiefly employed in irritable conditions of these parts, in *sore-throat*, *laryngitis*, and *bronchitis*. It may be conveniently used by allowing small fragments to dissolve in the mouth, or by adding it to the various syrups, lozenges, and mixtures appropriate to this purpose. It sometimes appears to prevent *flatulence* depending upon fermentation of the food, for which purpose a piece as large as a grain of wheat may be taken after meals.

EXTRACTUM HÆMATOXYLI, *U. S.*, *Br.*—EXTRACT OF LOGWOOD.

Extractum ligni campechiani, P. G.—*Extrait de bois Campêche*, Fr.; *Campecheholz-Extrakt*, G.

Preparation.—Take of Logwood rasped twelve troyounces; Water eight pints. Mix, and, having boiled to four pints, strain the decoction while hot; then evaporate to dryness. *U. S.*

Take of Logwood in fine chips one pound; Boiling Distilled Water one gallon. Infuse the logwood in the water for twenty-four hours; then boil down to one-half, strain, and evaporate to dryness by a water-bath, stirring with a wooden spatula. Iron vessels should not be used. *Br.*

The yield is about 12 per cent. The extract is not hygroscopic; it is of a red-brown color, and a sweet, afterwards astringent taste. It yields, with water, a red and almost clear solution. It is prepared on a large scale for uses in the arts. For composition compare *Hæmatoxylon*.

Medical Uses.—The extract has the medicinal qualities of the wood, and does not lose them by keeping. It may be administered in *doses* of ten grains or more, and in solution rather than in pills, which in time grow very hard.

EXTRACTUM HELLEBORI, *U. S.*—EXTRACT OF BLACK HELLEBORE.

Extractum hellebori nigri.—*Extrait d'ellebore noir*, Fr.; *Schwarze Niesswurz-Extrakt*, G.

Preparation.—Take of Black Hellebore recently dried and in fine powder twelve troyounces; Alcohol a pint; Diluted Alcohol a sufficient quantity. Introduce the powder, previously mixed with one-third of the alcohol, into a conical percolator, and pour upon it the remainder of the alcohol. When the liquid has all been absorbed by the powder, pour on diluted alcohol until a pint of tincture has been obtained. Set this aside in a warm place, and allow it to evaporate spontaneously until reduced to three fluidounces. Continue the percolation with diluted alcohol until two pints more of tincture have passed, or until the powder is exhausted; then evaporate, by means of a water-bath, at a temperature not exceeding 160° F., to the consistence of syrup. To this add the three fluidounces of tincture first obtained, and continue the evaporation at a temperature not exceeding 120° F., until the whole is reduced to the proper consistence. *U. S.*

This extract has been dismissed from most Pharmacopœias, on account of its inefficiency, which was owing to the aqueous or weak alcoholic menstruum, which is not adapted for exhausting the active principles. In France the extract is made with 60 per cent. alcohol.

Medical Uses.—The harshness of the purgative operation of black hellebore is such that its extract is seldom prescribed unless associated with other less active cathartics, or with aromatic stimulants. *Dose*, as a purgative, from five to ten grains.

EXTRACTUM HYOSCYAMI, *U. S.*, *Br.*—EXTRACT OF HYOSCYAMUS.

Extrait de jusquiame, Fr.; *Bilsenkraut-Extrakt*, G.

Preparation.—Take of Hyoscyamus Leaves fresh twelve troyounces. Bruise the leaves in a stone mortar, sprinkling on them a little water, and express the juice; then, having heated this to the boiling point, strain and evaporate to the proper consistence. *U. S.*

The British Pharmacopœia directs the extract to be made from fresh leaves and branches of hyoscyamus, like the extracts of aconite and belladonna. The yield is about 4 per cent.

The above extracts differ in color and consistency like the corresponding extracts of aconite and belladonna leaves; they retain to some extent the odor of the herb. The crystals observed in old extract, according to Attfield (1862), are potassium nitrate.

Medical Uses.—This preparation is notoriously one of the most variable in strength of all narcotic extracts. Its minimum *dose*, of two grains, should be rapidly increased until the characteristic effects of the medicine are produced.

EXTRACTUM HYOSCYAMI ALCOHOLICUM, *U. S.*—ALCOHOLIC EXTRACT OF HYOSCYAMUS.

Extrait alcoolique de jusquiame, Fr.; *Spirituöses Bilsenkraut-Extrakt*, G.

Preparation.—Take of Hyoscyamus Leaves recently dried and in moderately fine powder twenty-four troyounces; Alcohol four pints; Water two pints; Diluted Alcohol a sufficient quantity. Mix the alcohol and water and moisten the powder with a pint of the mixture; then pack it firmly in a conical percolator, and gradually pour upon it the remainder of the mixture. Continue the percolation with diluted alcohol until the tincture measures six pints. Lastly, evaporate, by means of a water-bath, to the proper consistence. *U. S.*

The yield is about 16 per cent.; the color is greenish-brown.

Medical Uses.—This, like the common extract, is of uncertain strength, but is perhaps somewhat less variable. The *dose* is two grains, increased until it becomes efficient.

EXTRACTUM IGNATIÆ, *U. S.*—EXTRACT OF IGNATIA.

Extractum ignatiæ alcoholicum.—*Extrait de fève de Saint-Ignace*, Fr.; *Ignazbohnen-Extrakt*, G.

Preparation.—Take of Ignatia in fine powder twelve troyounces; Alcohol a sufficient quantity. Mix the ignatia with four fluidounces of alcohol, and allow the mixture to stand for an hour. Then introduce it into a cylindrical percolater, press it firmly, and gradually pour alcohol upon it until three pints of tincture have slowly passed. Distil off the alcohol, by means of a water-bath, until the tincture is reduced to half a pint, and evaporate this to the proper consistence. *U. S.*

Ignatia is exceedingly difficult to powder; the object is best accomplished on a small scale by somewhat crushing the seeds and then heating them with a little water until they become soft enough to be bruised, while still warm, into a pulpy mass, with which a little alcohol is incorporated. It may then be dried and powdered for displacement. The powdering may be omitted and the pulpy mass macerated in alcohol. When the liquor has been somewhat concentrated, a fatty matter separates which, according to the officinal directions, should not be removed, but well mixed with the extract. The yield is about 9 per cent.

Medical Uses.—The extract preserves all the medicinal qualities of ignatia, and may be prescribed in *doses* of half a grain three times a day, and cautiously increased.

EXTRACTUM JALAPÆ, *U. S.*, *Br.*—EXTRACT OF JALAP.

Extrait de jalap, Fr.; *Jalapen-Extrakt*, G.

Preparation.—Take of Jalap in moderately fine powder twelve troyounces; Alcohol four pints; Water a sufficient quantity. Introduce the powder, previously mixed with three fluidounces of alcohol, into a conical percolator, and gradually pour upon it the remainder of the alcohol. When the liquid ceases to pass, pour sufficient water upon the residue to keep its surface covered, until four pints of tincture have passed. Set this portion aside and continue the percolation until six pints of infusion have been obtained. Distil off the alcohol from the tincture, and evaporate the infusion until the liquids respectively have been brought to the consistence of honey; then mix them and evaporate to the proper consistence. *U. S.*

Take of Jalap in coarse powder one pound; Rectified Spirit four pints; Distilled Water one gallon. Macerate the jalap in the spirit for seven days, press out the tincture, then filter, and distil off the spirit, leaving a soft extract. Again macerate the residual jalap in the water for four hours, express, strain through flannel, and evaporate by a water-bath to a soft extract. Mix the two extracts, and evaporate at a temperature not exceeding 140° F. until it has acquired a suitable consistence for forming pills. *Br.*

No advantage whatever results from treating jalap with water after it has been exhausted by alcohol. 240 grains of such an aqueous extract were taken by A. B. Taylor (1864) in the course of 8 hours without producing any noticeable effect. Alcohol alone will yield between 12 and 18 per cent. of active extract; and cold water will subsequently extract 30 to 35 per cent. of inert matter, with which the officinal extract is uselessly diluted and incumbered. The supposed advantage is due to an erroneous conception of the statement that the aqueous extract was possessed of mild purgative and diuretic properties; this statement is correct as far as it applies to that portion of the aqueous extract soluble in alcohol, or, what is the same thing, to the aqueous extract of the alcoholic extract. Exhaustion with alcohol of about 70 per cent. would yield a much more efficient extract, but considerably less, and the dose would have to be correspondingly smaller.

Medical Uses.—This preparation contains all the virtues of jalap in about half the bulk, and may be substituted for it in all prescriptions. The *dose* is from ten to twenty grains.

EXTRACTUM JUGLANDIS, *U. S.*—EXTRACT OF BUTTERNUT.

Extrait d'écorce de noyer gris, Fr.; *Butternussrinden-Extrakt*, G.

Preparation.—Take of Butternut in moderately coarse powder twelve troyounces; Water a sufficient quantity. Moisten the butternut with four fluidounces of water, pack it in a conical percolator, and gradually pour water upon it until the infusion passes but slightly imbued with the properties of the butternut. Boil the liquid to three-fourths of its bulk; then strain, and, by means of a water-bath, evaporate to the proper consistence. *U. S.*

The process with cold water is preferable to boiling the bark with water; (see *Juglans*), but a more efficient preparation, it seems, could be obtained by the use of an alcoholic menstruum. The extract is of a deep blackish-brown color and bitter taste.

Medical Uses.—It is a mild cathartic in the dose of twenty or thirty grains, and is said to be peculiarly appropriate for relieving habitual costiveness.

EXTRACTUM KRAMERIÆ, *U. S.*, *Br.*—EXTRACT OF RHATANY.

Extractum ratanhæ, P. G.—*Extrait de ratanhia*, Fr.; *Ratanha-Extrakt*, G.

Preparation.—Take of Rhatany in moderately fine powder twelve troyounces; Water a sufficient quantity. Moisten the powder with four fluidounces of water, pack it in a conical percolator, and gradually pour water upon it until the infusion passes but slightly imbued with the astringent property of the rhatany. Heat the liquid to the boiling point, strain, and by means of a water-bath, at a temperature not exceeding 160°, evaporate to the proper consistence. *U. S.*

Take of Rhatany Root in coarse powder one pound; Distilled Water a sufficiency. Macerate the rhatany in a pint and a half of the water for twenty-four hours; then pack in a percolator, and add more distilled water, until twelve pints have been collected, or the rhatany is exhausted. Evaporate the liquor by a water-bath to dryness. *Br.*

It is important that the design of both formulas be carried out, namely, to exhaust the root with *cold* water. Hot water will yield about five per cent. more extract, which, however, is but incompletely soluble in water, while the officinal extract yields a somewhat turbid solution with warm water, but a clear solution in the presence of sugar. The amount of extract obtainable depends on the size of the rhatany root used, the woody part of which contains but little soluble matter, the average yield being about 12 per cent. of *dry* extract. It is of a reddish-brown color, glossy, resembling kino in appearance, and is not hygroscopic. Iron utensils must not be used in its preparation.

Medical Uses.—This extract is a convenient form of krameria in nearly all of the cases to which that medicine is appropriate. The *dose* is from five to twenty grains, the smaller dose being frequently repeated.

EXTRACTUM LACTUCÆ, *Br.*—EXTRACT OF LETTUCE.

Extractum lactucæ virosæ, P. G.; *Thridacium.*—*Extrait de tiges de laitue*, *Thridace*, Fr.; *Giftlattich-Extrakt*, G.

Preparation.—Take of the Flowering Herb of Lettuce one hundred and twelve pounds. Bruise in a stone mortar, and press out the juice; heat it gradually to 130° F., and separate the green coloring matter by a calico filter. Heat the strained liquor to 200° F. to coagulate the albumen, and again filter. Evaporate the filtrate by a water-bath to the consistence of a thin syrup; then add to it the green coloring matter previously separated, and stirring the whole together assiduously, continue the evaporation at a temperature not exceeding 140° F., until the extract is of a suitable consistence for forming pills. *Br.*

The formula is identical with that for the inspissated juices of the other narcotic herbs. The extract contains the chlorophyll, and is incompletely soluble in water. The German and French Pharmacopœias direct the removal of the chlorophyll, and obtain an extract of a dark-brown color, which yields with water a somewhat turbid solution. The yield is about 4 per cent. The extract is sometimes called *French lactucarium.*

Medical Uses.—Like all the medicinal preparations of lettuce, it is an extremely feeble hypnotic. *Dose*, five or more grains.

EXTRACTUM LUPULI.—EXTRACT OF HOP.

Extractum humuli.—*Extrait de houblon*, Fr.; *Hopfenextrakt*, G.

Preparation.—Take of Hop one pound; Rectified Spirit one and a half pint; Distilled Water one gallon. Macerate the hop in the spirit for seven days, press out the tincture, filter, and distil off the spirit, leaving a soft extract. Boil the residual hop with the water for one hour, press out the liquor, strain, and evaporate by a water-bath to the consistence of a soft extract. Mix the two extracts, and evaporate at a temperature not exceeding 140° F., until it has acquired a suitable consistence for forming pills. *Br.*

Medical Uses.—This preparation represents pretty well the virtues of hop. *Dose*, five grains, or more.

EXTRACTUM MEZEREI ÆTHEREUM, *Br.*—ETHEREAL EXTRACT OF MEZEREON.

Extrait éthéré de mézéréon (de garou), Fr.; *Ætherisches Seidelbast-Extrakt*, G.

Preparation.—Take of Mezereon Bark cut small one pound; Rectified Spirit eight pints; Ether one pint. Macerate the mezereon in six pints of the spirit for three days with frequent agitation; strain and press. To the residue of the mezereon add the remainder of the spirit, and again macerate for three days with frequent agitation; strain and press. Mix and filter the strained liquors, recover the greater part of the spirit by distillation, evaporate what remains to the consistence of a soft extract; put this into a stoppered bottle with the ether, and macerate for twenty-four hours, shaking them frequently. Decant the ethereal solution, recover part of the ether by distillation, and evaporate what remains to the consistence of a soft extract. *Br.*

Ether dissolves the acrid principle of mezereon, and is therefore well adapted for the preparation of an efficient extract, the yield of which is about 7 per cent. The same extract was formerly officinal upon the continent of Europe, but has been pretty generally abandoned in favor of the alcoholic extract, which is obtained in the first part of the above process, and has the advantage of remaining quite soft and of being more manageable when prescribed as an addition to ointments; its yield is about 14 per cent. of the weight of bark employed, and, like the ethereal extract, it is of a green color, and is insoluble in water.

Medical Uses.—It is a powerful irritant, and may be added to stimulant and rubefacient liniments and ointments to increase their power. It is an ingredient of the Compound liniment of mustard, Br. Ph.

EXTRACTUM NUCIS VOMICÆ, *U. S.*, *Br.*—EXTRACT OF NUX VOMICA.

Extractum strychni spirituosum, P. G.; *Extractum nucum vomicarum spirituosum (vel alcoholicum)*.—*Extrait de noix vomique*, Fr.; *Weingeistiges Krähenaugen-Extrakt*, G.

Preparation.—Take of Nux Vomica in fine powder twelve troyounces; Alcohol a sufficient quantity. Mix the nux vomica with four fluidounces of alcohol, and allow the mixture to stand for an hour. Then introduce it into a cylindrical percolator, and gradually pour alcohol upon it until the tincture passes without bitterness. Distil off the alcohol by means of a water-bath until the tincture is reduced to half a pint, and evaporate this to the proper consistence. *U. S.*

Take of Nux Vomica one pound; Rectified Spirit a sufficiency. Apply steam to the nux vomica until it is thoroughly softened, then dry rapidly and reduce to fine powder. Exhaust the powder by boiling it with successive portions of the spirit until the latter comes off nearly free from bitterness. Strain, distil off the spirit, and evaporate by a water-bath to the consistence of a soft extract. *Br.*

The remarks made concerning Extr. ignatiæ are nearly all applicable to this extract and to the manipulation needed for obtaining it. Where steam is available for the softening of the seeds, we would recommend that they be crushed or bruised while hot. In this way the rapid drying will be facilitated. Otherwise the process indicated on page 557 may be followed. The fatty matter contained in the seeds is taken up by the alcohol, and retains a portion of the alkaloids in solution; it is evidently not intended by either Pharmacopœia that it should be removed. Its incorporation with the extract is hastened if the tincture is evaporated to a thin syrupy consistence, when hot water should be added with constant stirring, and the mixture then evaporated with continual agitation. The extract will be somewhat greasy. If the Pharmacopœias would direct alcohol of about 70 per cent., all the alkaloids, with but little of the fat, would be dissolved, and the extract could be evaporated to dryness and powdered. The officinal extract is of a yellowish-brown color, and of an intensely bitter taste; its yield is about 10 per cent. of the weight of the seeds; with the weaker alcohol indicated only 7 to 8 per cent. are obtained. It contains about 6 per cent. of strychnia.

Medical Uses.—It is chiefly used as an ingredient of pills intended to overcome habitual atonic constipation. The primary *dose* is about half a grain; it may gradually be increased to two or three grains when the specific action of the drug is sought.

EXTRACTUM OPII, *U. S.*, *Br.*—EXTRACT OF OPIUM.

Extrait d'opium, *Extrait thebaïque*, Fr.; *Opiumextrakt*, G.

Preparation.—Take of Opium twelve troyounces; Water five pints. Cut the opium into small pieces, macerate it for twenty-four hours in a pint of water, and reduce it to a soft mass by trituration. Express the liquid from it, and with each of the four pints of water remaining successively treat the residue in the same manner. Having mixed the liquids, filter the mixture, and evaporate by means of a water-bath to the proper consistence. *U. S.*

Take of Opium in thin slices one pound; Distilled Water six pints. Macerate the opium in two pints of the water for twenty-four hours, and express the liquor. Reduce the residue of the opium to a uniform pulp, macerate it again in two pints of the water for twenty-four hours, and express. Repeat the operation a third time. Mix the liquors, strain through flannel, and evaporate by a water-bath until the extract has acquired a suitable consistence for forming pills. *Br.*

The maceration of the opium is to be effected at the mean temperature of about 60° F. At a higher temperature a larger amount of extract is obtained, but of an inferior quality. The expressed liquids may be set aside for some time to settle, and then at once be passed through a well-moistened filter without waiting until the maceration is completed with the whole amount of water. A flannel strainer is well adapted for the purpose if it is well moistened with water and the filtrate returned upon the strainer as long as it passes turbid. The evaporation is completed in the water-bath, and might very properly be continued until a dry extract remains, which may be rubbed into a reddish-brown powder. The yield is 55 to 60 per cent. of the *dry* opium employed, and should contain about 17 per cent. of morphia to correspond with opium of 10 per cent. morphia strength.

Denarcotized extract of opium is still occasionally employed. It may be obtained by agitating the concentrated infusion with two portions of ether, each time allowing the mixture to settle, and decanting the ether, which dissolves the narcotina, but not the morphia; the aqueous liquid is then evaporated as before. This extract is probably in no way superior to the officinal preparation.

Off. Prep.—Emplast. opii, *U. S.;* Extract. opii liquid., *Br.;* Suppos. opii, Suppos. plumbi et opii, Trochisci glycyrrh. et opii, *U. S.;* Troch. opii, Vinum opii, *Br.*

Medical Uses.—This preparation is essentially opium purified from its inert constituents. Its average *dose* is about half a grain.

EXTRACTUM PAPAVERIS, *Br.*—EXTRACT OF POPPIES.

Extrait de pavot, Fr.; *Mohnextrakt*, G.

Preparation.—Take of Poppy Capsules, dried, freed from the seeds, and coarsely powdered, one pound; Rectified Spirit two ounces; Boiling Distilled Water a sufficiency. Mix the poppy capsules with two pints of the water and infuse for twenty-four hours, stirring them frequently; then pack them in a percolator, and, adding more of the water, allow the liquor slowly to pass until about a gallon has been collected, or the poppies are exhausted. Evaporate the liquor by a water-bath until it is reduced to a pint, and, when cold, add the spirit. Let the mixture stand for twenty-four hours, then separate the clear liquor by filtration, and evaporate this by a water-bath until the extract has acquired a suitable consistence for forming pills. *Br.*

Warm water extracts, with the medicinal principles, also the mucilaginous matters which are but imperfectly precipitated by the small quantity of alcohol added.

Medical Uses.—This extract appears to be unnecessary. It has no virtues that are not more decided in the various preparations of opium. *Dose*, from two to five grains.

EXTRACTUM PAREIRÆ, *Br.*—EXTRACT OF PAREIRA.

Extrait de pareira brava, Fr.; *Pareira-Extrakt*, G.

Preparation.—Take of Pareira Root in coarse powder one pound; Boiling Distilled Water one gallon or a sufficiency. Digest the pareira with a pint of the water for twenty-four hours, then pack in a percolator, and adding more of the water, allow the liquor slowly to pass until a gallon has been collected, or the pareira is exhausted. Evaporate the liquor by a water-bath until the extract has acquired a suitable consistence for forming pills. *Br.*

The use of boiling water, followed by prolonged digestion, must result in the solution of the starch, which is but imperfectly removed by the subsequent percolation. A diluted alcohol would seem to be a very appropriate menstruum for exhausting pareira.

Medical Uses.—The solid form of a medicine intended to act upon the mucous membrane of the urinary passages cannot be an eligible one. The fluid extract and the decoction are greatly preferable. *Dose*, from ten to twenty grains.

EXTRACTUM PHYSOSTIGMATIS, *U. S.*, *Br.*—EXTRACT OF CALABAR BEAN.

Extractum fabæ Calabaricæ, P.G.—*Extrait de fève de Calabar*, Fr.; *Kalabarbohnen-Extrakt*, G.

Preparation.—Take of Calabar Bean in moderately fine powder twelve troyounces; Alcohol a sufficient quantity. Moisten the powder with four fluidounces of alcohol, pack it in a conical percolator, and pour on half a pint of alcohol. Cork and closely cover the percolator, and set it aside in a moderately warm place for four days. Then having removed the cork, proceed with the percolation, and gradually pour on alcohol, until two pints of tincture have been obtained, or the bean has been exhausted. Distil off a pint and a half of alcohol from the tincture, and evaporate the remainder, by means of a water-bath, to the consistence of a soft extract. *U. S.*

Take of Calabar Bean in coarse powder one pound; Rectified Spirit four pints. Macerate the bean for forty-eight hours with one pint of the spirit in a close vessel, agitating occasionally, then transfer to a percolator, and when the fluid ceases to pass, add the remainder of the spirit so that it may slowly percolate through the powder. Subject the residue of the bean to pressure, adding the pressed liquid to the product of the percolation; filter, distil off most of the spirit, and evaporate what is left in the retort by a water-bath to the consistence of a soft extract. *Br.*

Calabar bean may be obtained in a sufficiently fine powder by drying it well and grinding it in a coffee-mill. The yield is about 6 per cent. of a greenish-brown extract, containing fatty matter, which will be left behind if alcohol of about 70 per cent. is used for exhausting the seeds. Kennedy (1875) suggested the addition of glycerin to the extract to keep it soft and to render it more convenient for manipulation.

Medical Uses.—The extract represents all the active constituents of Calabar bean. Its average *dose* may be stated at one-tenth of a grain.

EXTRACTUM PODOPHYLLI, *U. S.*—Extract of May Apple.

Extrait de podophylle, Fr.; *Fussblattwurzel-Extrakt*, G.

Preparation.—Take of May Apple in moderately fine powder twelve troyounces; Alcohol two pints; Diluted Alcohol a sufficient quantity. Introduce the powder, previously mixed with three fluidounces of alcohol, into a conical percolator, and pour upon it the remainder of the alcohol. When the tincture ceases to pass, pour gradually upon the powder sufficient diluted alcohol to keep its surface covered, until two pints of tincture have passed. Set this portion aside, and continue the percolation until two pints more of tincture have been obtained. Distil off the alcohol from the tinctures and evaporate them until the liquids respectively have been brought to the consistence of thin honey; then mix them, and evaporate to the proper consistence. *U. S.*

This formula is an improvement on that of the former Pharmacopœia, which directed the use of water after the powder had been extracted by alcohol Alcohol alone appears to deprive the drug completely of medicinal properties, and the subsequent exhaustion with diluted alcohol seems to be as unnecessary as with water.

Medical Uses.—The operation of this medicine closely resembles that of extract of jalap, and may be used for the same purposes in the *dose* of from five to twenty grains.

EXTRACTUM QUASSIÆ, *U. S.*, *Br.*—Extract of Quassia.

Extrait de quassie (*bois amer*), Fr.; *Quassia-Extrakt*, G.

Preparation.—Take of Quassia in moderately fine powder twelve troyounces; Water a sufficient quantity. Moisten the quassia with four fluidounces of water, pack it in a conical percolator, and gradually pour water upon it until the infusion passes but slightly imbued with the properties of the quassia. Boil the liquid to three-fourths of its bulk; then strain, and, by means of a water-bath, evaporate to the proper consistence. *U. S.*

Take of Quassia Wood rasped one pound; Distilled Water a sufficiency. Macerate the quassia with eight fluidounces of the water for twelve hours; then pack in a percolator, and adding more of the water, allow the liquor slowly to pass until the quassia is exhausted. Evaporate the liquor; filter before it becomes too thick; and again evaporate by a water-bath until the extract is of a suitable consistence for forming pills. *Br.*

The yield is about 4 or 5 per cent. J. S. Whall (1874) observed that one part of quassia is practically exhausted by obtaining from it four parts of percolate, and will yield rather less than 3½ per cent. of extract if water, or a little more if diluted alcohol is used; the latter is considered preferable. The yield is increased to about 6 or 7 per cent. if boiling water is used; but the extract has a jelly-like appearance, probably from pectin compounds.

Medical Uses.—The intense bitterness of this preparation denotes its possession of the virtues of quassia in a concentrated state. Like all other stomachic tonics, it should not be given in that form unless in a very small *dose*, such as one or two grains, and then usually associated with tonics of another order, *e. g.*, quinia, iron, etc.

EXTRACTUM RHEI, *U. S.*, *Br.*—EXTRACT OF RHUBARB.

Extractum rhei alcoholicum.—Extrait de rhubarbe, Fr.; *Rhabarber-Extrakt*, G.

Preparation.—Take of Rhubarb in moderately fine powder twelve troyounces; Alcohol a pint; Diluted Alcohol a sufficient quantity. Moisten the powder with four fluidounces of the alcohol, pack it in a conical percolator, and gradually pour upon it, first the remainder of the alcohol, and then diluted alcohol, until twelve fluidounces of tincture have been obtained. Set this portion aside in a warm place, and allow it to evaporate spontaneously until reduced to six fluidounces. Continue the percolation with diluted alcohol until the tincture passes nearly tasteless. Evaporate this in a porcelain vessel, by means of a water-bath, at a temperature not exceeding 160° F., to the consistence of syrup. With this mix the tincture first obtained, and continue the evaporation until the mixture is reduced to the proper consistence. *U. S.*

Take of Rhubarb Root sliced or bruised one pound; Rectified Spirit ten fluidounces; Distilled Water five pints. Mix the spirit and the water, and macerate the rhubarb in the mixture for four days; then decant, press, and set by, that the undissolved matter may subside; pour off the clear liquor, filter the remainder, mix the liquors, and evaporate by a water-bath, at a temperature not exceeding 160° F., until the extract has acquired a suitable consistence for forming pills. *Br.*

Weak alcohol and even cold water are well adapted for obtaining an efficient extract from rhubarb, though this is more completely exhausted by the first process. The yield is usually near 30 per cent., and varies with the quality of the rhubarb.

Medical Uses.—Owing to the difficulty of obtaining this preparation of good quality, it is scarcely to be preferred to good rhubarb root. Its *dose*, as a purgative, is from ten to twenty grains.

EXTRACTUM SENEGÆ, *U. S.*—EXTRACT OF SENEKA.

Extrait de polygale de Virginie, Extrait de sénéca, Fr.; *Senegaextrakt*, G.

Preparation.—Take of Seneka in moderately fine powder twelve troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with four fluidounces of diluted alcohol, pack it in a conical percolator, and gradually pour upon it diluted alcohol until three pints of tincture have passed. Evaporate this, by means of a water-bath, to the proper consistence. *U. S.*

The yield is about 30 per cent.; the extract is brown, has the acrid taste of the root, and may be conveniently kept in the state of powder.

Medical Uses.—This is a medicine very seldom prescribed, but which might perhaps be found advantageous in combination with squill in the decline of bronchial catarrhs. The *dose* is from one to three grains.

EXTRACTUM STRAMONII FOLIORUM, *U. S.*—EXTRACT OF STRAMONIUM LEAVES.

Extrait de feuilles de stramoine, Fr.; *Stechapfelkraut-Extrakt*, G.

Preparation.—Take of Stramonium Leaves recently dried and in fine powder twelve troyounces; Alcohol a pint; Diluted Alcohol a sufficient quantity. Introduce the powder, previously mixed with one-third of the alcohol, into a conical percolator, and gradually pour upon it the remainder of the alcohol. When the liquid has all been absorbed by the powder, pour on diluted alcohol until a pint of tincture has been obtained. Set this aside in a warm place, and allow it to evaporate spontaneously until reduced to three fluidounces. Continue the percolation with diluted alcohol until two pints more of tincture have passed, or until the powder is exhausted; then evaporate, by means of a water-bath, at a temperature not exceeding 160° F., to the consistence of syrup. With this mix the three fluidounces of tincture first obtained, and continue the evaporation, at a temperature not exceeding 120° F., until the mixture is reduced to the proper consistence. *U. S.*

It is strange that the Pharmacopœia should order inspissated juices to be prepared from narcotic herbs which rarely or never grow spontaneously in the United States, and not of the one which is a common weed in many sections of the country. The yield is about 20 per cent. of a greenish-brown extract. The fresh leaves and tops of stramonium yield nearly 3½ per cent. of inspissated juice free from albuminous compounds.

Medical Uses.—This extract possesses all the virtues of stramonium. It may be prescribed in the *dose* of one grain two or three times a day until its specific effects are exhibited.

EXTRACTUM STRAMONII SEMINIS, *U. S.*—EXTRACT OF STRAMONIUM SEED.

Extractum stramonii, Br.—*Extract of stramonium*, Br.; *Extrait de semences de stramoine*, Fr.; *Stechapfelsamen-Extrakt*, G.

Preparation.—Take of Stramonium Seed in moderately fine powder sixteen troyounces; Diluted Alcohol a sufficient quantity. Moisten the stramonium seed with four fluidounces of diluted alcohol, pack it in a conical percolator, and pour on twelve fluidounces of diluted alcohol. When the liquid begins to pass from the percolator, close the lower orifice with a cork, and, having closely covered the percolator, set it aside in a moderately warm place for four days. Then remove the cork, and gradually pour on diluted alcohol until two pints of tincture have been obtained, or until the tincture passes but slightly imbued with the properties of the stramonium. Distil off the alcohol from the tincture, and, by means of a water-bath, evaporate to the proper consistence. *U. S.*

Take of Stramonium Seeds in coarse powder one pound; Ether one pint, or a sufficiency; Distilled Water, Proof Spirit, each a sufficiency. Shake the ether in a bottle with half a pint of the water, and after separation decant the ether. Pack the stramonium in a percolator, and free it from its oil by passing the washed ether slowly through it. Having removed it and rejected the ethereal solution, pour the spirit over the residue of the stramonium in the percolator, and allow it to pass through slowly until the powder is exhausted. Distil off most of the spirit from the tincture, and evaporate the residue by a water-bath until the extract has acquired a suitable consistence for forming pills. *Br.*

The ether directed by the British Pharmacopœia removes the fixed oil of the seeds, which would otherwise remain in the extract. Petroleum-benzin would answer the same purpose, and have the advantage of cheapness. The yield is about 12½ per cent.

Medical Uses.—This extract is reckoned to be twice as strong as that of stramonium leaf, and its commencing *dose* should not exceed half a grain.

EXTRACTUM TARAXACI, *U. S.*, *Br.*—EXTRACT OF DANDELION.

Extrait de dent de lion, Fr.; *Löwenzahn-Extrakt*, G.

Preparation.—Take of Dandelion gathered in September sixty troyounces. Slice the dandelion, and bruise it in a stone mortar, sprinkling on it a little water, until reduced to a pulp. Then express and strain the juice, and evaporate it in a vacuum, or in a shallow dish over a water-bath, to the proper consistence. *U. S.*

Take of Fresh Dandelion Root four pounds. Crush the root, press out the juice, and allow it to deposit; heat the clear liquor to 212° F., and maintain the temperature for ten minutes; then strain, and evaporate by a water-bath at a temperature not exceeding 160° F., until the extract has acquired a suitable consistence for forming pills. *Br.*

The juice of taraxacum contains albumen which is very properly removed in the second process by heating the juice for a short time to the boiling point, and straining from the coagulum. Collected in the autumn the fresh root yields 9 to 10 per cent. of extract; the spring root yields a smaller amount. The extract is of a brown color, and should yield a nearly clear solution with water.

Medical Uses.—Owing to its liability to spoil, this extract is not an eligible preparation. It may be prescribed in the dose of half a drachm and upwards, dissolved in some aromatic water, and taken after meals.

EXTRACTUM VALERIANÆ, *U. S.*—EXTRACT OF VALERIAN.

Extrait de valériane, Fr.; *Baldrian-Extrakt*, G.

Preparation.—Take of Valerian in fine powder twelve troyounces; Alcohol a pint; Diluted Alcohol a sufficient quantity. Moisten the powder with four fluidounces of alcohol, pack it in a percolator, and gradually pour upon it the remainder of the alcohol. When the liquid has all been absorbed by the powder, pour on diluted alcohol until a pint of tincture has been obtained. Set this aside in a warm place, and allow it to evaporate spontaneously until reduced to three fluidounces. Continue the percolation with diluted alcohol until two pints more of tincture have passed, and evaporate, by means of a water-bath, to the consistence of syrup. Lastly, mix the two liquids, and continue the evaporation, at a temperature not exceeding 120° F., until the mixture is reduced to the proper consistence. *U. S.*

The object of the Pharmacopœia, to retain in the extract most of the volatile oil, is accomplished by the manipulation. The first portion of the tincture contains this oil, and is for that reason concentrated at a moderate temperature, at which the evaporation is also finally completed. The yield is about 20 per cent. The extract is of a deep brown color, has the odor of valerian, and dissolves only partially in water, but almost completely in diluted alcohol.

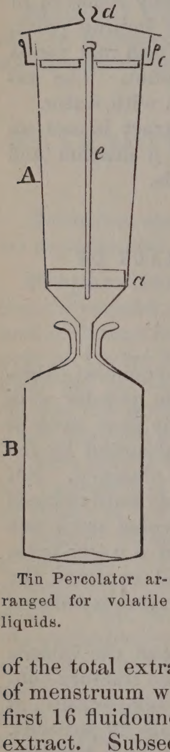
Medical Uses.—This extract is far inferior to the liquid preparations of valerian. Its average *dose* of twenty grains, coupled with its offensive taste, renders it inappropriate for obtaining the specific effects of valerian. It may be used with a possible slight advantage as a pilular excipient of quinia, nux vomica, and various nerve tonics.

EXTRACTA FLUIDA.—Fluid Extracts.

Extracta liquida.—Liquid extracts, E.; *Extraits liquides*, Fr.; *Flüssige Extrakte*, G.

Fluid or liquid extracts, in the meaning of the United States and British Pharmacopœias, are permanent concentrated solutions of vegetable drugs, made of such a strength that, in the United States, one fluidounce contains the medicinal principles, and represents the virtues, of one troyounce of the drug. The liquid extracts of former Pharmacopœias of Continental Europe, which are still occasionally described under their older officinal title *Mellago*, were solutions of extracts in water, made in proportion of three, or sometimes two parts of the former to one of the latter; they can be kept unaltered for a short time only, and are best prepared extemporaneously. The liquid extracts of the British Pharmacopœia vary in relative strength; one fluidounce (imperial measure) of some represents one avoirdupois ounce of the drug, of another two ounces, and different proportions in the remainder.

Fig. 69.



Tin Percolator arranged for volatile liquids.

Preparation.—The fluid extracts are made by percolation, and by concentrating the weakest percolate to a certain measure. The Pharmacopœia, very properly, orders a *suitable* percolator to be used, while for tinctures the use of a *conical*, and for extracts a *cylindrical* percolator is generally directed. The latter form, slightly diminishing in diameter towards the bottom, is also the one best adapted for the preparation of fluid extracts, although good results may, by careful management, be obtained with the funnel-shaped percolator. Dr. Squibb (1866) proved that in exhaustion by percolation there is a sufficient degree of uniformity of results to admit of the adoption of a model plan of proceeding applicable to drugs in general; second, that the extract or soluble matter yielded to the menstruum is not uniform in its chemical and therapeutical value, as obtained during the different stages of the percolation, but diminishes in effective value far more rapidly than the extract does in weight; and third, that this decrease in value depends upon the difference in solubility between the active and inactive portions of the extract, and that the ratio of this decrease is about the same for drugs in general, provided the proper menstruum be used. Critical experiments made with seven different drugs proved that the first twelve fluidounces of the percolate contained from 61 to 78 per cent. of the total extract obtainable with the much larger (than the present) amount of menstruum which was directed by the Pharmacopœia of 1860, and that the first 16 fluidounces contained from 71 to 84 per cent. of the total amount of extract. Subsequently (1869) Samuel Campbell showed that some drugs may be practically exhausted by careful management, on obtaining one fluidounce for every troyounce of the drug used. This principle, however, is applicable to those drugs only which are rather heavy, and at the same time are readily permeated by a menstruum in which the active principles are easily and freely soluble. With such, complete exhaustion is attained before the quantity of percolate directed by the Pharmacopœia (in most cases 24 fluidounces for 16 troyounces of the drug) has been obtained. The formulas of the Pharmacopœia require the first 14 fluidounces of percolate to be reserved, and the displacement to be continued until 10 fluidounces more are obtained, which, by evaporation, are reduced to two fluidounces, and then mixed with the reserved portion.

The manipulation is as follows: The powder is to be uniformly moistened with the specified quantity of menstruum, and well packed in the percolator. As usual, ligneous material requires to be very firmly packed, and when of more loose cellular structure the packing should be less firm; but in all cases it should be uniform. Again, when an alcoholic menstruum is used, the packing must be correspondingly firmer, as the menstruum is stronger in alcohol. When well packed, a disk of paper or muslin is spread upon the surface, and enough menstruum poured upon it to make sixteen fluidounces, including the portion used for moistening the powder. The liquid is allowed to penetrate the powder, and, if the latter is very dense and ligneous, will commence to drop from the percolator, the lower orifice of which should then be closed by a cork. Sixteen fluidounces of menstruum will not be sufficient to pass through a light powder; no more, however, should be added; but when it has been completely absorbed, the upper and lower orifice of the percolator should be closed to prevent evaporation, and the material allowed to macerate. One or two days will be ample time for this purpose, if all precautions have been properly attended to; but four days' maceration, as directed by the Pharmacopœia, will secure better results than a shorter period in the hands of the less skilful. Before percolation is properly started, the packing of the powder should be examined again, and, if necessary, adjusted by applying the requisite pressure upon the surface of the material, after which the cork is removed and more menstruum poured upon the disk until altogether about 28 fluidounces have been used, when its alcoholic strength may be gradually reduced until finally water is used for pushing the last portions of the percolate through. The more mucilaginous the material is, the greater the caution which should be exercised in this decrease of the alcoholic strength.

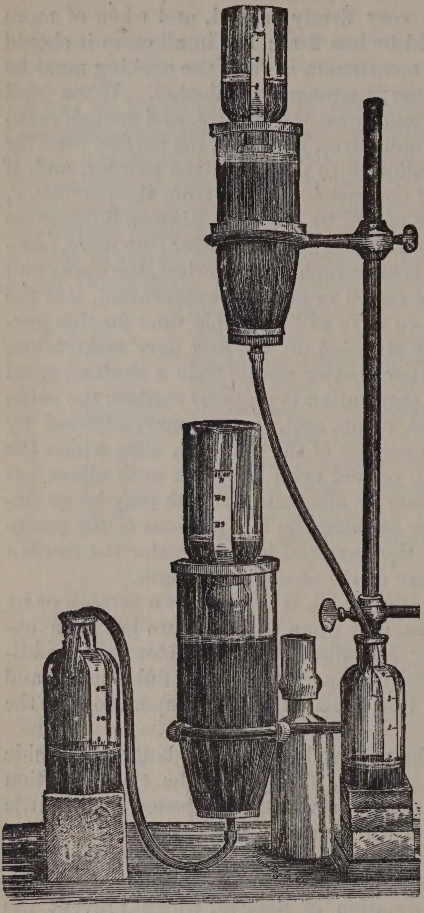
The percolate is collected in a pint bottle, which is marked by a scratch or by a strip of paper to indicate 14 fluidounces, and when that measure has been obtained the receiving vessel is changed for the collection of 10 fluidounces of additional percolate, which should be carefully evaporated to two fluidounces, and then mixed with the reserved portion. See remarks on the evaporation of the extracts (page 558).

After mixing the concentrated with the reserved portion, the bottle is set aside for a day or two, decanted from the sediment, if any, and the turbid portion passed through a small filter which has been previously dampened with a little alcohol. Filtration of the entire product will be rarely necessary.

The maceration of the material with the menstruum, as directed by the Pharmacopœia, is, in the majority of cases, accompanied by the complete absorption of the latter by the former, and the formation of fissures, which prevent the satisfactory percolation and exhaustion of the powder. The fissures are mostly removed by pressing the material again, before more menstruum is added; but, with proper precautions, it is evident from the results obtained by J. U. Lloyd, Dr. Squibb, and A. Robbins (1878), that the use of a larger quantity of menstruum in the beginning, sufficient to permeate the material, is advantageous. Using a sufficiency of liquid to completely expel the air, circulatory percolation is established during the prolonged maceration, the densest solutions, containing the largest proportion of principles, descending to the lowest part of the apparatus.

In 1866 Dr. Squibb recommended the process of *repercolation*, and has more recently somewhat modified it with the view of obtaining more uniform results, the object being preparation of fluid extracts without the use of heat. The process may be briefly described as follows: 32 parts of powder are divided into 4 equal portions, one of which is moistened, packed, macerated, and then slowly displaced until exhausted. The percolate is collected in fractions, the first 6 parts being reserved, and the next fraction used for moistening the second portion of 8 parts of the powder, which is afterwards macerated and displaced with the remaining fractions, the weakest being used last. Of this portion 8 parts of percolate are reserved. The third and fourth portions of 8 parts each of the powder are percolated in the same manner as the second portion, and, finally, the 4 reserved percolates are mixed to obtain 30 parts of fluid extract. The weaker percolates from the fourth portion are preserved for a subsequent operation, when from each portion of 8 parts of powder 8 parts of percolate are reserved.

Fig. 70.



Glass Percolators, with supply and receiving bottles.

A series of percolators may be conveniently arranged on a retort stand, and the rapidity of percolation regulated, as suggested by Dr. Squibb, by connecting the lower aperture of the percolator with a thin rubber tube, the end of which is raised high enough to prevent the liquid from escaping during maceration, and afterwards lowered, so that the percolation may proceed in drops, the position of the rubber tube being changed, to insure uniformity and regularity; the last portions of the liquid are withdrawn from the percolator, either by removing the rubber tube or by straightening it by sufficiently elevating the percolator. A uniform supply of menstruum may be provided for in various ways, the most simple of which is to invert a bottle containing the requisite quantity of liquid over the orifice of the percolator. The mouth of the bottle should be immediately above the disk covering the powder, and, if necessary, may be lengthened by a piece of rubber tubing.

The best *shape of the percolator* for preparing fluid extracts is the cylindrical form, somewhat narrowed towards the lower end, so as to represent a section of a long cone, which is closed below by a well-fitting cork, or it may terminate in the shape of a funnel. The relative proportion of *diameter to height* of powder is of importance, since it is evident that, with an increase of the latter, the same fraction of menstruum must come into contact with a larger number of particles of the powder. Its height should be 4 or 5 times greater than its diameter. The *cover* of the percolator should not fit air-tight, or, if from the volatility of the menstruum, this should be desirable, a communication should be established by means of a glass tube between the receiving vessel and the top of the percolator, for the equalization of pressure. Gum-cloth furnishes a convenient material for an ordinary cover.

Percolators may be made of any material which does not chemically react with the dissolved principles. In the majority of cases tin-percolators are unobjectionable. For some purposes, however, it is preferable to make the percolators of glass.

The *strength of fluid extracts* depends solely on the amount of the active principles, and not on the total amount of extractive matter contained in solution. Menstrua, which are best adapted to permanently dissolve the former in their natural combinations, and, at the same time, exclude the inert principles, are best adapted for the purposes the Pharmacopœia has in view. There can be no doubt that there is room for improvement in many of the formulas; however, but few critical observations on the best menstrua have been published.

A process for the preparation of fluid extracts without the use of heat deserves a passing notice, since from the employment of a very powerful press it is, perhaps, better adapted for the manufacturer than for the pharmacist. It was devised by N. S. Thomas (1865), and consists in moistening the ground drug with a portion of the menstruum, and, after sufficient maceration, expressing the liquid. The operation of maceration and expressing is repeated several times, until the proper quantity of fluid extract is obtained.

Fluid extracts should be kept in well-corked bottles which are not too large. The preparations, properly made, will fairly represent the drugs, and necessarily must vary to some extent in their efficacy; but the variation should be only within the limits of the variation which is unavoidable in the crude material.

EXTRACTUM BELÆ LIQUIDUM, *Br.*—LIQUID EXTRACT OF BAEL.

Extrait liquide de bael, Fr.; *Flüssiges Baelextrakt*, G.

Preparation.—Take of Bael Fruit one pound; Distilled Water twelve pints; Rectified Spirit two fluidounces. Macerate the bael for twelve hours in one-third of the water; pour off the clear liquor; repeat the maceration a second and third time for one hour in the remaining two-thirds of the water; press the marc, and filter the mixed liquors through flannel. Evaporate to fourteen fluidounces, and, when cold, add the rectified spirit. *Br.*

This fluid extract represents one avoirdupois ounce of bael in each fluidounce imperial measure. The amount of spirit seems very small for such a concentrated liquid.

Medical Uses.—This fluid extract is regarded as the most efficient form for the administration of bael, and is used chiefly in chronic diarrhœa and dysentery, and in atonic disorders of the stomach. *Dose*, one or two fluidrachms.

EXTRACTUM BELLADONNÆ RADICIS FLUIDUM, *U.S.*—FLUID EXTRACT OF BELLADONNA ROOT.

Extrait liquide de racine de belladonne, Fr.; *Flüssiges Tollkirschenwurzel-Extrakt*, G.

Preparation.—Take of Belladonna Root in moderately fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and, having moistened the belladonna root with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

Care should be taken that the root be not too woody. The use of alcohol alone would seem to be preferable; the preparation could then be used in making belladonna plaster. (See page 520.)

Medical Uses.—The *dose* of this preparation is from three to five minims. It is one of the most efficient representatives of belladonna.

EXTRACTUM BUCHU FLUIDUM, *U. S.*—FLUID EXTRACT OF BUCHU.

Extrait liquide de bucco, Fr.; *Flüssiges Buccoextrakt*, G.

Preparation.—Take of Buchu in moderately fine powder sixteen troyounces; Alcohol a sufficient quantity. Moisten the buchu with six fluidounces of alcohol, and proceed according to directions given in the general formula at page 585. *U. S.*

This is a very concentrated tincture, and, if properly made, fairly represents the drug. The leaves should be carefully powdered to avoid loss of the volatile oil.

Medical Uses.—This fluid extract is inferior to the infusion of buchu for diseases of the urinary organs; but in default of that preparation may be prescribed in *doses* of twenty or thirty minims very largely diluted with water.

EXTRACTUM CALUMBÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF COLUMBO.

Extrait liquide de colombo, Fr.; *Flüssiges Kolomboextrakt*, G.

Preparation.—Take of Columbo in fine powder sixteen troyounces; Glycerin two fluidounces; Alcohol, Water, each a sufficient quantity. Mix the glycerin with fourteen fluidounces of alcohol, and, having moistened the columbo with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with a menstruum consisting of two parts of alcohol and one part of water. *U. S.*

The use of a stronger alcohol would be of advantage, and tend to render the preparation more permanent.

Medical Uses.—It is a convenient substitute for the infusion, and may be prescribed in doses of a fluidrachm in two fluidounces of water.

EXTRACTUM CHIMAPHILÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF PIPSISSEWA.

Extrait liquide de pyrole ombellée, Fr.; *Flüssiges Doldenmangold-Extrakt*, G.

Preparation.—Take of Pipsissewa in moderately fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the pipsissewa with half a pint of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

The fluid extract has the sensible properties of the leaves in a high degree.

Medical Uses.—This preparation is less eligible than the decoction. *Dose*, a fluidrachm, largely diluted, three or four times a day.

EXTRACTUM CIMICIFUGÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF CIMICIFUGA.

Extrait liquide d'actée à grappes, Fr.; *Flüssiges Cimicifuga-Extrakt*, G.

Preparation.—Take of Cimicifuga in very fine powder sixteen troyounces; Stronger Alcohol a sufficient quantity. Moisten the cimicifuga with four fluidounces of stronger alcohol, and proceed according to directions given in the general formula at page 585. *U. S.*

This has all the sensible properties of the drug from which it was made, and is a permanent preparation.

Medical Uses.—This preparation is greatly preferable to the decoction, which was formerly used. *Dose*, from thirty minims to a fluidrachm.

EXTRACTUM CINCHONÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF CINCHONA.

Extractum cinchonæ flavæ liquidum, Br.; *Extractum Chinæ calisayæ fluidum.*—*Fluid extract of yellow cinchona or calisaya bark*, E.; *Extrait liquide de quinquina jaune*, Fr.; *Flüssiges Kalisayarinden-Extrakt*, G.

Preparation.—Take of Yellow Cinchona in very fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the cinchona with five fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Continue the percolation with diluted alcohol until two pints of tincture have been obtained, and having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

Take of Yellow Cinchona Bark in coarse powder one pound; Distilled Water a sufficiency; Rectified Spirit one fluidounce. Macerate the cinchona bark in two pints of the water for twenty-four hours, stirring frequently; then pack in a percolator, and add more water, until twelve pints have been collected, or until the water ceases to dissolve anything more. Evaporate the liquor at a temperature not exceeding 160° F., to a pint; then filter through paper, and continue the evaporation to three fluidounces, or until the specific gravity of the liquid is at 1.200. When cold add the spirit gradually, constantly stirring. The specific gravity should be about 1.100. *Br.*

The first formula is decidedly the better, and if any improvement is desirable it would be in the first part of the process, where the water might be partly or wholly replaced by alcohol. Water alone will but partially exhaust cinchona bark, and during the long-continued evaporation a portion of the alkaloids will become insoluble through the alteration of the tannin. On the other hand, a stronger alcohol will dissolve more cinchonic red, but secure the more thorough exhaustion of the alkaloids. The product of the second formula cannot represent in each fluidounce the virtues of the four ounces of bark used, and there must necessarily be a considerable waste of valuable material.

Medical Uses.—An advantage of this preparation is, that it contains in solution all the active principles of cinchona, and not merely one or the other of the alkaloids. As a tonic it may be given in the *dose* of a fluidrachm. For securing the antiperiodic effects of cinchona, it is eligible only in mild cases of periodical fever; for severer ones it must be given in doses too bulky to be convenient.

EXTRACTUM COLCHICI RADICIS FLUIDUM, *U. S.*—Fluid Extract of Colchicum Root.

Extrait liquide de bulbe de colchique, Fr.; *Flüssiges Zeitlosenknollen-Extrakt*, *G.*

Preparation.—Take of Colchicum Root in moderately fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and, having moistened the colchicum root with five fluidounces of the mixture, proceed according to directions given in the general formula at page 585, finishing the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

This fluid extract keeps well, and fully represents the drug from which it is prepared.

Medical Uses.—This preparation contains all the virtues of colchicum. *Dose*, from two to eight minims.

EXTRACTUM COLCHICI SEMINIS FLUIDUM, *U. S.*—Fluid Extract of Colchicum Seed.

Extrait liquide de semences de colchique, Fr.; *Flüssiges Zeitlosensamen-Extrakt*, G.

Preparation.—Take of Colchicum Seed in fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and, having moistened the colchicum seed with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

The amount of fixed oil contained in colchicum seeds, renders the employment of a weaker alcohol desirable. This would probably be of no disadvantage, since the active principle is readily soluble in water, and its preservation insured by the glycerin and alcohol.

Medical Uses.—Like the preceding, this extract is a full representative of colchicum. *Dose*, from two to eight minims.

EXTRACTUM CONII FRUCTÛS FLUIDUM, *U. S.*—Fluid Extract of Hemlock Fruit.

Fluid extract of conium seed, E.; *Extrait liquide de fruit de ciguë*, Fr.; *Flüssiges Schierlingsfrucht-Extrakt*, G.

Preparation.—Take of Conium Seed in fine powder sixteen troyounces; Glycerin four fluidounces; Muriatic Acid one hundred and eighty grains; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the conium seed with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add the muriatic acid and one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

A fluid extract, prepared from the fully developed green fruit of conium, is preferable to that from the leaves which was formerly officinal. The muriatic acid is added to the portion to be evaporated for the purpose of preventing the evaporation of the readily volatile conia.

Medical Uses.—It is a convenient form, and, next to the juice, the most reliable, for the administration of conium. *Dose*, from one to three minims.

EXTRACTUM CORNÛS FLORIDÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF DOGWOOD.

Extrait liquide de cornouiller à grandes fleurs, Fr.; *Flüssiges Kornelrinden-Extrakt*, G.

Preparation.—Take of Dogwood in fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and having moistened the dogwood with five fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

This fluid extract represents the virtues of the bark, and keeps well.

Medical Uses.—This officinal preparation appears to be entirely superfluous. It may be given in the *dose* of a fluidrachm or more.

EXTRACTUM CUBEBÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF CUBEB.

Extrait liquide de cubèbe, Fr.; *Flüssiges Cubeben-Extrakt*, G.

Preparation.—Take of Cubeb in moderately fine powder sixteen troyounces; Stronger Alcohol a sufficient quantity. Moisten the cubeb with six fluidounces of stronger alcohol, and proceed according to directions given in the general formula at page 585.

This fluid extract should not be confounded with the oleoresin of the same drug, which was formerly recognized as fluid extract; it contains the medicinally active resin, together with most of the volatile oil.

Medical Uses.—As a substitute for cubeb this preparation is of doubtful utility, except, perhaps, in chronic affections of the genito-urinary passages. *Dose*, from ten to thirty minims.

EXTRACTUM DIGITALIS FLUIDUM, *U. S.*—FLUID EXTRACT OF DIGITALIS.

Extrait liquide de digitale, Fr.; *Flüssiges Fingerhut-Extrakt*, G.

Preparation.—Take of Digitalis in moderately fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and, having moistened the digitalis with half a pint of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

This is a fair representative of digitalis leaves.

Medical Uses.—Its advantages over the tincture, and especially over the infusion, are not very apparent. The *dose* is one or two drops.

EXTRACTUM DULCAMARÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF BITTERSWEET.

Extrait liquide de douce-amère, Fr.; *Flüssiges Bittersüss-Extrakt*, G.

Preparation.—Take of Bittersweet in moderately coarse powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the bittersweet with six fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

The alcohol has been kept at as low a percentage as appeared to be consistent with the permanency of the preparation and with the medicinal properties of the medicine.

Medical Uses.—This fluid extract probably contains all the active elements of dulcamara, and may be prescribed in the *dose* of a fluidrachm, largely diluted and gradually increased.

EXTRACTUM ERGOTÆ FLUIDUM, *U. S.*, *Br.*—FLUID EXTRACT OF ERGOT.

Extrait liquide de seigle ergoté, Fr.; *Flüssiges Mutterkornextrakt*, G.

Preparation.—Take of Ergot in moderately fine powder sixteen troyounces; Glycerin four fluidounces; Acetic Acid half a fluidounce; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of Glycerin, and five fluidounces of water, and, having moistened the ergot with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add the acetic acid, and one fluidounce of Glycerin to the remainder of the percolate, before evaporation. *U. S.*

Take of Ergot in coarse powder one pound; Ether one pint, or a sufficiency; Distilled Water three and a half pints; Rectified Spirit eight fluidounces. Shake the ether in a bottle with half a pint of the water, and after separation decant the ether. Place the ergot in a percolator, and free it from its oil by passing the washed ether slowly through it. Remove the marc and digest it in three pints of the water at 160° F. for twelve hours. Press out, strain, and evaporate the liquor by the heat of a water-bath to nine fluidounces; when cold, add the spirit. Allow it to stand for an hour to coagulate, then filter. The product should measure sixteen fluidounces. *Br.*

The large quantity of fixed oil contained in ergot, and liable to be displaced by an alcoholic menstruum, is, in the second process, first exhausted by ether, for which a light petroleum benzin may perhaps be advantageously substituted. Both formulas yield efficient liquid preparations of ergot, of which, however, the first is not suited for concentration to be used for hypodermic injection; in that respect the second extract is preferable, or in its place a fluid extract made by exhausting the powdered ergot with diluted alcohol, omitting the glycerin in the first formula. The addition of acetic acid is made to prevent the volatilization of trimethylamin, but is of doubtful necessity as regards the medicinal effects of the preparation.

Off. Prep.—Vinum ergotæ, *U. S.*

Medical Uses.—This preparation represents the totality of the active elements of ergot. In cases of *uterine inertia* it may be prescribed in the *dose* of half a fluidrachm to a fluidrachm repeated every fifteen or twenty minutes. To counteract the effects of *spinal hyperæmia*, the commencing dose should not be less than two drachms three times a day, and it may be increased to three, or even four times that quantity.

EXTRACTUM ERIGERONTIS CANADENSIS FLUIDUM, *U. S.*—FLUID EXTRACT OF CANADA FLEABANE.

Extrait liquide d'érigeron du Canada, Fr.; *Flüssiges Canada-Berufskraut-Extrakt*, G.

Preparation.—Take of Canada Erigeron in moderately coarse powder sixteen troyounces; Alcohol a sufficient quantity. Moisten the erigeron with half a pint of alcohol, and proceed according to directions given in the general formula at page 585. *U. S.*

Alcohol is used for this fluid extract with the view of dissolving the volatile oil, to which its efficacy is mainly due.

Medical Uses.—The oil, which is the active principle of Canada fleabane, being wholly contained in this preparation, it fully represents the plant. The *dose* is from five to ten drops, on sugar, every hour or two.

EXTRACTUM FILICIS LIQUIDUM, *Br.* See OLEORESINÆ FILICIS.

EXTRACTUM GELSEMII FLUIDUM, *U. S.*—FLUID EXTRACT OF YELLOW JASMINE.

Extrait liquide de jasmine jaune, Fr.; *Flüssiges Gelber Jasmin-Extrakt*, G.

Preparation.—Take of Yellow Jasmine in very fine powder sixteen troyounces; Alcohol a sufficient quantity. Moisten the yellow jasmine with four fluidounces of alcohol, and proceed according to directions given in the general formula at page 585.

Alcohol is well adapted for exhausting gelsemium, and the fluid extract has the strong odor and bitter taste of the drug.

Medical Uses.—If used at all, for which there seems to be no necessity, great caution should be observed, on account of the profound and even fatal depression it has occasioned. The *dose* is from five to ten minims.

EXTRACTUM GENTIANÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF GENTIAN.

Extrait liquide de gentiane, Fr.; *Flüssiges Enzianextrakt*, G.

Preparation.—Take of Gentian in moderately coarse powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the gentian with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585.

Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

A fluid extract of gentian made with diluted alcohol and without glycerin, keeps very well, and the addition of glycerin does not seem either to improve or to impair its qualities.

Medical Uses.—It may be employed for all the purposes of the bitter tonics, but it is seldom prescribed alone. It may be used to reinforce the tonic properties of the compound tincture of gentian, and other liquid tonic preparations. *Dose*, half a fluidrachm.

EXTRACTUM GERANII FLUIDUM, *U. S.*—Fluid Extract of Geranium.

Extrait de bec-de-grue tacheté, Fr.; *Flüssiges Fleckenstorchschnabel-Extrakt*, G.

Preparation.—Take of Geranium in moderately fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the geranium with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

A dark reddish-brown fluid extract in which the astringent properties of the drug appear to be well preserved.

Medical Uses.—Fluid extract of cranesbill is an excellent substitute for the liquid preparations of catechu and other simple astringents. *Dose*, from half a fluidrachm to one or two fluidrachms.

EXTRACTUM GLYCYRRHIZÆ FLUIDUM, *U. S.*—Fluid Extract of Liquorice Root.

Extractum glycyrrhizæ liquidum, Br. Add.—*Liquid extract of liquorice root*, E.; *Extrait liquide de réglisse*, Fr.; *Flüssiges Süssholz-Extrakt*, G.

Preparation.—Take of Liquorice Root in fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the liquorice root with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

Take of Liquorice Root in coarse powder one pound; Distilled Water four pints. Macerate the liquorice root with two pints of the water for twelve hours, strain and press; again macerate the pressed marc with the remainder of the water for six hours, strain and press. Mix the strained liquors, heat them to 212° F., and strain through flannel; then evaporate by a water-bath until it has acquired, when cold, a specific gravity of 1.160; add to this one-eighth of its volume of rectified spirit; let the mixture stand for twelve hours, and filter. *Br. Add.*

Both formulas yield fluid extracts containing the peculiar sweet taste of the liquorice root. The preparation was recommended by Jos. Harrop (1869) for disguising the bitter taste of quinia.

Medical Uses.—It is a very agreeable substitute for the simple extract of liquorice in flavoring cough medicines, and concealing acrid flavors.

EXTRACTUM GOSSYPII RADICIS FLUIDUM, *U. S.*—FLUID EXTRACT OF COTTON ROOT.

Extrait liquide d'écorce de cotonnier, Fr.; *Flüssiges Baumwollenwurzel-Extrakt*, G.

Preparation.—Take of Cotton Root in very fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the cotton root with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

Properly prepared this fluid extract has a bright brownish-red color. Made according to the above formula it will sometimes thicken into a jelly-like substance, which is prevented by the use of a menstruum stronger in alcohol. J. U. Lloyd (1876) proposes to use a mixture of 10 fluidounces of alcohol, and three each of glycerin and water, and finish percolation with a menstruum composed of 10 fluidounces of alcohol and 6 of water. He also proposes to reserve the first 13 fluidounces of the percolate, and to evaporate the remainder to 3 fluidounces. Fresh or recently dried bark appears to yield a more effectual preparation than old bark.

Medical Uses.—It is used chiefly as a substitute for ergot, as an oxytocic and emmenagogue, and may be given in the *dose* of half a fluidrachm or more.

EXTRACTUM HYDRASTIS FLUIDUM, *U. S.*—FLUID EXTRACT OF HYDRASTIS.

Extrait liquide de hydrastis, Fr.; *Flüssiges Hydrastis-Extrakt*, G.

Preparation.—Take of Hydrastis in very fine powder sixteen troyounces; Glycerin two fluidounces; Alcohol, Water, each a sufficient quantity. Mix the glycerin with fourteen fluidounces of alcohol, and, having moistened the hydrastis with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with a menstruum consisting of two parts of alcohol and one part of water. *U. S.*

The fluid extract has a deep brown-yellow color, and the strongly bitter taste of the root.

Medical Uses.—This is a convenient and efficient form of the medicine. *Dose*, a fluidrachm two or three times a day.

EXTRACTUM HYOSCYAMI FLUIDUM, *U. S.*—FLUID EXTRACT OF HYOSCYAMUS.

Extrait liquide de jusquiame, Fr.; *Flüssiges Bilsenkraut-Extrakt*, G.

Preparation.—Take of Hyoscyamus Leaves in moderately fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and, having moistened the hyoscyamus with half a pint of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

This is made like the fluid extracts of other narcotic leaves, and has the heavy odor of the drug.

Medical Uses.—The fluid extract is a good representative of hyoscyamus, and may be prescribed in *doses* of from five to ten minims, and increased if necessary.

EXTRACTUM IPECACUANHÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF IPECACUANHA.

Extrait liquide d'ipécacuanha, Fr.; *Flüssiges Ipecacuanha-Extrakt*, G.

Preparation.—Take of Ipecacuanha in fine powder sixteen troyounces; Glycerin half a pint; Stronger Alcohol a pint and a half; Water twelve fluidounces; Diluted Alcohol a sufficient quantity. Mix the stronger alcohol and water, and, having moistened the ipecacuanha with six fluidounces of the mixture, pack it firmly in a conical percolator, and pour upon it twelve fluidounces of the mixture. When the liquid begins to drop from the percolator, close the lower orifice with a cork, and, having closely covered the percolator, set it aside for four days. Then remove the cork, and gradually pour on the remainder of the mixture, and finally diluted alcohol, until two pints of tincture have slowly passed. Mix this portion with the glycerin, and evaporate the mixture, at a temperature not exceeding 140° F., to one pint. *U. S.*

A fluid extract, which should yield an almost clear mixture with simple syrup, as intended by the Pharmacopœia, can be obtained by the above formula only when working on quantities much smaller than directed. The following modification, worked out by R. V. Mattison (1873), yields more satisfactory results. The percolate is mixed with only two fluidounces of glycerin, evaporated, at a temperature not exceeding 140° F., to eleven fluidounces, allowed to cool, and thrown on a moistened filter. The residue upon the filter, which is of a resinous appearance, is washed with sufficient water to make the filtrate measure twelve fluidounces. Should a precipitate occur in the latter, a second filtration through a small filter is necessary, after which the preparation is brought to the measure of a pint by the addition of four fluidounces of glycerin. The six fluidounces of glycerin have been found quite sufficient to preserve the fluid extract.

Off. Prep.—Syrupus ipecacuanhæ, *U. S.*

Medical Uses.—Fluid extract of ipecacuanha is a convenient addition to expectorant mixtures, but hardly as much so as the syrup, to the preparation of which, indeed, it is essential. The *dose*, as an emetic, is about twenty or thirty minims; as an expectorant, five minims.

EXTRACTUM KRAMERIÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF RHATANY.

Extrait liquide de ratanhia, Fr.; *Flüssiges Ratanha-Extrakt*, G.

Preparation.—Take of Rhatany in fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the rhatany with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

This fluid extract is of a deep brown-red color, and strongly astringent taste.

Medical Uses.—It has the advantage over the tincture of being more astringent and less stimulant. *Dose*, half a fluidrachm.

EXTRACTUM LUPULINÆ FLUIDUM, *U. S.*—Fluid Extract of Lupulin.

Extrait liquide de lupuline, Fr.; *Flüssiges Lupulin-Extrakt*, G.

Preparation.—Take of Lupulin sixteen troyounces; Stronger Alcohol a sufficient quantity. Moisten the lupulin with six fluidounces of stronger alcohol, and proceed according to directions given in the general formula at page 585. *U. S.*

The use of stronger alcohol is necessary to keep the volatile oil and resinous matter in solution; the preparation fairly represents the drug.

Medical Uses.—It affords a convenient mode of administering lupulin. The *dose* is fifteen or twenty minims, which should be mixed with syrup, and afterwards diluted with water.

EXTRACTUM MATICO LIQUIDUM, *U. S.*—Fluid Extract of Matico.

Extrait liquide de matico, Fr.; *Flüssiges Matico-Extrakt*, G.

Preparation.—Take of Matico in moderately fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and, having moistened the matico with half a pint of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

The virtues of the drug are well preserved by the officinal menstruum.

Medical Uses.—The utility of this preparation consists in the facility with which it is absorbed. It may be given in *doses* of from half a fluidrachm to two fluidrachms.

EXTRACTUM MEZEREI FLUIDUM, *U. S.*—Fluid Extract of Mezereon.

Extrait liquide de Mézéréon (de garou), Fr.; *Flüssiges Seidelbast-Extrakt*, G.

Preparation.—Take of Mezereon in moderately coarse powder sixteen troyounces; Stronger Alcohol a sufficient quantity. Moisten the mezereon with six fluidounces of stronger alcohol, and proceed according to directions given in the general formula at page 585. *U. S.*

This fluid extract is used in the preparation of Unguentum mezerei, for which purpose it is very convenient.

Medical Uses.—Diluted, this extract may take the place of decoction of mezereon. But an overdose of it undiluted may give rise to violent and even fatal effects. Its chief use is its external application to maintain a discharge from blistered surfaces.

EXTRACTUM OPII LIQUIDUM. *Br.*—LIQUID EXTRACT OF OPIUM.

Extrait liquide d'opium, Fr.; *Flüssiges Opiumextrakt*, G.

Preparation.—Take of Extract of Opium one ounce; Distilled Water sixteen fluidounces; Rectified Spirit four fluidounces. Macerate the extract of opium in the water for an hour, stirring frequently; then add the spirit, and filter. The product should measure one pint (imperial). It contains 22 grains of extract of opium, nearly, in 1 fluidounce. *Br.*

This is, perhaps, slightly stronger in opium than the tincture of opium, and scarcely deserves to be classed with the fluid extracts; it is analogous to the Tinctura opii deodorata, *U. S.*

Medical Uses.—Essentially a solution of the watery extract of opium, this preparation is probably less apt to nauseate and constipate than laudanum. *Dose*, from ten to forty minims.

EXTRACTUM PAREIRÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF PAREIRA BRAVA.

Extractum pareiræ liquidum, Br.—*Liquid extract of pareira*, E.; *Extrait liquide de pareira brava*, Fr.; *Flüssiges Pareira-Extrakt*, G.

Preparation.—Take of Pareira Brava in fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the pareira brava with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

Take of Pareira Root in coarse powder one pound; Boiling Distilled Water one gallon, or a sufficiency; Rectified Spirit three fluidounces. Digest the pareira with a pint of the water for twenty-four hours; then pack in a percolator, and, adding more of the water, allow the liquor slowly to pass until a gallon has been collected, or the pareira is exhausted. Evaporate the liquor by a water-bath to thirteen fluidounces, and, when it is cold, add the spirit, and filter through paper. *Br.*

The latter formula gives a concentrated infusion, preserved by the addition of a little alcohol. The former extracts the root more readily by the use of an alcoholic menstruum. The brown-colored preparation possesses the peculiar bitter taste of the root in a marked degree.

Medical Uses.—This preparation probably contains all the medicinal qualities of pareira brava. It may be given in teaspoonful *doses* three times a day, largely diluted.

EXTRACTUM PRUNI VIRGINIANÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF WILD CHERRY.

Extrait liquide de cerisier de Virginie, Fr.; *Flüssiges Wildkirschenrinden-Extrakt*, G.

Preparation.—Take of Wild Cherry in fine powder sixteen troyounces; Glycerin four fluidounces; Water half a pint; Stronger Alcohol a sufficient quantity. Mix the glycerin and water, and, having moistened the wild cherry with half a pint of the mixture, allow it to macerate in a covered vessel for four days; then pack it in a conical glass percolator, and pour on the remainder of the mixture; when this has disappeared from the surface, gradually pour on stronger alcohol until twelve fluidounces have been obtained, and set this portion aside. Continue the percolation with stronger alcohol until twenty fluidounces more have been obtained; evaporate to four fluidounces and filter through paper, rinsing the filter with a small portion of stronger alcohol, so as to preserve the measure of four fluidounces. Lastly, mix this with the reserved portion, and keep in a well-stopped bottle. *U. S.*

During the maceration of the powder with the aqueous liquid, the amygdalin of the bark is decomposed into hydrocyanic acid and volatile oil (benzaldehyd), a portion of both being contained in the reserved aqueous percolate. The finished preparation represents mainly the astringent and tonic virtues, and in part the sedative properties of wild cherry bark.

Medical Uses.—If well prepared, this extract represents more fully and in a more convenient form than any other preparation the virtues of wild cherry bark. It is an excellent adjuvant to cough mixtures in chronic *pulmonary* affections, and a palliative of *nervous* disorder of the heart's action. The *dose* is from thirty minims to a fluidrachm, and should be gradually increased.

EXTRACTUM RHEI FLUIDUM, *U. S.*—FLUID EXTRACT OF RHUBARB.

Extrait liquide de rhubarbe, Fr.; *Flüssiges Rhabarber-Extrakt*, G.

Preparation.—Take of Rhubarb in moderately fine powder sixteen troyounces; Glycerin two fluidounces; Alcohol, Water, each a sufficient quantity. Mix the glycerin with fourteen fluidounces of alcohol, and, having moistened the rhubarb with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with a menstruum consisting of two parts of alcohol and one part of water. *U. S.*

The rhubarb is well exhausted by the menstruum directed, the last portions of which may be pushed through by officinal diluted alcohol, but not by a more aqueous menstruum, which would swell the cellular tissue and stop percolation. The fluid extract has a blackish-brown color.

Off. Prep.—Syrupus rhei, *U. S.*

Medical Uses.—This preparation is not often used as a purgative; but its *dose* may be stated at from ten to thirty minims.

EXTRACTUM RUBI FLUIDUM, *U. S.*—FLUID EXTRACT OF BLACKBERRY.

Extrait liquide d'écorce de ronce, Fr.; *Flüssiges Brombeerrinden-Extrakt*, G.

Preparation.—Take of Blackberry in fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the powdered bark with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

The bark of blackberry root is fairly exhausted, and the preparation well preserved by the menstruum ordered. The deep brown liquid has a decidedly astringent taste.

Off. Prep.—Syrupus rubi, *U. S.*

Medical Uses.—It is a good astringent, and well suited for the treatment of mild cases of *diarrhœa* in children, after a proper evacuation of the bowels. The *dose* is from half a fluidrachm to two fluidrachms. It may, like other vegetable astringents, be added to chalk mixture.

EXTRACTUM SABINÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF SAVINE.

Extrait liquide de sabine, Fr.; *Flüssiges Sadebaum-Extrakt*, G.

Preparation.—Take of Savine in moderately fine powder sixteen troyounces; Stronger Alcohol a sufficient quantity. Moisten the savine with half a pint of stronger alcohol, and proceed according to directions given in the general formula at page 585. *U. S.*

The brown-green liquid contains the volatile oil, resin, and tannin of the drug, and is not only well adapted for making the officinal Ceratum sabinæ, *U. S.*, but it offers likewise a convenient way for administering savine.

Medical Uses.—The fluid extract appears to contain all the virtues of savine. *Dose*, from five to fifteen minims.

EXTRACTUM SARSAPARILLÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF SARSAPARILLA.

Extractum sarsæ liquidum, Br.; *Liquid extract of sarsaparilla*, E.—*Extrait liquide de salsepareille*, Fr.; *Flüssiges Sarsaparilla-Extrakt*, G.

Preparation.—Take of Sarsparilla in moderately fine powder sixteen troyounces; Glycerin half a pint; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol with four fluidounces each of glycerin and water, and, having moistened the sarsaparilla with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Continue the percolation with diluted alcohol until twenty-six fluidounces have been obtained. Reserve the first ten fluidounces, and, having added four fluidounces of glycerin to the remainder of the percolate, carefully evaporate to six fluidounces, and mix with the reserved portion. *U. S.*

Take of Jamaica Sarsaparilla cut transversely one pound; Distilled Water at 160° F. fourteen pints; Rectified Spirit one fluidounce. Digest the sarsaparilla in one-half of the water for six hours, and decant the liquor. Digest the residue in the remainder of the water for the same time, express and filter the liquors, and evaporate them by a water-bath to seven fluidounces, or until the specific gravity of the liquid is 1.13. When cold, add the spirit. The specific gravity should be about 1.095. *Br.*

Of the two preparations, the latter is apparently double the strength of the former; but the long evaporation requisite for reducing nearly 280 to 7 fluidounces is of questionable benefit, even if the root had been completely exhausted by the warm water. The first process appears to be well adapted for exhausting the root, and preserving the fluid extract, which contains but little over one-fourth its measure of alcohol.

Medical Uses.—It probably contains whatever active elements belong to sarsaparilla, and serves as a basis, or a vehicle, for other medicines. *Dose*, from thirty minims to a fluidrachm.

EXTRACTUM SARSAPARILLÆ COMPOSITUM FLUIDUM, *U. S.*—COMPOUND FLUID EXTRACT OF SARSAPARILLA.

Extrait liquide de salsepareille composé, Fr.; *Zusammengesetztes flüssiges Sarsaparilla-Extrakt*, G.

Preparation.—Take of Sarsaparilla in moderately fine powder sixteen troyounces; Liquorice Root in moderately fine powder, Sassafras in moderately fine powder, each two troyounces; Mezereon in moderately fine powder three hundred and sixty grains; Glycerin half a pint; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol with four fluidounces each of glycerin and water, and, having moistened with six fluidounces of the mixture the powders previously well mixed, proceed according to directions given in the general formula at page 585. Continue the percolation with diluted alcohol until two pints have been obtained. Reserve the first twelve fluidounces, and, having added four fluidounces of glycerin to the remainder of the percolate, carefully evaporate to six fluidounces, and mix with the reserved portion. *U. S.*

The frequent use which is made of the above combination of drugs probably renders such a fluid extract desirable, though it seems to be unnecessary, since the introduction of concentrated preparations of liquorice root and mezereon affords the opportunity of giving these and sarsaparilla in any proportion that may be desired.

Medical Uses.—The only very active ingredient in this preparation, after the sarsaparilla, is mezereon. It would appear to be a less eligible medicine than the compound decoction of sarsaparilla, which contains also guaiacum, and whose efficiency is established. *Dose*, from thirty minims to a fluidrachm.

EXTRACTUM SCILLÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF SQUILL.

Extrait liquide de scille, Fr.; *Flüssiges Meerzwiebel-Extrakt*, G.

Preparation.—Take of Squill in moderately coarse powder sixteen troyounces; Glycerin two fluidounces; Alcohol, Water, each a sufficient quantity. Mix the glycerin with fourteen fluidounces of alcohol, and, having moistened the squill with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with a menstruum consisting of two parts of alcohol and one part of water. *U. S.*

The use of alcohol in the first part of the process prevents the excessive swelling of the squill which would take place with a more aqueous menstruum, and render impossible the approximate exhaustion of the drug with so small a quantity of menstruum as directed. The extract is of a deep red color.

Medical Uses.—This preparation is a concentrated and convenient form of squill. It is especially adapted for use as a diuretic. *Dose*, three or more minims, largely diluted.

EXTRACTUM SENEGÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF SENEKA.

Extrait liquide de polygale de Virginie, Fr.; *Flüssiges Senegaextrakt*, G.

Preparation.—Take of Seneka in fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the seneka with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

An alcoholic menstruum like that directed is better adapted for dissolving the acrid polygalic acid than one of greater alcoholic strength; but it has also the disadvantage of dissolving various pectin compounds which are apt after some time to convert the liquid into a gelatinous mass. This result is prevented by the use of a little alkali, for which purpose Dr. Squibb (1871) proposed about 2½ drachms of ammonia water, and H. N. Rittenhouse the same quantity of bicarbonate of sodium. The fluid extract is dark brown in color.

Medical Uses.—The special object of this preparation is apparently to supersede the decoction, all of whose virtues it possesses. *Dose*, half a fluidrachm.

EXTRACTUM SENNÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF SENNA.

Extrait liquide de séné, Fr.; *Flüssiges Sennaextrakt*, G.

Preparation.—Take of Senna in fine powder sixteen troyounces; Glycerin half a pint; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol with four fluidounces each of glycerin and water, and, having moistened the senna with half a pint of the mixture, proceed according to directions given in the general formula at page 585. Continue the percolation with diluted alcohol until twenty-six fluidounces have been obtained. Reserve the first ten fluidounces, and, having added four fluidounces of glycerin to the remainder of the percolate, carefully evaporate to six fluidounces, and mix with the reserved portion. *U. S.*

Thus prepared the fluid extract is an efficient preparation, containing less than one-fourth its measure of alcohol. It is of a dark-brown color, and has the odor and taste of senna leaves.

Off. Prep.—Extractum spigeliæ et sennæ fluidum. *U. S.*

Medical Uses.—This fluid extract may be prescribed as a laxative in *doses* of a fluidrachm, and as a purgative in doses of two or more fluidrachms. It is apt to gripe severely without the addition of a carminative, such as oil of anise or oil of peppermint.

EXTRACTUM SERPENTARIÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF SERPENTARIA.

Extrait liquide de serpentaire, Fr.; *Flüssiges Schlangenwurz-Extrakt*, G.

Preparation.—Take of Serpentaria in fine powder sixteen troyounces; Alcohol a sufficient quantity. Moisten the serpentaria with four fluidounces of alcohol, and proceed according to directions given in the general formula at page 585. *U. S.*

The virtues of serpentaria are well exhausted and properly preserved by this process. The fluid extract has a red-brown color, and the peculiar odor and bitter taste of the drug.

Medical Uses.—It is a convenient and efficient substitute for the infusion of serpentaria. *Dose*, half a fluidrachm.

EXTRACTUM SPIGELIÆ ET SENNÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF SPIGELIA AND SENNA.

Extrait liquide de spigélie et séné, Fr.; *Flüssiges Spigelien- und Senna-Extrakt*, G.

Preparation.—Take of Fluid Extract of Spigelia ten fluidounces; Fluid Extract of Senna six fluidounces; Oil of Anise, Oil of Caraway, each twenty minims. Mix the fluid extracts, and dissolve the oils in the mixture. *U. S.*

This compound fluid extract contains spigelia and senna in a proportion which has been used with satisfactory results for a number of years.

Medical Uses.—This preparation represents in a concentrated form the well-tried and popular remedy "worm-tea." It should be prescribed in *doses* of one or more fluidrachms at intervals of an hour until it begins to purge.

EXTRACTUM SPIGELIÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF SPIGELIA.

Extrait liquide de spigélie, Fr.; *Flüssiges Spigelien-Extrakt*, G.

Preparation.—Take of Spigelia in fine powder sixteen troyounces; Glycerin half a pint; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol with four fluidounces each of glycerin and water, and, having moistened the spigelia with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Continue the percolation with diluted alcohol until twenty-six fluidounces have been obtained. Reserve the first ten fluidounces, and, having added four fluidounces of glycerin to the remainder of the percolate, carefully evaporate to six fluidounces, and mix with the reserved portion. *U. S.*

This is a dark-brown liquid, containing less than one-fourth its measure of alcohol, and representing the virtues of spigelia.

Off. Prep.—Extractum spigeliæ et sennæ fluidum.

Medical Uses.—It possesses fully the virtues of spigelia, and may be given in the *dose* of a fluidrachm and upwards.

EXTRACTUM STILLINGIÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF STILLINGIA.

Extrait liquide de stillingie, Fr.; *Flüssiges Stillingia-Extrakt*, G.

Preparation.—Take of Stillingia in fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and, having moistened the stillingia with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evapotion. *U. S.*

This fluid extract is of a dark-brown color, and has the bitterish, pungent taste of the root.

Medical Uses.—It may be employed in various chronic diseases, and especially scrofula, diseases of the skin, syphilis, etc. *Dose*, a fluidrachm.

EXTRACTUM TARAXACI FLUIDUM, *U. S.*—FLUID EXTRACT OF TARAXACUM.

Extrait liquide de pissenlit, Fr.; *Flüssiges Löwenzahn-Extrakt*, G.

Preparation.—Take of Dandelion in moderately fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the dandelion with four fluidounces of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

Prepared from good dandelion root, the fluid extract is an efficient preparation, of a reddish-brown color, and bitterish, sweet taste. We have seen commercial fluid extracts bearing this name, which, to judge from their appearance and their more decided bitterness, were evidently made from chickory root.

Medical Uses.—It is a more permanent preparation than the decoction of dandelion, and at the same time quite as operative. *Dose*, one or more fluidrachms.

EXTRACTUM UVÆ URSI FLUIDUM, *U. S.*—FLUID EXTRACT OF UVA URSI.

Extrait liquide de busserole, Fr.; *Flüssiges Bärentraubenblätter-Extrakt*, G.

Preparation.—Take of Uva Ursi in moderately fine powder sixteen troyounces; Glycerin four fluidounces; Alcohol, Water, each a sufficient quantity. Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the uva ursi with half a pint of the mixture, proceed according to directions given in the general formula at page 585. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate, before evaporation. *U. S.*

The process yields a good fluid extract of a dark-brown color, and of the bitter and astringent taste of the leaves, and it contains about 37 per cent. of alcohol.

Medical Uses.—It probably contains all the virtues of the plant. Like nearly all medicines intended to act upon the urinary organs, it should be given largely diluted. *Dose*, a fluidrachm.

EXTRACTUM VALERIANÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF VALERIAN.

Extrait liquide de valériane, Fr.; *Flüssiges Baldrian-Extrakt*, G.

Preparation.—Take of Valerian in fine powder sixteen troyounces; Stronger Alcohol a sufficient quantity. Moisten the valerian with five fluidounces of stronger alcohol, and proceed according to directions given in the general formula at page 585. *U. S.*

Stronger alcohol is well adapted for exhausting the volatile, bitter, and resinous principles of the root, and, if the percolation and evaporation of the weak tincture have been well managed, but little loss of volatile oil will occur.

Medical Uses.—An efficient preparation of this valuable drug. *Dose*, one fluidrachm.

EXTRACTUM VERATRI VIRIDIS FLUIDUM, *U. S.*—FLUID EXTRACT OF AMERICAN HELLEBORE.

Extrait liquide de vératre américain, Fr.; *Flüssiges Grüngermerwurz-Extrakt*, G.

Preparation.—Take of American Hellebore in fine powder sixteen troy-ounces; Stronger Alcohol a sufficient quantity. Moisten the hellebore with five fluidounces of stronger alcohol, and proceed according to directions given in the general formula at page 585. *U. S.*

The resins and alkaloids are readily taken up and held in solution by the menstruum directed, and the fluid extract is therefore of about double the strength of the tincture of the same drug.

Medical Uses.—This preparation is a very potent depressor of the heart's action. *Dose*, one to three minims.

EXTRACTUM ZINGIBERIS FLUIDUM, *U. S.*—FLUID EXTRACT OF GINGER.

Extrait liquide de gingembre, Fr.; *Flüssiges Ingwer-Extrakt*, G.

Preparation.—Take of Ginger in moderately fine powder sixteen troy-ounces; Alcohol a sufficient quantity. Moisten the ginger with four fluidounces of alcohol, and proceed according to directions given in the general formula at page 585. *U. S.*

Ginger is readily exhausted by alcohol; the fluid extract is four times stronger than the tincture of ginger, and has the same sensible properties, but in a higher degree. It is used in preparing Syrupus zingiberis. *U. S.*

Medical Uses.—It is a convenient substitute for the tincture, on account of its greater strength, and for the infusion on account of its small bulk. *Dose*, ten or more minims.

FARINA TRITICI, *Br.*—WHEATEN FLOUR.

Farine de froment, Fr.; *Weizenmehl*, G.

The grain of wheat, Triticum vulgare, *Villars*, ground and sifted.

Nat. Ord.—Graminaceæ.

Origin.—An annual or biennial herbaceous plant, which is probably indigenous to Central Asia, but has been under cultivation from a very early period, and is at present raised in most countries of the temperate zones. The smooth jointed stem (culm) is 3 to 5 feet high; the leaves are long, linear, somewhat rough; the terminal spikes are 3 to 4 inches long, with a flat and finely hairy axis (rachis), and 4 or 5 flowered, flattened spikelets, producing usually three fruits, which are oval-oblong, obtuse, grooved on the upper side, and of a yellowish or brownish color. Numerous varieties have been produced by cultivation, some having the chaff awnless, or the lower paleæ long-awned, and the fruit of a white or reddish color. Spring or summer wheat (*Tr. æstivum*) is awned or bearded; the winter wheat (*Tr. hybernum*) nearly awnless.

Of other species of wheat which are cultivated, the following may be mentioned: *Trit. turgidum*, Lin., of which *Tr. compositum*, or Egyptian wheat, is a variety with compound spikes; *Tr. durum*, Desf., or horny wheat, with long awns, including the varieties *villosum*, *hordeiforme*, and others; *Tr. spelta*, Lin., or spelt, with triangular ovate and obtuse grains, which are little mealy; and *Tr. monococcum*, Lin., or one-grained wheat, with small spikes, and three flowers in each spikelet, two being barren, the third one producing a somewhat triangular grain.

Wheat grain, like the similar graminaceous fruits, has the integuments of the fruit and seed united; underneath this covering is a layer of cells containing *gluten*, and then follows the cellular tissue of the so-called albumen or perisperm, this being filled with numerous *starch* granules. Wheat is most generally prepared for food by grinding, and separating, by means of sieves, the broken integuments, or *bran*, from the fine amylaceous white portion, or *flour*.

Description.—Wheaten flower is a very fine white powder, without odor, and of an insipid taste. The starch granules, which largely compose it, have been described on page 169.

Composition.—Air-dry wheat contains, according to Millon (1854), 12 to 17 per cent. of water, 8 to 16 per cent. of gluten, about 2 per cent. of fat, about 2 per cent. of cellulose, and 1½ to 2 per cent. of ash. Older analyses of different kinds of wheat were principally made by A. Vogel (1818), Proust (1820), Henry and Vauquelin (1822). The amount of starch varies between about 60 and 70 per cent., and the weight of nitrogen between 1.6 and 2.7 per cent. A small quantity of saccharine matter is also present, and the ash contains nearly 50 per cent. of phosphoric acid. The inorganic constituents are mostly found in the bran, to the extent of over 7 per cent., while the nitrogenated principles enter chiefly the flour. If the latter is kneaded with cold water as long as the liquid becomes milky, a yellowish-gray elastic and glutinous mass remains, which is the *gluten* of Beccaria, retains about 70 per cent. of water, and consists, according to Von Bibra, in the dry state of about 70 per cent. *vegetable fibrin*, 3.8 to 9.3 *vegetable casein*, 7.5 to 19.5 *glutin*, and 4.6 to 8.2 per cent. of fat. When fresh it dissolves in dilute phosphoric acid and a solution of potassa. On drying it assumes a hornlike appearance, and partly loses its solubility. According to Boussingault, it contains 15 per cent. of nitrogen.

To purify it Ritthausen (1862–1867) dissolves it in cold very dilute potassa solution (1 to 1000 parts of water), decants from the undissolved starch, and precipitates with acetic acid. The precipitate is repeatedly treated with fresh portions of alcohol, commencing with spec. gr. .914, and increasing the strength finally to absolute alcohol. After another washing with ether, the insoluble portion constitutes *gluten-casein*, which is slightly soluble in acetic acid, freely soluble in potassa, and becomes insoluble by heat. On evaporating the united alcoholic liquids to one-half, and cooling, *gluten-fibrin* is separated, which is freed from adhering casein by dissolving it repeatedly in 60 and 70 per cent. alcohol. It is freely soluble in dilute acetic acid, and when boiled with water, in which it is insoluble, it is converted into a jelly. After the separation of gluten-fibrin, the greater portion of the alcohol is evaporated, the precipitate appearing on cooling is treated with a little alcohol, washed with ether, dissolved in little 65 per cent. alcohol, and precipitated by absolute alcohol. The precipitate is *mucedin*, the solution contains *glutin* or *gliadin*. The former yields with cold or boiling water a milklike liquid; the latter is soluble in water, alcohol, acetic acid, potassa, etc., the aqueous solution being precipitated by the salts of the heavier metals; glutin contains sulphur and 18 per cent. of nitrogen. These principles are the most important ones of the *vegetable protein compounds*.

Off. Prep.—Cataplasma fermenti, *Br.*

Medical Uses.—Wheaten flour is often used as a dusting powder to allay the heat and pain of local inflammations, such as superficial *burns* and *scalds*, *erysipelas*, *erythema*, *intertrigo*, *prickly heat*, etc. But it is very far inferior, for such purposes, to powdered starch. Its dietetic uses need not here be considered, but one among them, which is also partly medicinal, is worthy of notice. It is the administration of an uncooked paste made from wheaten flour in many cases of *diarrhœa*, and especially in those depending upon debility. The summer diarrhœas of this climate are usually curable by this simple remedy, if the patient rests and abstains from other food.

FEL BOVINUM PURIFICATUM, *Br.*—PURIFIED OX-BILE.

Fel tauri depuratum, P. G.; *Fel bovis purificatum*, *Extractum fellis bovini.*—*Purified ox-gall*, E.; *Fiel* (*Bile*) *de bœuf purifié*, Fr.; *Gereinigte Ochsengalle* (*Rindsgalle*), G.

The purified gall of the ox, Bos taurus, *Linn.*

Origin.—Bile is a greenish or brownish, viscid, transparent liquid, which is separated by the liver in the gall-bladder; it has a peculiar odor, becoming prominent on heating; a nauseous, sweet, and bitter taste, a specific gravity of about 1.02, a slight alkaline reaction, and dissolves completely with water. When mixed with its own weight, or twice its bulk of alcohol, a precipitate is produced consisting almost exclusively of mucilaginous matter, and the liquid filtered from it and evaporated constitutes the purified ox-gall of the British Pharmacopœia. The yield is about 10 per cent. The use of copper vessels should be avoided.

Preparation.—Take of Fresh Ox-Bile one pint; Rectified Spirit two pints. Mix the bile and the spirit by agitation in a bottle, and set aside for twelve hours until the sediment subsides. Decant the clear solution, and evaporate it in a porcelain dish by the heat of a water-bath, until it acquires a suitable consistence for forming pills. *Br.*

Properties.—It is a deep yellowish-green extract-like mass, having the peculiar taste of bile, and being completely soluble in water and in spirit, whereby it is distinguished from crude inspissated gall, which does not yield a complete solution with alcoholic liquids.

The German Pharmacopœia directs a still purer article, from which, besides the mucilage, the biliary coloring matters also have been removed; the decolorization is effected after the removal of the mucilage, by distilling off the alcohol and then adding to the residue recently purified and well-washed still moist animal charcoal; 8 to 10 parts of it will be sufficient for 100 parts of bile. The mixture is occasionally agitated, and when the liquid shows only a slight yellow color it is passed through a moistened filter, evaporated in a porcelain capsule by means of a water-bath, and then completely exsiccated in a drying closet or by means of a sand-bath, the heat of which must not be allowed to rise above 100° C. (212° F.). The mass is then reduced to powder and preserved in small well-corked vials. The yield is nearly 7 per cent. It forms a yellowish or yellowish-white powder, which attracts moisture from the atmosphere, and dissolves completely in water and alcohol, the solutions being of a yellowish color and of the sweet and bitter taste of bile. When heated to redness it burns, leaving a small amount of a white alkaline ash. This preparation is sometimes sold as *Choleate* or *Choleinate of sodium.*

Constituents.—The principal coloring matter of bile appears to be *bilirubin*, formerly called *colepyrrhin*, $C_{16}H_{18}N_2O_3$, which is slightly soluble in alcohol and ether, but dissolves in chloroform, bisulphide of carbon, and benzol;

it forms an amorphous or crystalline orange-colored or red powder. It is accompanied by *bilifuscin*, a dark olive-brown powder, soluble in alcohol and in hot chloroform; *biliprasin*, a green-black powder, insoluble in chloroform, soluble in alcohol, with a green, or, in the presence of ammonia, with a brown color; and *bilihumin*, a blackish powder, insoluble in simple solvents, and often found in biliary concretions. *Biliverdin* is formed by the oxidation of bilirubin, is a dark-green powder, soluble in alcohol with a green color, and insoluble in water, ether, and chloroform (Städeler, 1864). The fatty matter of bile is chiefly *cholesterin*, $C_{26}H_{44}O$, which is also an ingredient of the brain, the nerves, the yolk of eggs, etc. It crystallizes in colorless laminæ or prisms, is unchanged by boiling potassa, dissolves in ether, chloroform, and hot alcohol, and is chemically a monatomic alcohol. Ox-gall contains the sodium salts of two peculiar acids, named *glycocholic* (the *cholic acid* of some older authors) and *taurocholic* (Strecker's *choleic*) *acid*, a part of the former of which, together with the remaining pigments, is precipitated by neutral acetate of lead from fresh bile, previously decolorized by animal charcoal. When to the filtrate from this precipitate subacetate of lead is carefully added, until the insoluble compound formed has a white color, the precipitate will consist of glycocholeate and taurocholeate of lead, and the filtrate contains only taurocholic acid, which is precipitated on the further addition of basic acetate of lead. Glycocholic acid, $C_{26}H_{43}NO_6$, is in very fine white needles, of a silky lustre and a sweetish bitter taste. Its salts have a sweet taste, and are mostly soluble in water and alcohol. Boiled with alkalies, it takes up one molecule of water and splits into *glycocol* (*glycin* or *amidoacetic acid*), $C_2H_5NO_2$, and *cholic acid* (*cholalic acid* of Strecker), which has a bitter and afterwards sweetish taste. *Taurocholic acid*, $C_{26}H_{45}NSO_7$, is in silky acicular crystals, easily soluble in water and alcohol, and when boiled with alkalies decomposed into *cholic acid* and *taurin* (*amido-isethionic acid*), $C_2H_7NSO_3$.

Ox-bile contains the two biliary acids in nearly equal proportion; human bile mainly taurocholic acid, which is found in dog-bile almost to the exclusion of other acids. Both acids, dissolved in water and mixed with a little syrup and afterwards with oil of vitriol, acquire a red color, changing to carmine, purple, and violet (*Pettenkofer's test for bile*). Cholic acid shows a similar behavior, and the coloration is also obtained with unpurified bile.

Physiological Action.—The function of the bile is far from being thoroughly understood, for its composition is exceedingly complex, but, along with the pancreatic juice, this secretion seems intended to neutralize the acidity of the chyme as it is received by the duodenum from the stomach, and at the same time to emulsify the fatty matters which the acid secretions of the stomach are not fitted to prepare for absorption. It is further probable that the excess of bile not so employed tends to quicken the peristaltic movements of the bowels. It is at least pretty certain that when the bile is profusely secreted it occasions diarrhœa. It is quite certain that, in doses of from half an ounce to an ounce, fresh ox-bile acts as a laxative, and that if its use be persisted in it is very apt to excite a burning sensation in the rectum, and to induce hemorrhoids. On the other hand it is a familiar fact that when from any cause bile enters the stomach from the intestine, it occasions loss of appetite, nausea, and even vomiting, for the reason, doubtless, that it neutralizes the acidity of the gastric juice which during healthy digestion is always strongly acid. In this way probably it may impair or wholly prevent the gastric digestion of starchy food. There is no physiological probability, nor any clinical evidence to show, that bile, however introduced into the stomach, can promote in any way the digestion of food in that organ. That when administered medicinally it may, on reaching the duodenum, reinforce the action of the bile secreted there, is indeed probable. When the latter secretion, therefore, is deficient, it may tend to prevent the fermentative and putrefactive decomposition of the food, aid in the solution of its fatty constituents, promote the peristaltic action of the intestine, and, in a sufficient dose, provoke purgation.

Medical Uses.—Ox-gall (or pig-gall, which is supposed to be more analogous to human bile) is thought to be an efficient remedy for habitual *constipation* depending upon atony of the intestine. After its use the bowel is not so apt to become torpid as after the use of ordinary purgatives. It is, perhaps, of some interest to note that the medicine which most nearly resembles it in this respect is aloes, which, like bile, is very bitter and tends to irritate the rectum. The *dyspeptic* derangements which are apt to attend constipation, and which often depend upon a distended colon compressing the liver or its ducts, usually subside under purgation of any kind. It is very doubtful if ox-gall exhibits any of the special virtues which have been attributed to it under these circumstances. In *jaundice* depending upon catarrh of the bile-ducts, this medicine is sometimes found advantageous, probably in virtue both of its purgative operation and of its supplying for duodenal digestion the agent which the liver fails to secrete. The objection to its use, that it will be absorbed into the blood already overcharged with bile, is more specious than sound. Bile has been used as a *vermifuge* for lumbricoid ascarides. As a topical remedy it has been applied with alleged success to the treatment of various *glandular* hypertrophies and indurations; but the method has not been accepted.

The administration of bile in a liquid state is too disgusting to be recommended. It may be given in the form of inspissated bile, as directed to be prepared by the British Pharmacopœia. Five grains of this preparation are estimated to be equal to one hundred grains of fresh bile. It may be made into pills coated with gelatin, or inclosed in gelatin capsules. If taken after meals, this coating delays the escape of the bile until the food is ready to pass into the pylorus. About ten grains may be given at a dose.

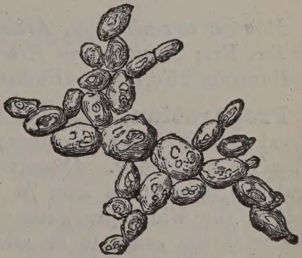
FERMENTUM, *U. S.*—YEAST.

Cerevisiæ fermentum, *Br.*—*Beer yeast*, E.; *Levûre de bière*, Fr.; *Bierhefe*, G.

The ferment obtained in brewing beer.

Origin and Description.—It has been previously stated (see *Alcohol*, p. 119) that alcoholic fermentation depends upon the development of a minute fungoid vegetable, *Torula cerevisiæ*, Turpin, which has also been named *Mycoderma cerevisiæ*, Desmaz., *Saccharomyces vini et cerevisiæ*, Schwann and Meyen, and *Cryptococcus fermentum*, Kützing. This constitutes principally the *brewer's yeast*, of which there are two varieties, the *upper* or *top yeast* (Oberhefe of the Germans), and the *lower* or *bottom yeast* (Unterhefe, *Germ.*). The former is the kind most generally met with in the United States, and is a viscid, semifluid, frothy mass, containing large more or less globular microscopic cells from which smaller ones are developed; it appears upon the surface of the fermenting liquid, and is reproduced therein at a temperature ranging between about 15° and 20° C. (59° and 68° F.). But wort fermented with top yeast at a temperature near or below 10° C. (50° F.) will produce both top and bottom yeast, the latter being solely reproduced by the fermentation from below (Untergährung, *Germ.*) at a temperature of about 9° C. (48° F.) and less. It consists of various sized cells differing from those of the top yeast in not having any small cells attached, and appears to be reproduced from isolated spores, while the

Fig. 71.



Yeast Cells.

other variety multiplies by budding. The cell membrane consists of a kind of cellulose, and the contents of a protein compound analogous to albumen.

When heated to the boiling point of water the yeast plant is killed; but, after expressing from it the water, it may be kept in the dry state without losing its vitality, and forms the *dry yeast* of commerce. *Vienna yeast* is the same article, and is stated by Dr. Vigla (1871) to be made by fermenting a wort obtained from a mixture of maize and rye with barley malt, skimming off the froth, draining and subjecting it to pressure. So-called *artificial* or *patent yeast* is either made of flour dough, with the addition of a little yeast, or of an infusion of hops to which malt is subsequently added. The existence in hops of a ferment, as asserted by Sacc (1875), was denied by Soxlet and Pasteur (1876), who proved that the only effect of hops, when used as stated above, is to impart some bitterness to the mass and somewhat delay the spoiling of the product.

When yeast is added to a solution of pure sugar, active fermentation takes place, the yeast being gradually rendered inert; but in the presence of albuminous matters in the saccharine liquid, the yeast plant is continually reproduced and augmented.

Some investigators have assumed the presence in yeast of a peculiar fermenting principle, *invertin*, which is prepared by Barth (1878), by expressing the water from yeast, drying it completely, heating for 6 hours to between 100° and 105° C. (212° and 221° F.), macerating with water at 40° C. (122° F.), and pouring the filtrate into six times its bulk of alcohol. The precipitate consists of the ferment and albumen, of which the latter is rendered insoluble by prolonged treatment with strong alcohol. Invertin is then dissolved by water, the solution precipitated by alcohol, and the precipitate dried, when it constitutes a brown horn-like mass, which is reduced to powder with difficulty.

Medical Action and Uses.—Yeast is generally described as nutritive and antiseptic. The former it can be only in a slight degree, from the fermented malt liquor which may be mixed with it. It is antiseptic through the carbonic acid which it evolves. There is no doubt that it has appeared to be serviceable in the *typhoid states* of febrile diseases, and that it really is so when applied as a dressing to *gangrenous* and *phagadenic sores*, whose fetor it corrects while it stimulates the nutritive processes in the affected tissues. That its action is a stimulant one is shown by the pain it sometimes causes, and by its popular use in the treatment of recent *bruises*. Through its carbonic acid it must also be anodyne. The power of yeast to convert starch directly into alcohol has been invoked in the treatment of *diabetes*, and in some cases has caused the entire disappearance of sugar from the urine. Some of the patients showed signs of alcoholic intoxication while undergoing this treatment. The yeast may be given in doses of two tablespoonfuls immediately before meals. It has also been used in *scurvy*.

FERRI ARSENIAS, *Br.*—ARSENIATE OF IRON.

Ferrum arsenicicum, Arsenias ferrosus.—Ferrous arseniate, E.; *Arséniate de fer*, Fr.; *Arsensaures Eisen*, G.

Formula $2Fe_3As_2O_8.4FeAsO_4.Fe_2O_3.32H_2O$. Molecular weight 2428.

Preparation.—Take of Sulphate of Iron nine ounces; Arseniate of Soda dried at 300° F. four ounces; Acetate of Soda three ounces; Boiling Distilled Water a sufficiency. Dissolve the arseniate and acetate of soda in two pints, and the sulphate of iron in three pints of the water, mix the two solutions, collect the white precipitate which forms, on a calico filter, and wash until the washings cease to be affected by a dilute solution of chloride of barium. Squeeze the washed precipitate between folds of strong linen in a screw press, and dry it on porous bricks in a warm air-chamber, whose temperature shall not exceed 100° F. *Br.*

On mixing solutions of ferrous sulphate and the officinal disodium arseniate, a white precipitate takes place, which is a mixture of ferrous arseniate ($Fe_3As_2O_8$), and ferrous hydrarseniate ($Fe_2H_4As_2O_8$). In the presence of sodium acetate, however, only the former is precipitated, and free acetic acid is found in the liquid besides sulphate of sodium. The reaction occurs as follows: $3FeSO_4 + 2Na_2HAsO_4 + 2NaC_2H_3O_2 = Fe_3As_2O_8 + 2HC_2H_3O_2 + 3Na_2SO_4$. The white precipitate is very bulky, and while being washed to free it from the mother-liquor and dried, it is oxidized and converted into ferroso-ferric arseniate of the formula given above. The change is indicated by the gradual disappearance of the white color until the salt finally becomes blue-green. In the reaction and final result the process corresponds nearly with the one for the officinal phosphate of iron.

Properties.—Arseniate of iron is a green or blue-green amorphous powder, insoluble in water and alcohol, but dissolving readily in dilute muriatic acid, yielding a bright yellow solution, in which blue precipitates are produced with both ferrocyanide and ferridcyanide of potassium, and which yields with sulphuretted hydrogen first a milkiness (sulphur) and afterwards a yellow precipitate of sulphide of arsenic. It contains nearly 24 per cent. of water, most of which is expelled when heated to 100° C. (212° F.). If the heat is increased a crystalline sublimate of arsenious acid is obtained. It may be distinguished from phosphate of iron, which resembles it in appearance, by boiling a small portion with an excess of caustic soda, filtering and neutralizing exactly with nitric acid, when a brick-red precipitate of arseniate of silver will be produced on the addition of silver nitrate. Phosphate of iron, similarly treated, yields a yellow precipitate. To determine the amount of ferrous salt, which theoretically corresponds to 17.94 per cent. of ferrous oxide, the British Pharmacopœia directs the dissolving of 20 grains in an excess of diluted hydrochloric acid, and adding thereto, gradually, volumetric solution of bichromate of potash, until a drop of the acid solution ceases to give a blue precipitate with potassium ferridcyanide; at least 170 grain measures of the test solution are required for the purpose, indicating 18 per cent. of FeO.

Medical Action and Uses.—It is difficult to conjecture on what grounds this compound was made officinal, since the proportion of iron contained in $\frac{1}{16}$ gr., the dose of it recommended, is too inconsiderable to have any curative action. Iron and arsenic are, both of them, medicines the dose of which must vary greatly and frequently with the nature of the disease and the special condition of the patient, and it is to be preferred that they should be given separately. To any liquid preparation of iron the solution of potassium arsenite may be added at the time of administration. The arseniate of iron is recommended to be given in a pill and in the *dose* of one-twentieth of a grain, gradually increased to half a grain.

FERRI BROMIDUM.—Bromide of Iron.

Brômure ferreux, Fr.; *Eisenbromür*, G.

Formula $FeBr_2$. Molecular weight 216.

Preparation and Properties.—It is prepared by gradually adding 2 parts of bromine to 1 part of iron filings or wire, contained under water, and digesting until the liquid has a greenish color, when it is filtered and evaporated in an iron dish to dryness. It forms a grayish-black mass which, on exposure to air, acquires a brown color through oxidation. On being heated to redness in contact with the atmosphere, it is converted into ferric oxide and ferric bromide, the latter subliming in yellow scales. An aqueous solution of bromide of iron, preserved by sugar, has been proposed as a convenient preparation. W. S. Thompson (1870) gives the following formula for *syrup. ferri bromidi:*—

To 5 fluidounces of water, contained in a pint flask, add 540 grains of bromine, and 270 grains of card teeth, the latter in small quantities, so as to prevent violent reaction, digest until the color has changed to green, filter into a bottle containing 10 troyounces of sugar, and wash the filter with water to make a pint of syrup. A fluidrachm contains rather more than 5½ grains of ferrous bromide.

Physiological Action and Medical Uses.—Five grains of this substance dissolved in two drachms of water and injected into a dog's jugular vein, occasioned dilated pupils, spasmodic twitching, and death in ten minutes; ten grains introduced in the same manner produced general tetanic spasm, in which the animal died. In both cases the veins were engorged, the heart was distended with coagula, and its irritability was very faint. Half a drachm thrown into the stomach brought on violent vomiting, dilatation of the pupils, rapid pulse and respiration, and diarrhœa with dark stools. Signs of inflammation were found in the lungs and stomach.

It is somewhat singular that two agents so physiologically antagonistic as iron and bromine should have been united in the same medicine, since the one tends to produce what the other is employed to subdue. Practically, however, the bromine of the compound is its only active element, as may be inferred from the experiments just related. This preparation has been recommended as an energetic astringent and anti-strumous medicine, and has been prescribed in hypertrophy of the heart and uterus, for scrofulous glandular swellings, both topically and internally, in leucorrhœa, hysteria, and pulmonary phthisis. There is not the slightest evidence of its ever having been useful as a medicine; and, as it is dangerously poisonous, it ought never to be used internally.

FERRI CARBONAS SACCHARATA, *Br.*—SACCHARATED CARBONATE OF IRON.

Ferrum carbonicum saccharatum, P. G.; *Carbonas ferrosus saccharatus.*—*Saccharure de proto-carbonate de fer* (*de carbonate ferreux*), Fr.; *Zuckerhaltiges Kohlensaures Eisen*, G.

Formula of the carbonate $FeCO_3.H_2O$. Molecular weight 134.

The mixture of ferrous carbonate with sugar contains 37 per cent. (20 per cent., *P. G.*) of carbonate of iron, *Br.*

Preparation.—Take of Sulphate of Iron two ounces; Carbonate of Ammonia one and a quarter ounce; Boiling Distilled Water two gallons; Refined Sugar one ounce. Dissolve the sulphate of iron and the carbonate of ammonia each in half a gallon of the water, and mix the two solutions with brisk stirring in a deep cylindrical vessel, which is then to be covered as accurately as possible. Set the mixture by for twenty-four hours, and from the precipitate, which has subsided, separate the supernatant solution by a siphon. Pour on the remainder of the water, stir well, and, after subsidence, again remove the clear solution. Collect the resulting carbonate on a calico filter, and, having first subjected it to expression, rub it with the sugar in a porcelain mortar. Finally dry the mixture at a temperature not exceeding 212° F. *Br.*

Ferrous sulphate and ammonium carbonate decompose each other, forming ferrous carbonate and ammonium sulphate, thus: $FeSO_4+(NH_4)_2CO_3=FeCO_3+(NH_4)_2SO_4$. The operation must be performed with the air as much excluded as possible; hence the importance of employing boiling water from which the air has been expelled, of performing the washing by decantation in deep cylindrical and well-covered vessels, and of collecting and expressing the precipitate rapidly; the subsequent addition of the sugar will, in a measure, protect it against oxidation until it has been finally dried.

Properties.—It forms small lumps, or a gray or greenish-gray powder, having a sweet taste like that of sugar, followed by a very feeble chalybeate taste. When heated in contact with the air, it becomes black, evolving the odor of burning sugar, and is finally converted into red-brown ferric oxide. It dissolves with effervescence in dilute hydrochloric acid, and this solution gives a blue precipitate with potassium ferridcyanide (ferrous salt), and should yield not any or but a very slight white precipitate with chloride of barium, indicating only traces of sulphate left behind from the mother liquor. The pure ferrous carbonate represents 53.7 per cent of ferrous oxide; if no oxidation has taken place, the saccharated carbonate will contain 26 per cent. of ferrous oxide, or 48.5 per cent. of ferrous carbonate. The Pharmacopœia, however, requires less, since the solution of 20 grains in an excess of hydrochloric acid must give a blue precipitate with red prussiate of potassium until only 210 grain measures of the volumetric solution of bichromate of potassium have been used, indicating only 37 per cent. of ferrous carbonate, the remainder having been oxidized.

Off. Prep.—Pilula ferri carbonatis, *Br.*

Medical Action and Uses.—There is no essential difference between the medicinal effects of this preparation and of the subcarbonate of iron, U. S. P. It may be given in the *dose* of from five to twenty grains, after meals.

FERRI CHLORIDUM, *U. S.*—CHLORIDE OF IRON.

Ferrum sesquichloratum, P. G.; *Ferrum muriaticum oxydatum, Chloridum vel Chloruretum ferricum, Ferri perchloridum.—Sesquichloride* (*Perchloride*) *of iron, Ferric chloride*, E.; *Perchlorure de fer, Chlorure ferrique*, Fr.; *Eisenchlorid*, G.

Formula $Fe_2Cl_6.12H_2O$. Molecular weight 541.

Preparation.—Take of Iron in the form of wire and cut in pieces two troyounces; Muriatic Acid twelve troyounces; Nitric Acid a troyounce, or a sufficient quantity. Add the iron to eight troyounces of the muriatic acid, contained in a two-pint flask, and apply a gentle heat until the acid is saturated, and effervescence has ceased. Filter the solution, add to it the remainder of the muriatic acid, heat the mixture nearly to the boiling point, in a four-pint porcelain capsule, and add nitric acid in successive portions until red fumes are no longer evolved, and a drop of the liquid ceases to yield a blue precipitate with ferridcyanide of potassium. Transfer the liquid to a smaller capsule, evaporate it by a gentle heat, on a sand-bath, until reduced to eight troyounces and three hundred and sixty grains, and set aside the residue, covered with glass, until it forms a solid, crystalline mass. Lastly, break this into pieces, and keep the fragments in a well-stopped bottle protected from the light. *U. S.*

In making this officinal salt, about 10 or 15 grains more of iron are advantageously used to facilitate the saturation of the 8 troyounces of muriatic acid; the metal in combining with the chlorine of the acid will produce ferrous chloride $FeCl_2$, hydrogen being given off. The liquid should be passed through a paper filter, and the filtrate at once mixed with the remaining hydrochloric acid, to prevent the deposition of ferric oxychloride, which would be formed by the oxidizing influence of the atmospheric air. When the mixture has been heated to near boiling, the nitric acid is poured in small portions down the side of the porcelain capsule, and the mixture continually stirred. The extrication of the red vapors causes the liquid to froth considerably, hence the necessity of using a capsule holding at least three times the measure of the liquid. Diehl (1867) prefers to heat about three-fourths of the nitric acid, and to add to it gradually the hot mixture of ferrous chloride and muriatic acid, afterwards more nitric acid as required ; frothing is avoided by this manipulation. The object of this part of the process is to transform the ferrous into ferric chloride ; the muriatic and nitric acids react upon each other, with the production of chlorine which unites with the ferrous chloride, and of nitric oxide which escapes, water being formed at the same time, according to the equation $6FeCl_2+6HCl+2HNO_3=3Fe_2Cl_6+2NO+4H_2O$. The liquid should now be tested for ferrous salt by placing a drop upon a porcelain plate, and adding a drop of freshly dissolved potassium ferridcyanide. If a blue color or precipitate is produced, a little more nitric acid is required. Should the brown color be merely darkened, the iron has been all oxidized ; but there may be an excess of nitric acid, which is detected by placing a drop of it upon a plate in contact with a little ferrous sulphate, and adding a drop of strong sulphuric acid. The production of a black color indicates the presence of free nitric acid, which cannot be completely removed by boiling, but requires the addition of a little hydrochloric acid and the application of heat to expel the nitric oxide and chlorine formed until no more nitric acid is shown by the test. During this and the subsequent operation the use of iron spatulas or stirrers must be carefully avoided ; only porcelain or glass should be used.

On evaporating a solution of ferric chloride to the crystallizing point, acid vapors containing muriatic acid are given off, and if the heat is raised to the boiling point, ferric chloride is mechanically carried off. The Pharmacopœia endeavors to avoid this by directing a gentle heat for evaporating the liquid. It will, however, be found of advantage to add about one or two drachms of muriatic acid at the beginning of the evaporation. If this acid has been of the officinal strength, about 9½ troyounces of crystallized ferric chloride will be finally obtained. The crystallization may be effected by keeping the capsule in a warm place until the contents solidify ; but the crystals will then be very damp from inclosed moisture. It is by far better to follow the directions of the Pharmacopœia, and evaporate to less than the weight of the expected salt ; on cooling, the mass will now remain liquid, and is set aside loosely covered, to protect it from dust and other impurities, and at the same time to admit the atmosphere, from which it will attract moisture and gradually crystallize. The crystals begin to form as small circular nodules, having a radiated appearance, floating upon the liquid, and increasing in size until the entire liquid forms a solid mass, which adheres firmly to the vessel. By warming it slightly, the mass is readily detached, at once broken into pieces, and put into dry well-stopped bottles.

Properties.—The officinal ferric chloride forms orange-colored, wart-like pieces, which have a crystalline texture, are very deliquescent, and readily and completely soluble in water, alcohol, and ether, yielding yellowish-brown solutions of an acid reaction, and a strongly ferruginous taste. The crystals fuse, according to Ordway, at 35.5° C. (96° F.); at a higher temperature they are partly decomposed and volatilized.

Impurities.—The presence of nitric acid or of ferrous salt is detected as described above; the complete solubility in the menstrua mentioned is generally an indication of the absence of other metallic salts. A solution of the chloride in water should not be precipitated by barium chloride (absence of sulphate), and when precipitated by an excess of ammonia, the filtrate, on evaporation to dryness, should leave only ammonium chloride, which is completely volatilized at a red heat (absence of alkalies, alkaline earths, zinc, etc.). Copper, if present, is detected by the black precipitate formed by the aqueous solution with sulphuretted hydrogen.

Medical Action and Uses.—Chloride of iron is a powerful astringent and hæmostatic. Its chief uses consist of its applications for stanching *hemorrhage*, as in epistaxis, in hæmotopsis (by inhaling an atomized solution), in bleeding from leech-bites, from the jaw after the extraction of teeth, from the tonsils, from ulceration of the neck of the uterus, from the umbilical cord, from the uterus during and subsequent to abortion, from fungous tumors of various parts, etc. It has also been used in the form of a solution containing one part of "liquor ferri perchloridi fortior," B. P., to three parts of water, and injected into the uterus to control hemorrhage after labor. One pint and a half of the mixture is recommended to be very slowly thrown into the uterus after all clots have been removed. Very many cases in which this method has arrested hemorrhage abruptly are on record, and no doubt can be entertained of its efficacy; but grave apprehensions have arisen respecting its adoption as a general method. It would seem doubtful whether it tends very actively to promote uterine contractions, which must be the chief source of permanent safety in hemorrhage *post-partum*. There is much reason to think that by permitting the retention of coagula in the uterus, a great danger exists of septicæmia from their decomposition. The better opinion seems to be that when such hæmostatics as ergot and ice have failed to arrest the flow, the solution of chloride of iron may be used; but that the clots formed by it should be removed before the products of their decomposition can have had time to affect the system.

Varicose aneurisms have been treated successfully by injections of a solution of chloride of iron; but sudden death having occurred in several instances, the operation can no longer be regarded as warrantable. In regard to other aneurisms, the results have been such that "no prudent surgeon would expose his patient to so disastrous a mode of treatment." It has also been used, apparently without accident, to cure varicose veins, the precaution being taken to compress the vein above and below the puncture.

Chloride of iron, if kept in a bottle, gradually deliquesces, and may be applied with a glass rod or brush. As a hæmostatic, five parts of the chloride may be dissolved in one hundred parts of distilled water, and applied on lint.

FERRI CITRAS, *U. S.*—CITRATE OF IRON.

Ferrum citricum oxydatum, P. G.; *Citras ferricus.—Ferric citrate*, E.; *Citrate de sesquioxyde de fer*, *Citrate ferrique*, Fr.; *Citronensaures Eisenoxyd*, *Eisencitrat*, *G.*

Formula $F_2 2C_6H_5O_7$. Molecular weight 490.

Preparation.—Take of Solution of Citrate of Iron a convenient quantity. Evaporate the solution at a temperature not exceeding 140° F., to the consistence of syrup, and spread it on plates of glass, so that, on drying, the salt may be obtained in scales. *U. S.*

At a higher temperature than indicated by the formula, the salt is slowly reduced to ferrous citrate. When the solution is concentrated to a thick, syrupy liquid, it is spread on plates, and then dried in a dry or warm place. Failure in scaling is usually due to the incomplete saturation of the citric acid with ferric hydrate, occasionally to the presence of saline impurities retained by the negligently washed hydrate.

Properties.—If of the proper composition it readily comes off the plates in the form of thin, garnet-red scales, which yield a red-brown powder. The dry salt was found by Wittstein to yield on ignition 29.5 to 30 per cent. of iron. It is slowly soluble in cold water, more easily and completely in boiling water. It is not precipitated by ammonia, and is not liable to adulteration. The presence of tartaric acid would be detected by acidulating the solution with a few drops of hydrochloric acid, and then adding some potassium acetate, when cream of tartar would be precipitated.

Ammonio-citrate of iron is sometimes sold as *soluble citrate of iron;* it resembles the former in appearance and behavior, except that it is more readily soluble in cold water, gives off the odor of ammonia when heated with an excess of potassa solution, and does not strike a blue color on mixing its solution with potassium ferrocyanide, unless it be acidulated with muriatic acid.

Medical Uses.—It is a mild preparation, and suitable for children and persons of delicate stomach. It should be given in watery solution, and in the *dose* of from five to twenty grains.

FERRI ET AMMONII CITRAS, *U. S.*—CITRATE OF IRON AND AMMONIUM.

Ferri et ammoniæ citras, Br.; *Ferrum citricum ammoniatum*, P. G.; *Ferri ammonio-citras*, *Ferro-ammonium citricum.*—*Ammonio-citrate of iron*, *Soluble citrate of iron*, E.; *Citrate de fer et d'ammoniaque* (*de fer ammoniacal*), *Citrate ferrique ammoniacal*, Fr.; *Citronensaures Eisenoxyd-Ammonium* (*Ammoniak*), G.

Preparation.—Take of Solution of Citrate of Iron a pint; Water of Ammonia six fluidounces. Mix the solution of citrate of iron with the water of ammonia, evaporate the mixture at a temperature not exceeding 140° F. to the consistence of syrup, and spread it on plates of glass, so that, on drying, the salt may be obtained in scales. *U. S.*

Take of Solution of Persulphate of Iron eight fluidounces; Solution of Ammonia nineteen and a half fluidounces; Citric Acid four ounces; Distilled Water a sufficiency. Mix fourteen fluidounces of the solution of ammonia with two pints of distilled water, and to this add gradually the solution of persulphate of iron, previously diluted with two pints of distilled water, stirring them constantly and briskly. Let the mixture stand for two hours, stirring it occasionally; then put it on a calico filter, and, when the liquid has drained away, wash the precipitate with distilled water until that which passes through the filter ceases to give a precipitate with chloride of barium. Dissolve the citric acid in eight ounces of distilled water, and, having applied the heat of a water-bath, add the oxide of iron, previously well drained, and stir them together until the whole or nearly the whole of the oxide has dissolved. Let the solution cool; then add five and a half fluidounces of solution of ammonia. Filter through flannel, evaporate to the consistence of syrup, and dry it in thin layers on flat porcelain or glass plates at a temperature not exceeding 100° F. Remove the dry salt in flakes, and keep it in a stoppered bottle. *Br.*

The second formula requires the preparation of hydrate of iron by decomposing ferric sulphate with ammonia. It is washed and then dissolved in citric acid to obtain a solution of ferric citrate, which, without being filtered, is mixed with ammonia. The turbid liquid at once becomes deeper colored, and is filtered and concentrated. The United States Pharmacopœia, recognizing a solution of ferric citrate, simply requires it to be mixed with ammonia and concentrated.

Properties.—The salt closely resembles citrate of iron in appearance and behavior, except as stated on page 615. Impurities, if present, may be determined in the same manner. The British Pharmacopœia requires it to yield on ignition not less than 27 per cent. of ferric oxide. Being made from normal ferric citrate with the addition of ammonia, it is probably a mixture or compound of ammonio-ferric citrate with ferric oxycitrate. The German Pharmacopœia attempts to obtain a double salt by mixing solutions of ferric citrate and ammonium citrate.

Off. Prep.—Ferri et strychniæ citras, *U. S.;* Vinum ferri citratis, *Br.*

Medical Uses.—The advantages of an iron salt containing ammonia are more than contestable upon theoretical grounds, and there is no evidence of its special value. The addition to a solution of the salt of a solution of citric acid causes effervescence. The *dose* is five or more grains.

FERRI ET AMMONII SULPHAS, *U. S.*—SULPHATE OF IRON AND AMMONIUM.

Ferrum sulfuricum oxydatum ammoniatum, P. G.; *Ferrum ammonio-sulphuricum, Ferri ammonio-sulphas, Sulphas ammonico-ferricus.—Ammonio-ferric alum*, E.; *Sulfate de fer et d'ammoniaque, Sulfate de fer (ferrique) ammoniacal, Alun de fer ammoniacal*, Fr.; *Schwefelsaures Eisenoxyd-Ammonium, Ammoniakalischer Eisenalaun*, G.

Formula $(NH_4)Fe(SO_4)_2.12H_2O$. Molecular weight 482.

Preparation.—Take of Solution of Tersulphate of Iron two pints; Sulphate of Ammonium four troyounces and a half. Heat the solution of tersulphate of iron to the boiling point, add the sulphate of ammonium, stirring until it is dissolved, and set the liquid aside to crystallize. Wash the crystals quickly with very cold water, wrap them in bibulous paper, and dry them in the open air. *U. S.*

On dissolving the ammonium sulphate in the liquid with the aid of heat, a double salt is formed which crystallizes on cooling; the mother liquor will yield another crop of crystals on being concentrated to about one-half. If the solution of ferric sulphate happens to be slightly deficient in acid, the crystals may be of an unsightly appearance; they should then be redissolved in the mother liquor by heat, and a small quantity of sulphuric acid added before crystallizing.

Properties and Tests.—It crystallizes like alum in regular octohedrons, which are colorless or of a pale amethyst or violet color, a strongly astringent taste, and somewhat efflorescent on exposure. At 15° C. (59° F.) the salt requires 3 parts, and at the boiling temperature less than its own weight of water for solution. The aqueous solution has an acid reaction, and shows the chemical reactions of ferric salts, sulphuric acid, and ammonia. Boiled with an excess of potassa solution ammonia is liberated, ferric hydrate is deposited, and the alkaline filtrate neutralized with hydrochloric acid, and again rendered alkaline by ammonia, does not yield a white gelatinous precipitate of aluminium hydrate.

Medical Action and Uses.—Like most of the compounds of sulphuric acid with metals this one is astringent, but its astringency appears to be modified by the ammonia in its composition. It may be advantageously used in chronic *mucous fluxes* of the bowels, vagina, and bronchia, when these affections are prolonged by a general feebleness and relaxation of the tissues. *Dose*, from five to fifteen grains.

FERRI ET AMMONII TARTRAS, *U. S.*—TARTRATE OF IRON AND AMMONIUM.

Ferri ammonio-tartras.—Ammonio-tartrate of iron, E.; *Tartrate de fer et d'ammoniaque, Tartrate ferrique ammoniacal*, Fr.; *Weinsaures Eisenoxyd-Ammonium*, G.

Formula $Fe_2(NH_4)_2 4C_4H_4O_6.5H_2O$. Molecular weight 542.

Preparation.—Take of Tartaric Acid twelve troyounces; Solution of Tersulphate of Iron two pints and a half; Carbonate of Ammonium, Distilled Water, each a sufficient quantity. Dissolve six troyounces of the tartaric acid in two pints of distilled water, and neutralize it carefully by means of carbonate of ammonium; then add the remainder of the acid, dissolved in half a pint of distilled water, and mix the solutions. With the solution of tersulphate of iron, prepare the hydrated oxide of iron according to the formula for that substance, and add it gradually to the solution of bitartrate of ammonium, kept at the temperature of 140° F., until it is no longer dissolved. Then filter the solution, and evaporate, at a temperature not exceeding 140° F., to the consistence of syrup. Lastly, spread it on plates of glass, so that the salt, when it is dry, may be obtained in scales. *U. S.*

This formula is essentially that suggested by Prof. Procter (1841). By neutralizing one-half of the tartaric acid with ammonium carbonate, ammonium tartrate is formed, which is converted into the acid salt by the addition of the reserved tartaric acid. By digesting this with ferric hydrate a solution of the officinal salt is obtained, which, by careful evaporation and drying upon plates, yields it in scales.

Properties and Tests.—It is in transparent garnet-red scales, of a sweetish and slightly ferruginous taste, and yields a rust-colored powder. When heated it gives off water and ammonia, is then charred with the odor of burning sugar, and finally leaves 29 per cent. of ferric oxide, which amount corresponds with the formula given above. It is very probable, however, that compounds of somewhat different composition may be formed by the officinal process. The salt is not soluble in alcohol or ether, but dissolves slowly and freely in glycerin and water. The latter solution is neutral to test-paper, is not precipitated by alkalies or their carbonates, and is not colored blue by potasssium ferrocyanide unless acidulated. When acidulated with muriatic acid and mixed with potassium acetate, cream of tartar is precipitated.

Medical Uses.—The only advantage of this salt is the one it shares with the ammonium salts, viz., that of great solubility. In proportion to its bulk, like them also, it contains but little iron. Its *dose* is from ten to thirty grains.

FERRI ET POTASSII TARTRAS, *U. S.*—TARTRATE OF IRON AND POTASSIUM.

Ferrum tartaratum, Br.; *Tartarus ferratus*, P. G.; *Ferri potassio-tartras, Ferrum tartarizatum, Tartras ferrico-potassicus, s. potassico-ferricus, s. ferrico-kalicus.*—*Tartarated (tartarized) iron, Ferro-tartrate of potassium*, E.; *Tartrate de fer et de potasse, Tartrate ferrico-potassique, Tartre chalybé, Tartre martial*, Fr.; *Weinsaures Eisenoxyd-Kali, Eisenweinstein*, G.

Formula $K_6Fe_2 6C_4H_4O_6$. Molecular weight 1234.

Preparation.—Take of Solution of Tersulphate of Iron a pint; Bitartrate of Potassium seven troyounces; Distilled Water four pints. From the solution of tersulphate of iron prepare the hydrated oxide of iron according to the formula for that substance. Mix the bitartrate of potassium with the distilled water, heat the mixture to 140° F., and keeping it at that temperature, gradually add the hydrated oxide, frequently stirring, until it ceases to be dissolved. Then filter the solution, evaporate it by means of a water-bath, at a temperature not exceeding 140° F., to the consistence of syrup, and spread it upon plates of glass or porcelain, so that when it is dry the salt may be obtained in scales. *U. S.*

The formula of the British Pharmacopœia is like the above, the proportions used being solution of persulphate of iron 5½ fluidounces, solution of ammonia, 10 fluidounces, and acid tartrate of potassium 2 ounces. As in the preceding case, ferric hydrate is first formed, and this is used for saturating the potassium salt. A salt of the above formula is probably first formed, which would yield somewhat over 12 per cent. of ferric oxide; the British Pharmacopœia requires 15; and Soubeiran and Capitaine obtained even 30.8 per cent. of ferric oxide. It is likely that different basic compounds may be formed by prolonged digestion.

Properties.—In its physical properties, as well as in its behavior to solvents, alkalies, and potassium ferrocyanide, it resembles tartrate of iron and ammonium, from which it differs in not giving off ammonia when heated, and, when incinerated, in leaving an ash which has an alkaline reaction to test-paper, and effervesces on the addition of muriatic acid.

TARTARUS FERRATUS, *P. G.*, *s. Ferro-kali tartaricum s. Tartarus martiatus*, is made by digesting 1 part of iron filings and 5 parts of commercial cream of tartar with water until a small portion of it is found to be almost wholly soluble in water when it is dried and powdered. It is a dirty-greenish powder, gradually turning brown, and is almost wholly soluble in 16 parts of cold water. It is a purer potassio-ferrous tartrate, than the *Globuli martiales s. Glob. tartari ferruginosi*, formerly officinal, which preparation, made in the same manner with crude tartar, and formed into balls, with the aid of a little gum-arabic, was known by the name of *steelballs* (*Stahlkugeln*).

Medical Uses.—This salt is one of the richest in iron, the most agreeable to the taste, the least irritating to the bowels and oppressive to the stomach, and the least apt to occasion constipation, of all the soluble ferruginous preparations. *Dose*, from five to twenty grains three times a day, before meals.

FERRI ET QUINIÆ CITRAS, *U. S.*, *Br.*—CITRATE OF IRON AND QUINIA.

Chininum ferro-citricum, P. G.; *Citras ferrico-quinicus.*—*Citrate de fer et de quinine*, Fr.; *Citronensaures Eisen-Chinin*, G.

Preparation.—Take of Solution of Citrate of Iron ten fluidounces; Sulphate of Quinia a troyounce; Diluted Sulphuric Acid, Water of Ammonia, Distilled Water, each a sufficient quantity. Triturate the sulphate of quinia with six fluidounces of distilled water, and, having added sufficient diluted sulphuric acid to dissolve it, cautiously pour in the solution water of ammonia, with constant stirring, until in slight excess. Wash the precipitated quinia on a filter, and, having added it to the solution of citrate of iron, maintained at the temperature of 120° F. by means of a water-bath, stir constantly until it is dissolved. Lastly, evaporate the solution, at a temperature not exceeding 140° F., to the consistence of syrup, and spread it on plates of glass, so that the salt when it is dry may be obtained in scales. *U. S.*

Take of Solution of Persulphate of Iron four and a half fluidounces; Sulphate of Quinia one ounce; Diluted Sulphuric Acid twelve fluidrachms; Citric Acid three ounces; Solution of Ammonia, Distilled Water, of each a sufficiency. Mix eight fluidounces of the solution of ammonia with two pints of distilled water, and to this add the solution of persulphate of iron previously diluted with two pints of distilled water, stirring them constantly and briskly. Let the mixture stand for two hours, stirring it occasionally, then put it on a calico filter, and when the liquid has drained away, wash the precipitate with distilled water until that which passes through the filter ceases to give a precipitate with chloride of barium. Mix the sulphate of quinia with eight ounces of distilled water, add the diluted sulphuric acid, and when the salt is dissolved precipitate the quinia with a slight excess of solution of ammonia. Collect the precipitate on a filter and wash it with a pint and a half of distilled water. Dissolve the citric acid in five ounces of distilled water, and, having applied the heat of a water-bath, add the oxide of iron previously well drained; stir them together, and when the oxide has dissolved, add the precipitated quinia, continuing the agitation until this also has dissolved. Let the solution cool, then add in small quantities at a time twelve fluidrachms of solution of ammonia diluted with two fluidounces of distilled water, stirring the solution briskly, and allowing the quinia which separates with each addition of ammonia to dissolve before the next addition is made. Filter the solution, evaporate it to the consistence of a thin syrup, then dry it in thin layers on flat porcelain or glass plates at a temperature of 100° F. Remove the dry salt in flakes, and keep it in a stoppered bottle. *Br.*

The process of the U. S. Pharmacopœia consists simply in dissolving freshly precipitated quinia in solution of ferric citrate. The apparently complicated process of the British Pharmacopœia is in its first part essentially the same, ferric hydrate and afterwards quinia being dissolved in citric acid; but it differs very materially in the subsequent addition of ammonia and in the formation of ammonium citrate by which the physical properties of the resulting scales are changed.

The corresponding salt of the German Pharmacopœia again differs in containing, besides quinia, both ferric and ferrous salt, but no ammonia; it is made by dissolving powdered iron in citric acid, adding afterwards quinia, evaporating, and scaling.

Properties and Tests.—The product of the first process is in transparent scales, of a yellowish green-brown to reddish-brown color, varying according to their thickness. When heated to redness it leaves a brown ash free from alkaline reaction to test-paper. The salt dissolves slowly in cold, more readily in hot water, and is insoluble in alcohol and ether. The solution is slightly acid to test-paper, has a bitter and chalybeate taste, and yields with ammonia a white precipitate of quinia, with tannin a grayish-black one, consisting of the mixed tannates of iron and quinia, and a blue precipitate with potassium ferrocyanide and some muriatic acid.

The product of the British Pharmacopœia corresponds with the behavior and tests described above, except that it is readily soluble in cold water; it is of a greenish golden-yellow color, and in the air somewhat deliquescent. The Pharmacopœia tests the quality as follows: "Fifty grains dissolved in a fluidounce of water and treated with a slight excess of ammonia give a white precipitate, which, when collected on a filter and dried, weighs eight grains; the precipitate is almost entirely soluble in ether, and when burned leaves but a minute residue." It might be added, that its solution in dilute sulphuric acid shows the characteristic behavior of quinia solutions (see *Quiniæ sulphas*).

Medical Uses.—This preparation has no other demonstrable advantage over an extemporaneous union of the medicines composing it, than arises from the convenience of dispensing it. Five grains of it contain about a grain of quinia, and may be given in pill or solution, before meals.

FERRI ET STRYCHNIÆ CITRAS, *U. S.*—CITRATE OF IRON AND STRYCHNIA.

Citrate de fer et de strychnine, Fr.; *Citronensaures Eisen-Strychnin*, G.

Preparation.—Take of Citrate of Iron and Ammonium five hundred grains; Strychnia, Citric Acid, each five grains; Distilled Water nine fluidrachms. Dissolve the citrate of iron and ammonium in a fluidounce, and the strychnia together with the citric acid in a fluidrachm of the distilled water. Mix the two solutions, evaporate the mixture by means of a water-bath, at a temperature not exceeding 140° F., to the consistence of syrup, and spread it upon plates of glass, so that the salt, when it is dry, may be obtained in scales. *U. S.*

This is simply a mixture of citrate of strychnia with ammonio-ferric citrate, scaled in precisely the same manner as the other iron preparations.

Properties.—It closely resembles ammonio-citrate of iron in appearance, but differs from it in the distinctly bitter taste and in the white precipitate produced by ammonia, the precipitate being soluble in boiling alcohol, from which, if the solution is sufficiently concentrated, crystals will be obtained giving the peculiar reactions of strychnia.

Medical Uses.—This very unnecessary officinal compound may be prescribed in *doses* of one or two grains, and cautiously increased.

FERRI FERROCYANIDUM, *U. S.*—FERROCYANIDE OF IRON.

Ferri ferrocyanuretum, Ferrum ferrocyanatum (s. borussicum s. zooticum), Cyanuretum ferroso-ferricum, Cœruleum borussicum.—Ferrocyanuret of iron, Prussian blue, E.; *Ferrocganure (Prussiate, Cyanure) de fer, Bleu de Prusse (de Berlin)*, Fr.; *Ferrocyaneisen, Berliner Blau*, G.

Formula $Fe_4Fcy_3 = Fe_43Fe(CN)_6.18H_2O$. Molecular weight 1184.

Preparation.—Take of Ferrocyanide of Potassium nine troyounces; Solution of Tersulphate of Iron a pint; Water three pints. Dissolve the ferrocyanide of potassium in two pints of the water, and add the solution gradually to the solution of tersulphate of iron, previously diluted with the remainder of the water, stirring the mixture during the addition. Then filter the liquid, and wash the precipitate on the filter with boiling water until the washings pass nearly tasteless. Lastly, dry it, and rub it into powder. *U. S.*

The process is one of simple decomposition, the basylous radicals exchanging their acids, thus $3K_4Fcy + 2Fe_2(SO_4)_3 = 6K_2SO_4 + Fe_4Fcy_3$. The precipitate requires considerable washing to free it from the potassium salt, and when dried at a temperature of about 40° C. (104° F.), or less, it retains $18H_2O$ in combination, which it gradually loses at a higher temperature.

For uses in the arts, Prussian blue is made by precipitating ferrous sulphate with potassium ferrocyanide, and exposing the bluish-white precipitate to the air, or treating it with oxidizing agents until it has acquired the proper shade; the commoner varieties contain alumina and other impurities.

Properties.—Ferric ferrocyanide is in hard dark-blue masses, which exhibit upon the fresh somewhat conchoidal fracture a reddish lustre, and yield a deep-blue powder. It is tasteless, insoluble in water, alcohol, and dilute mineral acids, but yields, with oxalic acid, equal to one-sixth or upwards of its own weight, a powder which dissolves completely in water, and which has been used as *wash-blue* and *blue ink*. Commercial Prussian blue should be previously purified for this purpose by treating it with dilute muriatic or sulphuric acid, and washing it with water. Concentrated mineral acids decompose it with the liberation of hydrocyanic acid, and, when boiled with alkalies, ferric hydrate is separated and alkaline ferrocyanide dissolved.

Impurities and Adulterations.—On boiling impure Prussian blue with dilute muriatic acid, the presence of carbonates will be indicated by effervescence, and the potassium sulphate, alumina, and ferric hydrate will enter into solution. Ammonia water added to it will precipitate some of these impurities, and the filtrate may be tested for calcium by oxalic acid, or evaporated to dryness and ignited, when no residue should be left. The ammonia, if any, is evolved when boiled with potassa solution, which leaves ferric hydrate behind, and, if alumina should have been present, the clear liquid will yield a white precipitate on being neutralized with muriatic acid, and again rendered alkaline by ammonia. On incinerating Prussian blue, and treating the residue with strong muriatic acid, barium sulphate (heavy spar) will be left undissolved; and the clear acid filtrate, when diluted with water, will yield a black precipitate with sulphuretted hydrogen, should lead or allied metals have been present.

Medical Uses.—The daily *dose* of this preparation is stated by certain authorities to be from half a drachm to five drachms. It is probably inert.

FERRI HYPOPHOSPHIS, *U. S.*—HYPOPHOSPHITE OF IRON.

Ferrum hypophosphorosum, Hypophosphis ferricus.—Hypophosphite de fer, Fr.; *Unterphosphorigsaures Eisenoxyd*, G.

Formula $Fe_2 6PH_2O_2$. Molecular weight 502.

Preparation.—A solution of hypophosphite of sodium, which is free from carbonate, is added to a solution of ferric chloride or ferric sulphate, which should not contain any excess of acid. The precipitate is well washed with distilled water, and dried with a moderate heat. It is a process of double decomposition between the sodium and ferric salts. The presence of carbonate in the former would contaminate the salt with a corresponding quantity of ferric hydrate, while an excess of acid would occasion loss by preventing the ferric hypophosphite from being precipitated.

Properties.—It is a white or grayish powder, nearly tasteless, slightly soluble in water, more so in hypophosphorous acid, but freely so in muriatic acid. It is readily oxidized by nitric acid and other oxidizing agents, and when heated in the dry state evolves inflammable hydrogen phosphide, and leaves ferric pyrophosphate. Its formula is given above; it contains, in addition, water of hydration, the amount of which has not been determined.

Tests.—It should be completely soluble in dilute acetic acid, which leaves white ferric phosphate undissolved. The solution is not precipitated by oxalate of ammonium (absence of calcium salt).

Medical Action.—It is theoretically assumed to possess virtues belonging to phosphorus as well as iron, an assumption which nothing justifies. It may be given in *doses* of five or ten grains.

FERRI IODIDUM, *Br.*—IODIDE OF IRON.

Ferrum iodatum, P. G.; *Ioduretum ferrosum.—Ferrous iodide*, E.; *Iodure de fer, Iodure ferreux*, Fr.; *Eisenjodür, Jodeisen*, G.

Formula FeI_2. Molecular weight 304.

Preparation.—Take of Fine Iron one and a half ounces; Iodine three ounces; Distilled Water fifteen fluidounces. Put the iodine, iron, and twelve ounces of the water into a flask, and having heated the mixture gently for about ten minutes, raise the heat and boil until the froth becomes white. Pass the solution as quickly as possible through a wetted calico filter into a dish of polished iron, washing the filter with the remainder of the water, and boil down until a drop of the solution taken out on the end of an iron wire solidifies on cooling. The liquid should now be poured out on a porcelain dish, and, as soon as it has solidified, should be broken into fragments and inclosed in a well-stoppered bottle. *Br.*

Iodine unites with iron in the presence of water, forming a green solution of ferrous iodide which, on evaporation, is readily oxidized; hence the direction to evaporate in a polished iron dish, which, however, cannot prevent the formation of oxide, or possibly oxy-iodide of iron. The residuary salt is therefore never completely soluble in water.

Properties.—According to De Luca, pure anhydrous ferrous iodide is white and, in the presence of moisture, greenish. The British Pharmacopœia requires it to be green with a tinge of brown. By the officinal process, however, it is usually obtained as a steel-gray laminated mass, with a metallic lustre, fusing at about 177° C. (350° F.) and evolving vapors of iodine. It is deliquescent when pure, dissolves readily with a green color in water, also in glycerin and alcohol, the solution yielding a dark blue precipitate with potassium ferridcyanide, and separating iodine on the addition of a little chlorine water, when on the further addition of mucilage of starch a blue coloration will be produced.

Solid ferrous iodide is, at best, a very unsatisfactory medicinal preparation, owing to the unavoidable changes occurring under ordinary circumstances. It would be better, by far, when ferrous iodide is desired in a solid form, to evaporate a definite quantity of the officinal syrup and convert that at once into pills by the addition of some vegetable powder; or to preserve the solid salt in the manner directed by the German Pharmacopœia for *Ferrum iodatum saccharatum*, by adding to the filtered solution of the ferrous iodide five parts of sugar of milk for each part of iodine employed; then evaporating to dryness and powdering. This yields a yellowish-white powder, which gives a nearly clear solution with 7 parts of water, and contains 20 per cent. of dry ferrous iodide.

Medical Action and Uses.—They are sufficiently described under *Syrupus ferri iodidi*, the only officinal preparation, *U. S. P.*, which contains iodine and iron in combination. The *dose* of this iodide may be stated at from one to three grains three times a day. It should be prescribed in pilular form and taken after meals.

FERRI LACTAS, *U. S.*—Lactate of Iron.

Ferrum lacticum, P. G.; *Lactas ferrosus.*—*Lactate de fer*, Fr.; *Milchsaures Eisenoxydul*, *Eisenlactat*, G.

Formula $Fe2C_3H_5O_3.3H_2O$. Molecular weight 288.

Preparation.—Take of Lactic Acid a fluidounce; Iron in the form of filings half a troyounce; Distilled Water a sufficient quantity. Mix the acid with a pint of distilled water in an iron vessel, add the iron, and digest the mixture on a water-bath, supplying distilled water, from time to time, to preserve the measure. When the action has ceased, filter the solution while hot into a porcelain capsule, and set it aside to crystallize. At the end of forty-eight hours decant the liquid, wash the crystals with a little alcohol, and dry them on bibulous paper. By evaporating the mother-water in an iron vessel to one-half, filtering it while hot, and setting the liquid aside, more crystals may be obtained. *U. S.*

The iron unites directly with the acid, displacing the basylous hydrogen, the solution of ferrous lactate merely requiring to be evaporated and crystallized.

Properties.—It is a greenish-white or yellowish crystalline powder or crusts, having a sweetish and mild chalybeate taste, and containing 19 per cent. of water of crystallization. It is insoluble in cold alcohol, dissolves in 48 parts of water at 10° C. (50° F.), and in 12 parts of boiling water. On the application of heat it turns brown and black, and then, with frothing, emits white acid vapors. In contact with the air the aqueous solution turns speedily brown, forming ferric lactate; the salt boiled for fifteen minutes with an excess of nitric acid, diluted with an equal bulk of water, yields on cooling white granules of mucic acid.

To prepare a purer salt than can be obtained by the officinal process, Pagenstecher (1842) proposed to dissolve an alkaline lactate in alcohol, and to mix this with a concentrated solution of ferrous chloride, when, after a day or two, crystalline crusts are obtained, which are washed with alcohol. Thus prepared it is less prone to oxidation.

Impurities and Adulterations.—The salt is not liable to be contaminated with impurities except ferric salt, the formation of which it is difficult to prevent by the officinal process. Accidental and wilful adulterations are detected, according to the German Pharmacopœia, by adding to the aqueous solution neutral acetate of lead, which should scarcely cause a slight turbidity.

A white precipitate might indicate the presence of hydrochloric, sulphuric, citric, malic, or tartaric acid. When heated with a slight excess of caustic soda and filtered from the precipitate, the nearly cold liquid should not yield a white coagulation on the addition of alcohol (absence of gum) or produce a red precipitate on boiling with a little sulphate of copper (absence of sugars).

Medical Action and Uses.—Lactate of iron has been alleged to be more assimilable than other ferruginous salts, upon the ground that lactic acid is a normal secretion of the stomach. Admitting this ground to be settled, the inference is illogical. Clinically, it may be said that lactate of iron is a very unirritating salt, and that, owing to its feeble flavor, it is taken without repugnance. The statements made of its curative powers are neither more nor less than may be made of other mild salts of iron. It may be given in the dose of one or more grains, in pill or in solution. Owing to its difficult solution in water and its liability to oxidation, it is not readily dispensed in a liquid form; but it may be dissolved in hot syrup to the extent of about four grains to the fluidounce. Locally, attempts have been made to cure *erectile tumors* by injecting them with a solution of "eight grains of lactate of iron to a drachm of distilled water." The statement is incorrect, since the salt requires forty-eight parts of cold water to dissolve it.

FERRI OXALAS, *U. S.*—OXALATE OF IRON.

Ferrum oxalicum, Oxalas ferrosus.—Oxalate de fer, Fr.; *Oxalsaures Eisenoxydul*, G.

Formula $FeC_2O_4.H_2O$. Molecular weight 162.

Preparation.—Take of Sulphate of Iron two troyounces; Oxalic Acid four hundred and thirty-six grains; Distilled Water a sufficient quantity. Dissolve the sulphate of iron in thirty fluidounces, and the oxalic acid in fifteen fluidounces of distilled water. Filter the solutions, and having mixed them with agitation, set aside the mixture until the precipitate is deposited. Decant the clear liquid, wash the precipitate until the washings cease to redden litmus, and dry it with a gentle heat. *U. S.*

On adding a solution of oxalic acid to a solution of a ferrous salt, the acid of the latter is liberated, while the iron unites with the former to ferrous oxalate, which, being almost insoluble, is deposited.

Properties.—It is a pale, almost lemon-yellow, crystalline powder, requiring 4500 parts of cold, and nearly the same quantity of boiling water for solution. It dissolves in cold concentrated muriatic and in hot diluted sulphuric acid, but is scarcely soluble in oxalic acid. Alkalies and their carbonates decompose it, with the formation of alkaline oxalates. When heated to about 155° C. (311° F.) it loses its water of crystallization, and at a higher temperature is completely decomposed, yielding, in contact with the air, 49.3 per cent. (not less than 48, U. S. P.) of ferric oxide. This corresponds with the formula given above, the correctness of which was proved (1861) by H. Croft and E. Reynold. Formerly it was assumed to contain double the amount of water ($2H_2O$).

Medical Uses.—The special therapeutical uses of this preparation are unknown to us. The *dose* is stated to be two or three grains.

FERRI OXIDUM HYDRATUM, *U. S.*—HYDRATED OXIDE OF IRON.

Ferri peroxidum humidum, Br.; *Antidotum arsenici*, P. G.; *Hydras ferricus.—Moist peroxide of iron*, E.; *Sesquioxide (Peroxyde) de fer hydraté humide; Hydrate de peroxyde de fer gélatineux*, Fr.; *Feuchtes Eisenoxydhydrat, Gegengift der Arsenigen Säure*, G.

Preparation.—Take of Solution of Tersulphate of Iron a pint; Water of Ammonia twenty fluidounces; Water a sufficient quantity. To the water of ammonia, mixed with two pints of water, add, stirring it constantly, the solution of tersulphate of iron, previously mixed with two pints of water. Then pour the whole on a wet muslin strainer, and wash the precipitate with water until the washings pass nearly tasteless. Lastly, mix the precipitate with sufficient water to make the mixture measure a pint and a half, and transfer it to a wide-mouthed bottle, which must be well stopped.

When hydrated oxide of iron is to be made in haste for use as an antidote, the washing may be performed more quickly, though less perfectly, by pressing the strainer forcibly with the hands until no more liquid passes, and then mixing the precipitate with sufficient water to make the mixture measure a pint and a half. *U. S.*

Take of Solution of Persulphate of Iron sixty parts; Common Water one hundred and twenty parts. Mix, and add of Calcined Magnesia seven parts, previously triturated, intimately, with Common Water, one hundred and twenty parts; then shake together constantly until a soft homogeneous pulp is produced. *P. G.*

Ferric hydrate is prepared from the solution of the sulphate by decomposing the salt with ammonia (U. S. P.), or with soda (Brit. Ph.), the latter authority ordering four fluidounces of its solution of persulphate after diluting with a pint (imper.) of distilled water, to be gradually poured into 33 fluidounces of soda solution, and to set aside for two hours before straining and washing as directed in the first formula. In the one case ammonium sulphate, in the other sodium sulphate, is formed; salts which are readily soluble in water, and almost completely removed by continued washing with water. The brown ferric hydrate remaining behind has the formula $Fe_2 6HO$ (mol. weight 214). It combines very easily with acids, and for this reason is an effectual antidote to arsenic, which forms with it an insoluble salt. It cannot be dried without losing water, and being converted into oxyhydrate of the formula $Fe_2O_2 2HO$, which combines less readily with acids, and not at all with arsenious acid. This change is prevented by keeping the hydrate, as obtained by the above processes, under water; but after some time it parts with half its water of hydration, forming the reddish-brown ferric oxyhydrate $Fe_2O_3.Fe_2 6HO$, which has lost the power of combining with weak acids, such as arsenious acid. A similar effect may be wholly or partly obtained during the preparation of the hydrate if the mixture is allowed to become hot. Its effectiveness as an antidote is due to two conditions—the making of the hydrate at the *ordinary*, not at an elevated temperature; and its *recent* preparation.

But since the apothecary does not receive previous notice when the antidote will be required, it is best to make it fresh, when needed, by a process which will occupy but a few minutes. This may be accomplished by at once collecting upon a strainer, and expressing as directed by the United States Pharmacopœia; the mixture will then contain some ammonium sulphate and a little ammonia—the latter, however, should be scarcely recognizable by the odor. The same object is attained by the German Pharmacopœia in substituting magnesia for the more caustic ammonia or soda. The magnesia is used in excess, more than is necessary for separating all the ferric hydrate, and the mixture is prevented from becoming heated by triturating the magnesia previously with water. Neither filtration nor straining is requisite, the compounds of the mixture being ferric and magnesium hydrates and magnesium sulphate, none of which has any caustic or otherwise injurious effect, nor forms a soluble compound with arsenic. The solution of tersulphate of iron (*U. S. P.*) is almost identical with that of the German Pharmacopœia, and the same proportions (by weight) may therefore be used in making the antidote; by decreasing the 60 to 55 parts, leaving the other ingredients as directed in the formula, nearly identical preparations are obtained.

Medical Action and Uses.—It is chiefly used as a chemical antidote to arsenic. But although the chemical relations of an arsenical solution may favor the precipitation of its arsenic by freshly prepared hydrated oxide of iron, there is good reason to suppose that in ordinary cases of arsenical poisoning, the greater part of the poison remains in the stomach undissolved, and that the iron, in so far as it is useful, operates chiefly as a mechanical antidote, by enveloping the arsenic, and shielding the stomach until the bulk of the mass or emetics cause its discharge. This statement is inferred from the fact that a very large excess of the oxide is essential to its efficiency.

FERRI OXIDUM MAGNETICUM, *Br.*—MAGNETIC OXIDE OF IRON.

Ferrum oxydatum magneticum, Oxydum ferroso-ferricum.—Black oxide of iron, E.; *Oxide de fer noir (magnétique)*, Fr.; *Magneteisen, Eisenoxyd-Oxydul*, G.

Formula $Fe_3O_4 = FeO.Fe_2O_3$. Molecular weight 232.

Preparation.—Take of Solution of Persulphate of Iron five and one-half fluidounces; Sulphate of Iron two ounces; Solution of Soda four pints; Distilled Water a sufficiency. Dissolve the sulphate of iron in two pints of the water, and add to it the solution of persulphate of iron; then mix this with the solution of soda, stirring them well together. Boil the mixture, let it stand for two hours, stirring it occasionally; then put it on a calico filter until it ceases to give a precipitate with chloride of barium. Lastly, dry the precipitate at a temperature not exceeding 120° F. *Br.*

Magnetic oxide, which is found in Sweden as magnetic iron ore, consists of one molecule each of ferrous and ferric oxides. When solutions of ferrous and ferric salts are mixed in molecular proportions, and then precipitated by a caustic alkali, the same compound is thrown down in a hydrated condition. The mixture should without delay be boiled for some time until the precipitate has become denser and settles readily. It may then without difficulty be washed by decantation, and finally upon the filter without being prone to oxidation as before the boiling.

Properties.—It is a tasteless brownish-black powder, which is strongly attracted by the magnet, and dissolves without effervescence in warm muriatic acid diluted with half its volume of water. This solution yields blue precipitates with both ferrocyanide and ferridcyanide of potassium. When heated in a test-tube it gives off moisture, and when the heat is continued in contact with the air, red ferric oxide is left. Lefort (1852) found magnetic oxide of iron to contain 1 molecule, or 7.2 per cent. of water. According to the British Pharmacopœia, it contains about 20 per cent.

Its purity is ascertained by the tests given and by sulphuretted hydrogen added to the dilute solution in muriatic acid, which should produce only a white turbidity from separated sulphur, but not a black precipitate (absence of copper, etc.). Should it have been insufficiently washed, the alkaline sulphates or chlorides may be detected in the distilled water, shaken with a portion of the oxide.

Under the name of *Æthiops martialis* various old Pharmacopœias recognized black ferroso-ferric oxide, which varied in composition according to the different methods of preparation.

Medical Action and Uses.—This preparation has been but little used of late, owing to the want of uniformity in its composition. It is, however, rich in iron, and may be prescribed in all the cases in which the subcarbonate is employed. The *dose* is from five to ten grains, and should be taken after meals.

FERRI PEROXIDUM HYDRATUM, *Br.*—HYDRATED PEROXIDE OF IRON.

Ferrum oxydatum fuscum, P. G.; *Ferrum hydricum*, *Ferri oxydum rubrum*, *Oxydum ferricum hydratum*, *Ferrugo*, *Rubigo*, *Crocus martis aperiens.*—*Ferric oxide*, E.; *Sesquioxide de fer hydraté*, *Hydrate de susquioxyde de fer sec*, Fr.; *Eisenoxydhydrat*, G.

Formula $Fe_2O_3.H_2O = Fe_2O_32HO$. Molecular weight 178.

Preparation.—The British Pharmacopœia directs this to be prepared by drying the moist peroxide of iron at a temperature not exceeding 100° C. (212° F.).

The process of the German Pharmacopœia is like that for Ferri oxidum hydratum, *U. S.*, the resulting moist oxide being dried at a gentle heat.

This preparation is almost identical with Ferri subcarbonas, *U. S.*, which see.

A so-called oxide of iron soluble in water has been adopted in the German Pharmacopœia under the name of FERRUM OXYDATUM SACCHARATUM SOLUBILE; saccharate of iron, soluble saccharated oxide of iron, *E.;* Saccharure d'oxyde de fer, *Fr.;* Eisenzucker, Lösliches Eisenoxyd, *G.*

The following directions are given for its preparation:—

Take of solution of Ferric Chloride and Simple Syrup each twenty parts; mix them, and add slowly, with constant stirring, Solution of Soda forty parts. After twenty-four hours pour the clear solution into three hundred parts of hot distilled water, decant the liquid from the precipitate, wash it with distilled water first by decantation, afterwards upon a filter, as long as the washings pass off colorless and have a strong alkaline reaction. Strain the precipitate and press it, then add to it ninety parts of sugar and evaporate the mixture in a porcelain capsule by means of a steam bath, and when dry, add sufficient sugar to make the whole weigh one hundred parts.

This is reduced to a reddish powder, which has a sweet and mild chalybeate taste, and is entirely soluble in five parts of distilled water, yielding a deep reddish-brown solution of a feeble alkaline reaction. It contains 3 per cent. of metallic iron.

Medical Action and Uses.—Hydrated peroxide of iron, formerly known as sesquioxide of iron, is not an eligible preparation of the metal, on account of its comparative insolubility and the bulk of it which must be given. Owing to the former quality it blackens the stools, and to the latter it is apt to oppress the stomach. It was at one time largely used in the treatment of *neuralgia* and also of *cancer*, but with little advantage. The *dose* is from ten to thirty grains or more, given in an aromatic syrup.

FERRI PHOSPHAS, *U. S.*, *Br.*—PHOSPHATE OF IRON.

Ferrum phosphoricum, P. G.; *Phosphas ferroso-ferricus.*—*Ferroso-ferric phosphate*, E.; *Phosphate de fer*, *Phosphate ferroso-ferrique*, Fr.; *Phosphorsaures Eisenoxydul* (*Eisenoxydul-Oxyd*), G.

Formula $Fe_3 2PO_4.FePO_4.12H_2O$. Molecular weight 725.

Preparation.—Take of Sulphate of Iron five troyounces; Phosphate of Sodium six troyounces; Water eight pints. Dissolve the salts separately, each in four pints of the water; then mix the solutions, and set aside the mixture until the precipitate has subsided. Lastly, having poured off the supernatant liquid, wash the precipitate with hot water, and dry it with a gentle heat. *U. S.*

Take of Sulphate of Iron three ounces; Phosphate of Soda two and a half ounces; Acetate of Soda one ounce; Boiling Distilled Water four pints. Dissolve the sulphate of iron in one-half of the water, and the phosphate and acetate of soda in the remaining half. Mix the two solutions, and, after careful stirring, transfer the precipitate to a calico filter, and wash it with hot distilled water, till the filtrate ceases to give a precipitate with chloride of barium. Finally dry the precipitate at a temperature not exceeding 120° F. *Br.*

The mineral *vivianit*, which forms pale-blue crystals, is mainly ferrous phosphate. On bringing together solutions of ferrous sulphate and sodium phosphate, a white precipitate of ferrous phosphate is produced, which, on exposure, and during the washing, is oxidized, and acquires a more or less blue, greenish-blue, or grayish-blue color. During the reaction a portion of the sulphuric acid is set free, and retains phosphate of iron in solution, to obtain which the British Pharmacopœia directs the addition of sodium acetate, which, reacting with the free sulphuric acid, forms sodium sulphate and free acetic acid, in which the phosphates of iron are insoluble. The washing of the precipitate must be continued until the filtrate fails to give a reaction for sulphuric acid.

Properties.—It is a tasteless and inodorous bluish powder, varying somewhat in shade. It is insoluble in water, dissolves in hydrochloric acid, yielding a yellow solution in which dark-blue precipitates are produced by both ferro- and ferridcyanide of potassium. If the acid solution is treated with sufficient tartaric acid, and then with an excess of ammonia, no precipitate is produced; but, on the addition of sulphate of magnesium a white precipitate falls. When the powder is boiled with caustic soda, the filtrate, after being neutralized, yields a yellow precipitate with nitrate of silver. Both precipitates indicate phosphoric acid. The chemical composition varies to some extent, and is influenced by its exposure to the atmosphere while moist, the temperature at which it is dried, etc. The above formula is that of Rammelsberg. Wittstein obtained a somewhat different result. The British Pharmacopœia regards it as ferrous phosphate partially oxidated, and requires 20 grains of it dissolved in hydrochloric acid to give a blue precipitate with potassium ferridcyanide, until 250 grain measures of the volumetric solution of potassium bichromate have been added.

Tests.—The salt should yield nothing to hot distilled water (insufficient washing), and the solution in muriatic acid should only yield a white turbidity of sulphur with sulphuretted hydrogen, but not a black (copper, etc.) or a yellow (arsenic) precipitate. The same solution, digested with bright copper, does not form a dark deposit of arsenic upon the metal.

Medical Action and Uses.—Owing to its insolubility in water, this preparation must be given in pill or in powder, of which the last is preferable, in the *dose* of from five to ten grains. It is extremely doubtful whether the phosphoric acid in its composition confers any special virtues upon it.

FERRI PYROPHOSPHAS, *U. S.*—PYROPHOSPHATE OF IRON.

Ferrum pyrophosphoricum cum ammonio citrico, P. G.; *Pyrophosphas fericus cum citrate ammonico.—Pyrophosphate of iron with ammonium citrate*, E.; *Pyrophosphate de fer citro-ammoniacal*, Fr.; *Pyrophosphorsaures Eisenoxyd mit Citronensaurem Ammonium*, G.

Preparation.—Take of Phosphate of Sodium seven troyounces and a half; Solution of Tersulphate of Iron seven fluidounces, or a sufficient quantity; Citric Acid two troyounces; Water of Ammonia five fluidounces and a half, or a sufficient quantity; Water a sufficient quantity. Heat the phosphate of sodium in a porcelain capsule until it undergoes the watery fusion, and continue the heat until it becomes dry. Transfer the dry salt to a shallow iron capsule, and heat it to incipient redness, without fusion. Then dissolve it in three pints of water, with the aid of heat, and, having filtered the solution and cooled it to the temperature of 50° F., add solution of tersulphate of iron until this ceases to produce a precipitate. Stir the mixture thoroughly, and pour it upon a muslin strainer, and, when the precipitate has drained, wash it with water until the washings pass nearly tasteless, and transfer it to a weighed porcelain capsule.

To the citric acid, contained in a suitable vessel, add water of ammonia, until the acid is saturated and dissolved. Then add the solution to the precipitate in the weighed capsule, stir them together, and evaporate until the liquid is reduced to sixteen troyounces. Spread this on plates of glass or porcelain, so that the salt, when it is dry, may be obtained in scales. Lastly, preserve it in a well-stopped bottle, protected from the light. *U. S.*

When sodium phosphate is exsiccated, and afterwards heated almost to redness, it is converted into pyrophosphate, $Na_4P_2O_7$. On precipitating its solution by ferric sulphate, a white precipitate of ferric pyrophosphate, $Fe_43P_2O_7$, is obtained, which, like other insoluble ferric salts, is readily soluble in alkaline citrates, forming green solutions. Ammonium citrate is directed by the Pharmacopœia, the solution being evaporated and the syrupy liquid scaled upon plates.

Properties.—The salt is obtained in transparent apple-green scales, which are freely soluble in water, yielding a greenish solution; this has a slightly saline and mild chalybeate taste, and gives, with potassium ferrocyanide, a blue color, but no precipitate. Exposed to dry air, the scales become opaque, and are then but partly soluble in water, but wholly so on the addition of some ammonia. Excess of ammonia produces no precipitate, but boiling with caustic potassa yields a yellowish-white deposit. The officinal salt represents 48 per cent. of anhydrous ferric pyrophosphate.

Regarding its chemical composition, two views have been entertained. According to the one, it is a double salt of ferric pyrophosphate and ammonium citrate; according to the other, which has been advocated by Rother (1876), it is a mixture of ammonio-ferric pyrophosphate, $Fe_43P_2O_7.3(NH_4)_4P_2O_7$, with ammonio-ferric citrate and ferric citrate. The latter formula corresponds with that of Gladstone for sodio-ferric pyrophosphate, for which Fleitmann and Persoz (1848) give the formula $Fe_43P_2O_7.2Na_4P_2O_7$.

The double salt mentioned has been admitted in the German Pharmacopœia as *Natrum pyrophosphoricum ferratum.* It is directed to be prepared by adding to a solution of 200 parts of sodium pyrophosphate in 400 parts of water so much ferric chloride in aqueous solution that a permanent precipitate is not produced, and mixing with the greenish liquid 1000 parts of alcohol. A white amorphous powder is thus obtained, which dissolves slowly in water, yielding a greenish solution; this, on boiling, separates a white precipitate.

Medical Action and Uses.—The tastelessness, solubility, and richness in iron of this salt, render it one of the best of ferruginous preparations. *Dose*, from two to five grains.

FERRI SUBCARBONAS, *U. S.*—SUBCARBONATE OF IRON.

Crocus martis aperitivus (*aperiens*), *Ferri peroxidum hydratum*, Br.; *Ferrum oxydatum fuscum*, P. G.—*Oxide of iron*, E.; *Oxyde de fer hydraté*, *Sous-carbonate de fer*, Fr.; *Eisenoxyd Hydrat*, G.

Preparation.—Take of Sulphate of Iron eight troyounces; Carbonate of Sodium nine troyounces; Water eight pints. Dissolve the salts separately, each in four pints of the water: mix the solutions thoroughly, and set aside the mixture, until the precipitate has subsided; then pour off the supernatant liquid, wash the precipitate with water until the washings pass nearly tasteless, and dry it on bibulous paper without heat. *U. S.*

On mixing a solution of sodium carbonate with a solution of pure ferrous sulphate in boiled water, a white precipitate of ferrous carbonate is obtained, which in contact with the air rapidly darkens, changing in color through various shades of green, blue, and olive into brown, carbonic acid being at the same time given off. This change of color is accompanied with its conversion into ferric hydrate, with the exception of small and variable proportions of ferrous carbonate, which escape oxidation. This preparation must, therefore, be regarded as identical, or nearly so, with the ferric hydrates of the Pharmacopœias mentioned above.

Properties.—It is an amorphous reddish-brown powder, inodorous and almost tasteless, and closely resembling ferric hydrate. Dilute muriatic acid dissolves it with slight effervescence, the yellow liquid yielding blue precipitates with ferridcyanide (difference from pure ferric hydrate) and ferrocyanide of potassium, but not with barium chloride (absence of sulphates). If it has been dried at an elevated temperature, it is of a brighter red color, does not readily dissolve in warm dilute muriatic acid, and consists mainly of the oxyhydrate $Fe_2O_3.H_2O$. Dried at ordinary temperature it consists chiefly of the oxyhydrate $Fe_2O_3.Fe_2 6HO$. (See Ferri oxidum hydratum and Ferri peroxidum hydratum.)

Pharmaceutical Uses.—Subcarbonate of iron is used for preparing ferrum redactum, and forms a constituent of Emplastrum ferri and Trochisci ferri subcarbonatis, *U. S.*

Medical Action and Uses.—This is one of the oldest pharmaceutical preparations of iron, and was intended to imitate and take the place of rust of iron, which from time immemorial had been used in medicine. It continues to be one of the most employed members of its class, but is ineligible whenever it is desired to introduce a large amount of iron into the blood; it has been recommended in all forms of *anæmia* and *anæmic chlorosis*, and in *neuralgia*, *chorea*, and other nervous affections depending upon a deficiency of red corpuscles in the blood. In a disease of a different order, *tetanus*, a number of cures have been attributed to this medicine, but of late years it has been entirely supplanted by other means, and the question of its utility is unsettled. Subcarbonate of iron in large doses, mixed with water, may be resorted to when the hydrated peroxide cannot be procured, in cases of poisoning by *arsenious acid.* The *dose* of subcarbonate of iron is from five grains upwards. In some cases of neuralgia it has been taken by the teaspoonful. Caution should be exercised, lest it accumulate in the bowels and obstruct them.

FERRI SULPHAS, *U. S.*, *Br.*—SULPHATE OF IRON.

Ferrum sulfuricum purum, P. G.; *Sulfas ferrosus*, *Ferrum vitriolatum purum*, *Vitriolum martis purum.*—*Ferrous sulphate*, E.; *Sulfate* (*Protosulfate*) *de fer*, *Sulfate ferreux*, Fr.; *Schwefelsaures Eisenoxydul*, G.

Formula $FeSO_4.7H_2O$. Molecular weight 278.

Preparation.—Take of Iron in the form of wire and cut in pieces twelve troyounces; Sulphuric Acid eighteen troyounces; Water eight pints. Mix the sulphuric acid and water, and add the iron; then heat the mixture until effervescence ceases. Pour off the solution, and, having added thirty grains of sulphuric acid, filter through paper, allowing the lower end of the funnel to touch the bottom of the receiving vessel. Place the filtered liquid in a matrass and evaporate until sufficiently concentrated; then set it aside in a covered vessel to crystallize. Drain the crystals in a funnel, dry them on bibulous paper, and keep them in a well-stopped bottle. *U. S.*

Take of Iron Wire four ounces; Sulphuric Acid four fluidounces; Distilled Water one and a half pint. Pour the water on the iron placed in a porcelain dish, add the sulphuric acid, and when the disengagement of gas has nearly ceased, boil for ten minutes. Filter now through paper, and, after the lapse of twenty-four hours, separate the crystals which have been deposited from the solution. Let these be dried on filtering paper placed on porous bricks, and preserved in a stoppered bottle. *Br.*

The British Pharmacopœia recognizes also *Ferri sulphas granulata*, which is prepared by precisely the same process, except that on filtering the solution is collected in a jar containing eight fluidounces of rectified spirit and that the mixture is stirred so that the salt shall separate in granular crystals. These are deprived by decantation of adhering liquid, transferred on filtering paper to porous tiles, and dried by exposure to the atmosphere.

Ferrous sulphate is obtained on a large scale from alum shale and by roasting iron pyrites, exposing it to the air and exhausting the mass with water; also by passing solutions of copper sulphate over scraps of iron, whereby copper is precipitated, the iron entering into solution. It is also obtained as a by-product in various manufactures where sulphuric acid is used for the purpose of purifying certain products. The article thus obtained is usually impure, and not fit for medicinal purposes, except for disinfecting and in this impure state is known in commerce as *copperas*, or *green vitriol* (Couperose verte, Vitriol vert, *Fr.*, Kupferwasser, Grüner Vitriol, *G.*). For medicinal use it should be prepared directly from sulphuric acid acting upon iron wire or clean iron filings in the presence of water, when hydrogen is evolved, ferrous sulphate remaining in solution. $Fe_2 + 2H_2SO_4$ yields $2H_2 + 2FeSO_4$. The salt is prone to oxidation if its chemically neutral solution is evaporated to crystallization; but in the presence of some free sulphuric acid yields crystals which are far more permanent. This explains the necessity of having some free sulphuric acid in the liquid from which ferrous sulphate is crystallized. The crystals are collected upon a diaphragm, washed rapidly with a little water to remove the mother-liquor, and then dried.

Properties.—Ferrous sulphate is in transparent bluish-green monoclinic and rhombic crystals. When the concentrated solution on filtering is allowed to drop into an equal bulk of alcohol, or as directed by the British Pharmacopœia, well agitated with a smaller quantity of alcohol, and the precipitate rinsed with some diluted alcohol, it forms a pale-green crystalline powder, which is more permanent in the air than the large crystals. It has a specific gravity of 1.9, a styptic taste, a slight acid reaction, and when exposed to the air effloresces and is gradually oxidized. It dissolves at 10° C. (50° F.) in 1.64, at

30° C. (86° F.) in 0.7, and at 100° C. (212° F.) in 0.3 parts of water. It is insoluble in alcohol and ether. The aqueous solution yields a white precipitate with barium chloride, a dark-blue one with potassium ferridcyanide, and a bluish-white one with potassium ferrocyanide.

Tests.—Impurities are rarely present if the salt has been prepared from iron and sulphuric acid. The aqueous solution treated with hydrosulphuric acid should not give a blackish precipitate (copper, etc.), and when completely precipitated by sulphydrate of ammonium, the filtrate on evaporation and ignition should leave no residue (magnesium, alkalies). The aqueous solution, after being oxidized with nitric acid and supersaturated with ammonia, should yield a filtrate, which is not affected by sulphuretted hydrogen (zinc, manganese); and if the oxidized liquid is supersaturated with warm potassa solution, the filtrate neutralized with muriatic acid and again supersaturated with ammonia, no precipitate (alumina) should occur.

Pharmaceutical Uses.—Nearly all the officinal compounds of iron, with the exception of the chloride, iodide, sulphide, and nitrate, are prepared from the sulphate, either directly or indirectly. Ferrous sulphate is used in preparing Mistura ferri comp., *U. S.*, *Br.;* Pil. aloes et ferri, *Br.;* Pil. ferri carbonatis, Pil. ferri comp., *U. S.*

FERRI SULPHAS EXSICCATA, *U. S.*, *Br.*—DRIED SULPHATE OF IRON.

Ferrum sulfuricum siccum, P. G.—*Sulfate de fer desséché*, Fr.; *Entwässertes schwefelsaures Eisenoxydul*, G.

Formula $FeSO_4.H_2O$. Molecular weight 170.

Preparation.—Take of Sulphate of Iron in coarse powder twelve troy-ounces. Expose it, in an unglazed earthen vessel, to a moderate heat, with occasional stirring, until it has effloresced; then increase the heat to 300° F., and maintain it at about that temperature until the salt ceases to lose weight. Lastly, reduce the residue to fine powder, and keep it in a well-stopped bottle. *U. S.*

The process of the British Pharmacopœia is the same, except that a porcelain or iron dish is used, and the heat permitted to be raised to about 165° C. (400° F.). Crystallized ferrous sulphate contains 45.3 per cent. of water of crystallization, a portion of which is lost in a dry atmosphere at the ordinary temperature, the remainder except one molecule at 115° C. (239° F.). The last molecule of water is expelled only at about 280° C. (536° F.), and if proper care be taken, without the loss of sulphuric acid.

Properties.—Exsiccated ferrous sulphate forms a grayish-white powder, which dissolves slowly in cold, more rapidly in hot water, leaving only a small quantity of ferric oxysulphate. Otherwise the behavior and tests of purity are the same as for the crystalline salt, nearly 10 parts of which are represented by 6 parts of the exsiccated salt.

Medical Action and Uses.—The intense astringency of the sulphates of iron renders them, as a rule, ineligible for internal administration except when it is intended to exert a directly constringing action upon the capillaries. If the dose much exceed one or two grains, it is apt to occasion gastric pain and vomiting, and the prolonged use of even smaller doses is not without the risk of impairing the digestive function. Besides passive *hemorrhages*, it is well adapted to control excessive secretions produced by debility, as *sweating*, *chronic diarrhœa*, *leucorrhœa*, *gleet*, and *hydruria*. Externally it has been used as an application to the skin in superficial traumatic *erysipelas;* but it is quite useless in the idiopathic form of the disease. A solution of half an ounce of the salt in a pint of water, or an ointment containing two drachms to the ounce of lard, may be employed in the former affection. An ointment made with one or two parts of the dried sulphate to thirty of lard is a useful application in cases of obstinate local *diseases of the skin*, as eczema, intertrigo, and impetigo. It may also aid in healing the sores occasioned by *rupia*, *ecthyma*, *syphilis*, and *scrofula*, but has no advantage over zinc ointment for this purpose.

FERRI SULPHURETUM, *U. S.*—SULPHURET OF IRON.

Sulphuretum ferrosum.—*Sulphide of iron*, E.; *Sulfure de fer*, Fr.; *Schwefeleisen*, G.

Formula FeS. Molecular weight 88.

Preparation.—Iron unites with sulphur in various proportions, some of the compounds, like iron pyrites, FeS_2, being found in nature. The officinal compound is the monosulphide which is solely employed for generating sulphuretted hydrogen. It is made by mixing 3 parts of iron filings with 2 parts of sublimed sulphur, introducing the mixture in *small* portions into a crucible, heated to bright redness, and kept covered after each addition. Or a rod of iron is raised nearly to a white heat and then brought into contact with sulphur; ferrous sulphuret will at once form and melt, and should be permitted to drop into cold water to solidify.

Properties.—It is in yellowish or blackish masses or irregular pieces, which have a metallic lustre, and are permanent in dry air, but are oxidized when kept in a damp atmosphere. It dissolves readily in dilute sulphuric or muriatic acid with the evolution of sulphuretted hydrogen, and without leaving any residue when the sulphuret is pure. As met with it sometimes contains an excess of sulphur, but usually has an excess of iron, and the sulphuretted hydrogen evolved is mixed with hydrogen.

Sulphuretted hydrogen, *hydrogen sulphide*, or *hydrosulphuric acid* is a colorless gas having a disgusting odor suggesting that of rotten eggs. Its specific gravity is 1.19; water dissolves three times its volume of the gas; the solution is not permanent in the air, but is oxidized, water being formed and white sulphur deposited. The formula of sulphuretted hydrogen is H_2S, its molecular weight 34.

Medical Uses.—This compound has no direct medicinal value. It is only used for the production of hydrosulphuric acid.

FERRI VALERIANAS.—VALERIANTE OF IRON.

Ferrum valerianicum.—*Valérianate de fer*, Fr.; *Baldriansaures Eisenoxyd*, G.

Preparation.—This salt is best obtained by adding to a solution of ferric sulphate or ferric chloride a solution of sodium valerianate as long as a precipitate is produced, collecting this upon a filter, washing it with water and drying it at the ordinary temperature.

Properties.—Ferric valerianate is a dark brown-red amorphous powder, having a faint odor and taste of valerian. When slowly heated it parts with its acid without fusing; but when rapidly heated it fuses and gives off inflammable vapors having the odor of butyric acid. It is decomposed by boiling water, ferric hydrate remaining undissolved. It is completely soluble in dilute hydrochloric acid. It contains between 28 and 51 per cent. of ferric oxide, the composition varying with the degree of exposure to heat and probably with the care with which it has been washed.

Medical Action and Uses.—It was expressly stated, when this preparation was first introduced into medicine, that it would be an error to regard it as a true antispasmodic because it contained valerianic acid, and that its value depended mainly upon the iron it contained, the valerianic acid being only an adjuvant. It should have been added that the iron might be introduced into the system under many more eligible forms, and in more suitable doses than were recommended for this salt. It is probably but little used, even for the affections for which it was originally recommended and which were described as "chlorosis with hysterical or epileptiform attacks." It was prescribed in pills in the *dose* of from one to three grains several times a day.

FERRUM, *U. S.*, *Br.*—IRON.

Mars.—*Fer*, Fr.; *Eisen*, G.

Symbol Fe. Atomicity bivalent and sexivalent (Fe_2). Atomic weight 56.

Origin.—Iron is the most useful and one of the most widely diffused metals in nature, being present in most rocks and soils, and generally forming one of the constituents of the ashes of plants and animals. It is rarely found in the metallic state. It is often combined with sulphur as *iron pyrites*, more frequently oxidized as *magnetic iron*, *spathic iron*, *hæmatite*, and other ores, and likewise in combination with mineral acids. It is found in large quantities in several States of North America, and in Great Britain, Sweden, Germany, France, and other European countries.

The manufacture of metallic iron must of necessity vary with the nature of the ore; but the principle is in all cases the same. The ore frequently requires roasting or calcination, mainly for the purpose of rendering it more porous and better adapted for the smelting process; this process is conducted in blast-furnaces, the ore being mixed with carbonaceous matter, coke and the like, some flux, either lime or clay, being added at the same time, whereby a more readily fusible silicate of aluminum and calcium is formed, which, on cooling, forms the glass-like slag. The crude iron obtained from the blast-furnace is called *pig* or *cast iron*, and contains various proportions of carbon, silicon, sulphur, phosphorus, and other impurities, from which it must be purified to adapt it for various uses in the arts. In the *refining* or *puddling* process it is fused, and by stirring brought into contact with a blast of air, by which the impurities are oxidized, or the oxidation is effected with the aid of an impure oxide of iron (iron scales). The slag still remaining in the iron is then, at a white heat, pressed out under a steam hammer, and the iron thus purified rolled out into bars. For many purposes a further purification is requisite.

Properties.—Iron is a grayish metal, of the spec. grav. 7.7 to 7.9. Its tenacity or strength is nearly twice as great as that of any other metal commonly used; and when heated it possesses a ductility admitting of its being drawn into the thinnest wire. It remains unchanged in dry air, but in the presence of moisture its surface becomes covered with brown-red oxide (*rust*). It enters into combination with nearly all the elements, and forms the base of two important series of salts, the *ferrous* and *ferric*, in the former of which it is a dyad, Fe'', in the latter a hexad, Fe_2''' or $(Fe_2)^{vi}$.

Ferrous salts, when anhydrous, are mostly white, and bluish-green in the hydrated state; the oxalate is yellow. When moist or in solution they are easily oxidized on exposure to the air or under the influence of oxidizing agents. Their aqueous solutions are colored brownish-black by nitric oxide, and yield black precipitates with sulphydrate of ammonium, and white ones, changing to green, black, and brown, with alkalies and their carbonates; the precipitation, particularly with ammonia, is incomplete. Soluble phosphates precipitate white ferrous phosphate, changing to greenish-blue; potassium ferrocyanide produces a bluish-white precipitate changing to dark-blue, and potassium ferridcyanide a dark-blue one. Ferrous solutions free from ferric salt are not affected by potassium sulphocyanide or tannin. The soluble chemically neutral ferrous salts have an acid reaction to test-paper; those insoluble in water dissolve in hydrochloric acid.

Ferric salts are either neutral or basic; the neutral salts, when soluble, have an acid reaction, are mostly white when anhydrous, and brown or brown-yellow when hydrated: the basic salts are of a darker brown or reddish-brown color. Those insoluble in water dissolve in muriatic acid. Sulphuretted hydrogen reduces ferric to ferrous salts, sulphur being separated; ammonium sulphydrate produces the same reduction, and afterwards a black precipitate. Alkalies and alkaline carbonates added in excess separate brown ferric hydrate, in the latter case with the evolution of carbonic acid; the precipitation is prevented by the presence of tartaric acid and some other organic compounds. Sodium acetate added in the cold colors the solutions deep brown-red, the color disappearing on the addition of muriatic acid; on boiling, a brown precipitate of basic ferric acetate or ferric hydrate is deposited. Solutions of ferric salts, treated with metallic iron, sulphurous acid, or other deoxidizing agents, are reduced to ferrous salts. Sodium phosphate precipitates white ferric phosphate, which is insoluble in acetic acid, becomes brown by ammonia, and if excess of sodium phosphate be present, dissolves in ammonia with a red-brown color. Arseniate of sodium has a behavior similar to that of the phosphate. Gallo-tannic acid causes a blue-black color and precipitate (writing ink). Meconic acid and sulphocyanides color the solutions blood-red, the color produced by the latter reagent being destroyed by corrosive sublimate and by strong mineral acids. Potassium ferridcyanide darkens somewhat the solutions of ferric salts; potassium ferrocyanide precipitates Prussian blue.

Off. Prep.—Besides ferrum redactum the following *chemical* compounds are officinal: Ferri arsenias, *Br.;* Ferri chloridum, Ferri citras, *U. S.;* Ferri et ammon. citras, *U. S.*, *Br.;* Ferri et ammon. sulphas, Ferri et ammon. tartras, *U. S.;* Ferri et potass. tartras (Ferrum tartaratum), Ferri et quiniæ citras, *U. S.*, *Br.;* Ferri et strychniæ citras, Ferri ferrocyanidum, Ferri hypophosphis, *U. S.;* Ferri iodidum, *Br.;* Ferri lactas, Ferri oxalas, *U. S.;* Ferri oxidum humidum (hydratum), *U. S.*, *Br.;* Ferri oxidum magneticum, Ferri peroxidum hydratum, *Br.;* Ferri phosphas, *U. S.*, *Br.;* Ferri pyrophosphas, Ferri subcarbonas, *U. S.;* Ferri sulphas, Ferri sulphas exsiccata, *U. S.*, *Br.*; Ferri sulphas granulata, *Br.*; Ferri sulphuretum, *U. S.*

The following are solutions of iron salts in water, syrup, or alcohol: Liquor ferri chloridi, Liq. ferri citratis, *U. S.;* Liq. ferri nitratis (pernitratis), *U. S.*, *Br.;* Liq. ferri perchloridi, Liq. ferri perchlor. fortior, *Br.;* Liq. ferri subsulphatis, *U. S.;* Liq. ferri tersulphatis (persulphatis), Syrupus ferri iodidi, *U. S.*, *Br.;* Syrupus ferri phosphatis, Tinctura ferri acetatis, *Br.;* Tinct. ferri chloridi (perchloridi), *U. S.*, *Br.*

The following pharmaceutical preparations contain iron in various forms: Emplastr. ferri, *U. S.*, *Br.;* Ferri carbonas saccharata, Mistura ferri aromatica, *Br.;* Mistura ferri comp., Pil. ferri carbonatis, Pil. ferri iodidi, *U. S.*, *Br.;* Pil. aloes et ferri, *Br.;* Pil. ferri comp., *U. S.*; Trochisci ferri redacti, *Br.;* Troch. ferri subcarbonatis, *U. S.;* Vinum ferri, Vin. ferri citratis, *Br.*

Physiological Action. *On Animals.*—Iron is an essential constituent of the animal economy, and is chiefly found in the red corpuscles of the blood, rendering them fit vehicles for carrying oxygen to every part of the economy. The animals in whose blood the proportion of iron approaches most nearly to that of man, are the ox, the dog, the goose, and the hog. By experiment it has been proved that the quantity of iron in the blood, the bile, and the milk may be increased by administering the metal with the food.

On Man.—In medicinal doses, varying greatly according to the preparation employed, iron does not produce any immediate effects; but, after a variable interval, it gives rise to a condition of plethora with characteristic phenomena. The feces are blackened, either by the formation of salts of iron with the tannic acid of the food, or by the sulphur derived from its decomposition. But preparations which are insoluble in the stomach and the potassio-tartrate have not this effect. A small portion only is excreted with the urine, yet enough in some instances to become a constituent of urinary calculi, and also to provoke a genito-urinary irritation. Doubtless, also, in appropriate morbid conditions, iron may stimulate the sexual functions, as it does all others, by increasing the organic vigor. It augments the excretion of urea, and raises the animal temperature. Some of the preparations are more or less irritant, especially the chlorides, the sulphates, and the iodides, and have occasioned death by their local action on the stomach, an effect due chiefly to the acid associated with the metal. There is little doubt that the whole physiological and therapeutical action of iron depends upon its power of absorbing oxygen from the air in the lungs and carrying it to the various organs and tissues. Its proportion in the blood is, therefore, other things being equal, a measure of the vital activity and energy. It appears that a point of saturation may be reached beyond which the use of iron may, on the one hand, produce plethora, or, on the other, be eliminated from the economy as superfluous. But plethora, it must be remembered, is an exaggerated degree of a normal state.

Medical Uses.—Naturally, iron is chiefly indicated when the proportion of red corpuscles in the blood is permanently diminished. Their transient loss by hemorrhage is better repaired by food, out of which the constituents of the blood are normally elaborated, supposing that the assimilative functions remain unimpaired. But when such impairment exists, the speediest and the surest cure is brought about by the direct introduction of iron into the economy. By its means the proportion of red corpuscles in the blood is directly increased, and their condition, as seen under the microscope, changed from pale and shrivelled to red and full; through them more oxygen is introduced into the system, and a more active assimilation of nutriment, as well as a more perfect renewal of tissue, is secured. The cases in which *anæmia* may be thus remedied comprise idiopathic anæmia, associated or not with chlorosis, hypochondria, convalescence from prolonged and exhausting diseases, malarial and saturnine, and some other cachexiæ attended with imperfect elaboration of the blood or its habitual waste, certain varieties of dyspepsia, some forms of albuminuria, etc. Although in the greater number of *chronic nervous diseases* distinguished by morbid susceptibility the condition of the blood is impaired, and the restoration of this fluid to its normal state is an essential element of the cure, yet it often happens that the disorder is apparently limited to the nervous system, especially when the latter has been directly affected by the morbid cause. In such cases the use of iron is more prejudicial than profitable; it oppresses and does not invigorate, it impairs the appetite, constipates the bowels, and induces a dangerous plethora. When anæmia constitutes only one out of many symptoms of a disease, the use of iron will be more or less efficient according to whether the anæmia depends or not upon removable causes. The anæmia of tuberculosis, of cancer, of certain forms of Bright's disease, and some other affections, is subordinate to an incurable lesion, and iron can, therefore, act only as a palliative. In the case of tubercular phthisis the danger of its causing hæmoptysis must not be overlooked. In these, and, indeed, in nearly all forms of anæmia, iron is food, and, like other food, must be productive of good or evil according to the patient's need of it and his power of assimilating it.

Scanty, as well as excessive, *menstruation* may both be appropriately treated by iron, for either may be due to a deficiency of normal blood. When the catamenia are profuse but watery, they are diminished by iron, and the proportion of solids in the discharge is increased; on the other hand, when they are both scanty and pale, iron is the best agent for increasing them. The former case is the more hopeful one, because it shows a certain energy, with a supply of material; the latter, in its chronic type, is usually a sign of progressive and incurable exhaustion, but sometimes, also, it results from uterine congestion, which must first be treated before iron can be of much avail. This object is usually sought through the use of aloetic purges, and other stimulant and derivative agencies. In all cases of active *uterine hemorrhage*, if there be any such independently of disease of the womb, iron should not be given internally; but, when the flow is passive, the case enters the category of passive hemorrhages generally; and for these, whether they take place from the organ named, from the rectum, bladder, kidneys, or other part, iron becomes one of the best remedies; not, however, as iron, but in combination with a mineral acid, in which compound the astringency is derived from the acid rather than from the ferruginous base. The combinations of hydrochloric and of sulphuric acids with iron are in this respect the most efficient. The stimulant action of iron salts renders them less appropriate for *pulmonary* than for other internal hemorrhages, except in the form of atomized solutions. Iron is useful in regulating the *heart* when it becomes irregular through weakness, whether or not the condition be aggravated by valvular obstruction. By giving tone to this, as well as to other organs, it sometimes permits the removal of dropsies dependent upon cardiac obstruction.

Various *nervous disorders*, more or less dependent upon impoverishment of the blood, may be cured by iron. Of these, the most directly amenable to its operation are *neuralgia*, especially of the fifth pair, and next to this of the gastric nerves; and *chorea*, which, very often, like neuralgia, is the result of debility, and, remotely, of impoverishment of the blood. Of other nervous affections for which iron is appropriate, are various irritations of the bladder and urethra tending to occasion *retention* or *incontinence of urine*, in which the tincture of the chloride, or the solution of the iodide, of iron may be used with much confidence in their virtues. *Seminal emissions* in weak, nervous, and excitable persons may sometimes be prevented by the same agent, especially if associated with belladonna or ergot, which, indeed, render the cure more prompt and certain. The same is true of the use of iron in certain cases of incontinence of urine.

The cure of *insanity* and of *whooping-cough* may be accomplished through iron, like neuralgia and chorea, when they depend upon exhaustion of the nervous system. One of the most valuable results of recent experience in regard to insanity consists in the proof that good food and other hygienic means are essential elements in its proper treatment. In like manner, iron is not a specific for whooping-cough, it only destroys the soil in which that disease tends to gain strength. Iron is contraindicated in *epilepsy*.

Intermittent fever is cured by iron only when the disease is prolonged by exhaustion of the system and impoverishment of the blood, and this occurs especially when the sick remain in malarial localities, and when an appropriate anti-periodic treatment has not been employed. Hence the use of quinia after a course of iron is found to be more efficient than before, in the cases alluded to. Enlargement of the *spleen* may be rapidly lessened by iron, if the affection be not inveterate. In a word, the efficacy of iron in malarial affections is wholly subordinate to its renovating action upon the blood.

The same statement is, in the main, true respecting the use of iron in *dyspepsia*. The medicine acts chiefly by improving the blood, and thereby increasing the secretion of gastric juice and the muscular power of the stomach. But, if acid preparations are used, they also act as local stimulants. Hence the latter should be given immediately before meals, but other martial preparations either along with the food or directly after meals. In either case cinchona and its derivatives are important adjuvants.

The action of iron in *albuminuria* probably consists mainly in its lessening the destruction of the red blood disks, and in a subordinate degree in its local action upon the kidneys. The latter is, however, less probable than the former, since it is alleged that the iron cannot be detected in the urine. It, nevertheless, lessens the proportion of albumen discharged, and in the desquamative forms of Bright's disease often effects a stable cure. This is particularly evident in albuminuria and dropsy occurring after scarlatina, or from the action of cold and dampness upon the skin. But the medicine is still the best, even in granular and in amyloid degeneration of the kidney. The form in which iron is administered is of secondary importance, but probably the best is a solution of muriated tincture of iron in acetate of ammonia, with an excess of acetic acid.

Iron is one of the most important aids to a proper diet in the treatment of *diabetes;* it tends to sustain the general health even when it does not directly cause a diminution in the proportion of sugar excreted. Basham's mixture (which represents the solution mentioned in the last paragraph) appears to be the best form for its administration. In chronic *mucous fluxes* of every description iron is invaluable; in those of the bowels, by its direct application, partly; and in the rest, by its influence upon the blood, and perhaps, also, by constringing the capillary vessels. It is of great value in the treatment of intestinal *worms;* not so much, probably, by directly destroying them as by rendering the intestinal secretions more healthy, and thereby depriving the parasites of their nidus. Among mucous profluvia, *chronic bronchitis* is often cured by iron, especially when the sputa are muco-purulent. Hence the reputation of the compound iron mixture as an anti-hectic medicine; and hence also the error of applying the same treatment to consumption of the lungs. True pulmonary *phthisis*, with tissue degeneration, is benefited by iron only in so far as its use is proportioned to the diminished blood formation belonging to that affection. It may be not only tolerated, but useful while active exercise can be taken; but unless great care is exercised, it increases the tendency to hæmoptysis, and hastens the progress of the disease. It is most readily tolerated by the dull and lymphatic, when there is but little tendency to febrile irritation, and when the disorder is essentially chronic. Iron is more appropriate in the histologically allied, but clinically quite different, disease, *scrofula;* but even in this affection, its value, except to meet incidental conditions, such as anæmia and dyspepsia, is not great. The iodide of iron is probably useful in glandular scrofula in virtue of the iodine it contains. In *syphilis* and *cancer*, for which iron has been recommended, it has no other virtues than arise from its power of sustaining the general health, or, in the case of the former disease, of mitigating the mischiefs of an excessive use of mercury.

The most efficient remedy in idiopathic *erysipelas* is the tincture of the chloride of iron given in full and repeated doses, such as from twenty to forty drops every two or three hours, properly diluted. Smaller doses are quite useless. Its action is probably to constringe the capillary bloodvessels, although its acid element may directly tend to antagonize the febrile poison.

The same preparation has been reported to act very favorably in low forms of *scarlatina*, *measles*, and *puerperal fever;* but although there is no reason to reject its use, there is not enough to recommend it. The sulphuret of iron has been proposed as an antidote to constitutional *poisoning by lead*, and as a means of neutralizing the salts of *mercury*, *lead*, *antimony*, *copper*, and especially *arsenic* in the stomach. For the last-named the hydrated oxide is generally employed, but it probably acts by mechanically enveloping the particles of arsenic rather than as a chemical antidote. The same remark applies to the insoluble saccharated oxide of iron.

The *contraindications* for the use of iron it is essential to keep in mind. The one which surpasses all others in importance is feverishness. Almost the only exception to this statement is that tincture of chloride of iron cures erysipelas;

but it doubtless acts, not as iron, but as a powerful astringent. In nearly all other cases fever, or even feverishness, should exclude iron, whether it be produced by chronic disease, as phthisis, or by local irritations, such as dyspepsia with constipation. In this affection the tongue is apt to be coated, not by continuous or any other "sympathy" with the gastro-intestinal disorder, but because the local disorder produces general feverishness. Under such circumstances purgation is an esential preliminary to the favorable action of iron; and hence the saline chalybeate mineral waters are very efficient in such cases.

The local therapeutical uses of iron are numerous, but they owe their value to the astringency of the acid compounds of the metal rather than to the metal itself. Solutions and ointments of the sulphate have been applied with apparent advantage in traumatic *erysipelas*, in *phlegmasia alba*, and in various chronic eruptions of the *skin* occurring in persons in whom these affections tend to ulcerate or to persist unchanged. The subsulphate, in strong solution, has been applied to the cure of nasal, aural, and other *polypi;* and in weak solution to arrest chronic *mucous discharges* from the urethra, vagina, etc. Solution of chloride of iron represses *fungous granulations* in cases of ingrown toe-nail, ulcerated gums, etc.

Like other astringents, salts of iron may be used in the treatment of varicose or simply dilated bloodvessels of the *conjunctiva*, and in relaxed conditions of the *fauces*. The solution of chloride of iron is said to be useful as a local application in *diphtheria*, and it probably is so when the exudation is in its forming stage and of limited extent. It is worse than useless when the false membrane is extensive and thick. In the decline of the disease, gargles containing a small proportion of the solution tend to constringe the part, and renew its healthy action. It and the sulphate of iron are hæmostatics, and have often arrested threatening *hemorrhage* in epistaxis, gastric hemorrhage, that from the extraction of teeth, leech-bites, the excision of tonsils, cancerous ulceration, and hemorrhage after delivery. In the last case it must be sufficiently diluted with water, and carefully pumped into the uterine cavity. In pulmonary hemorrhage an atomized weak solution (one part of the tincture to ten parts of water) has been inhaled with prompt effect. The injection of solutions of the lactate, the perchloride, and other salts of iron into varicose and other *aneurisms*, would form an eligible method of treatment if it were not extremely dangerous. In a number of instances the operation has been speedily followed by the patient's death, either suddenly by embolism, or later by ulceration.

FERRUM DIALYSATUM.—DIALYZED IRON.

Liquor ferri dialysati.—Fer dialysé, Fr.; *Dialysirtes Eisen*, G.

Preparation.—Dialyzed iron is made by saturating an aqueous solution of ferric chloride with ferric hydrate, putting the liquid into a dialysator, and suspending this in water, which is often renewed, as long, indeed, as it acquires an acid reaction. Very little iron will pass through the parchment septum; when dialysis is completed, the ferric solution is diluted so that 100 grains of it, when evaporated and dried at a temperature not exceeding 100° C. (212° F.), will leave a solid residue weighing 5 grains. In France the following process has been adopted: 100 grams of solution of ferric chloride of 30° B., are mixed in small quantities with 35 grams ammonia water of 22° B. The precipitate dissolves at first rapidly, afterwards very slowly. When the liquid has become transparent it is introduced into a dialysator, and treated as stated before; eight to ten days are required in the preparation.

Properties and Tests.—Similar solutions were obtained by Ordway (1858) and Béchamp (1859) by leaving pure ferric hydrate in contact with ferric chloride for a prolonged time. Th. Graham (1861) subjected this to dialysis, and succeeded in removing the acid until chlorine corresponding to 1.5 per cent. of HCl was left. Such a solution, however, which would correspond to $Fe_2Cl_6.95Fe_2O_3$, gelatinized ultimately. Hager (1868) found dialyzed iron to have the composition $Fe_2Cl_6.12Fe_2O_3$; Ordway's oxychloride was $Fe_2Cl_6.23Fe_2O_3$. It is evident, therefore, that dialyzed iron may have a somewhat varying composition. Some solutions may be boiled without being precipitated, but they cannot be evaporated by heat to dryness without losing their solubility. The solution has a deep brown-red color, and is almost destitute of styptic taste. It is miscible with alcohol, glycerin, syrup, and distilled water, but not with spring water, or other even dilute saline solutions. A small quantity of tannin merely darkens the liquid, a larger quantity causes a deep brown gelatinous precipitate. A minute quantity of nitrate of silver will not disturb the liquid; a larger quantity will cause a gelatinous brown precipitate, which is again soluble in distilled water; but on adding first a slight excess of ammonia, filtering from the ferric hydrate, acidulating with nitric acid, and then testing with nitrate of silver, a white precipitate of chloride of silver is formed.

It is a dark reddish-brown liquid, perfectly transparent in thin layers, and nearly free from ferruginous taste. It is best given alone, or diluted with a simple solvent.

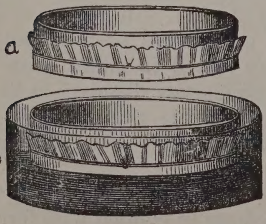
H. Trimble (1878) has analyzed six samples met with in commerce, and found the saline portion to vary in amount between 2.51 and 4.83 per cent., and in composition between $Fe_2Cl_6.11Fe_2O_3$ and $Fe_2Cl_6.31Fe_2O_3$. A solution which, when evaporated on a water-bath until the residue is pulverulent and weighs 5 per cent., has, according to E. B. Shuttleworth (1877), the spec. grav. 1.034. If 5 per cent. of residue is left after completely drying in a water-bath, the spec. grav. is 1.040; and if the same amount of residue is left after ignition, the spec. grav. of the solution is 1.046.

Prof. E. Scheffer (1878) shows that by precipitation with ammonia very basic oxychlorides of iron may be obtained, which, after having been thoroughly washed, will slowly dissolve in distilled water. The limits at which a soluble precipitate is obtained appear to have been reached on mixing 150 volumes of the officinal solution of ferric chloride with 91.5 volumes of ammonia water. The washed precipitate contained 97.83 per cent. Fe_2Cl_6 to 2.17 per cent. Fe_2Cl_6, and required over seven weeks for effecting solution in distilled water. The preparation known in some parts of Europe as *Ferrum catalyticum* is probably made by a similar process.

On precipitating a solution of ferric chloride with an excess of ammonia, the hydrate of iron invariably retains ammonia, and, on being added to ferric chloride, ammonium chloride is produced, which sets a limit to the solution of ferric hydrate; the basicity of such a preparation must necessarily be in an inverse ratio to the quantity of ammonium chloride contained in it, but it may be increased by subjecting it to dialysis.

The process of *dialysis* depends upon the difference in the diffusing power possessed by solid bodies when in solution. Graham (1861) ascertained that the power of diffusing from one liquid into another is greatest in those bodies which are capable of assuming a crystalline form, and that those which are amorphous and capable of forming with water a gelatinous mass, are but very slightly and slowly diffusible. He distinguished the former as *crystalloids*, and the latter as *colloids*. When both are together in aqueous solution, and separated by a septum of animal membrane or parchment paper from water, the crystalloids only will pass through the septum, and may thus be completely separated from the colloids. The dialyser or dialysator is

Fig. 72.



a, Dialyser; *b*, The same in use.

conveniently made from a section of a glass cylinder or a wooden hoop, or from gutta percha, or similar insoluble material. The septum is made to cover one aperture of the short cylinder, and, after having been securely fastened, is permitted to project above. If the dialyser is larger than about 10 or 12 inches in diameter, its sacking in the centre may be prevented by means of a net, stretched over it, or used for supporting it. The liquid should not be more than about one-half inch deep upon the septum, and should never be immersed below the surface of the water in the outer vessel; on the contrary, it is best to keep the surface of the dialyzing liquid higher, so as to prevent it from becoming too dilute by the upward dialysis of water. The water in the receiving vessel should be changed daily, or, if possible, provision should be made for a continuous supply of distilled water, and for the simultaneous removal of the saline solution from the bottom. The extent of surface of the septum, depth of the dialyzing liquid, and the frequency of renewal of the water in the receiver, are the main conditions which influence the success of the process. The dialysis of a solution of oxychloride of iron requires from 1 to 2 weeks, and is known to be finished when the liquid has lost its ferruginous taste, and the dialysate or diffusate in the receiver shows merely traces of chlorides. The residue upon the septum is then assayed by evaporating 100 grains of it, in a water-bath, to complete dryness; from the weight obtained the amount of water which is necessary to bring the whole amount of the liquid to the standard of 5 per cent. is easily determined. If the process has been properly managed, evaporation will not be necessary, and should be avoided, as it interferes with the stability of the preparation.

The best material for the septum is *parchment paper*, which is made by immersing unsized paper for a short time, and at the ordinary temperature, in sulphuric acid, sp. grav. 1.56 to 1.60; the paper is afterwards well washed with water. Bladder may likewise be used, but is less efficient. A bladder may be completely filled with the solution of ferric oxychloride, well tied, and immersed in water; it must be strong enough to sustain a considerable amount of pressure caused by the dialysis of water into the iron solution.

Medical Action and Uses.—The merits of dialyzed iron are claimed to be that it has no styptic taste, mixes well with water in any proportion, and does not stain the teeth or cause constipation. On pharmaceutical grounds "the action of dialyzed iron upon animal products forbids us to suppose *à priori* that it acts like other ferruginous preparations" (Depaire); and a very competent judge (Bouchardat) has declared that, "theoretically, dialyzed iron must be regarded as an inert, or, at best, a very feeble preparation of iron." We have found it utterly to fail in cases for which iron appeared to be the proper remedy, and which other preparations caused to speedily improve. The *dose* is about thirty drops. The following formula has been employed: ℞. Ferri oxid. dialysat., Aquæ cinnamomi, āā f℥j; Glycerin., Alcohol. dil., āā fʒiss.—M. S.—A dessertspoonful three or four times a day. If the views elsewhere expressed of iron as an antidote to arsenic be correct, the proposed use of dialyzed iron for the purpose is unwarranted.

FERRUM REDACTUM, *U. S.*, *Br.*—REDUCED IRON.

Ferrum reductum, P. G.; *Ferrum hydrogenio reductum, Ferrum ope hydrogenii paratum.—Iron reduced by hydrogen, Iron by hydrogen*, E.; *Fer réduit par l'hydrogène*, Fr.; *Reducirtes Eisen*, G.

Preparation.—Take of Subcarbonate of Iron thirty troyounces. Wash the subcarbonate thoroughly with water until no traces of sulphate of sodium are indicated by the appropriate tests, and calcine it in a shallow vessel until free from moisture. Then spread it upon a tray, made by bending an oblong piece of sheet iron in the form of an incomplete cylinder, and introduce this into a wrought-iron reduction-tube, of about four inches in diameter. Place the reduction-tube in a charcoal furnace; and, by means of a self-regulating hydrogen generator, pass through it a stream of hydrogen gas, previously purified by bubbling successively through solution of subacetate of lead diluted with three times its volume of water, and through milk of lime, severally contained in four-pint bottles about one-third filled. Connect with the further extremity of the reduction-tube a lead tube bent so as to dip into water. Make all the junctions air-tight by appropriate lutes; and, when the hydrogen has passed long enough to fill the whole of the apparatus to the exclusion of atmospheric air, light the fire, and bring that part of the reduction-tube occupied by the subcarbonate to a dull-red heat, which must be kept up so long as the bubbles of hydrogen, breaking from the water covering the orifice of the lead tube, are accompanied by visible aqueous vapor. When the reduction is completed, remove the fire, and allow the whole to cool to the ordinary temperature, keeping up, during the refrigeration a moderate current of hydrogen through the apparatus. Withdraw the product from the reduction-tube, and, should any portion of it be black instead of iron-gray, separate such portion for use in a subsequent operation. Lastly, having powdered the reduced iron, keep it in a well-stopped bottle.

When thirty troyounces of subcarbonate of iron are operated on, the process occupies from five to eight hours. *U. S.*

Take of Hydrated Peroxide of Iron one ounce; Zinc, granulated, a sufficiency; Sulphuric Acid a sufficiency; Chloride of Calcium a sufficiency. Introduce the hydrated peroxide of iron into a gun-barrel, confining it to the middle part of the tube by plugs of asbestos. Pass the gun-barrel through a furnace, and when it has been raised to a strong red heat, cause it to be traversed by a stream of hydrogen gas developed by the action on the zinc of some of the sulphuric acid diluted with eight times its volume of water. The gas before entering the gun-barrel must be rendered quite dry by being made to pass first through the remainder of the sulphuric acid, and then through a tube eighteen inches long, packed with small fragments of the chloride of calcium. The further end of the gun-barrel is to be connected by a cork with a bent tube dipping under water, and when the hydrogen is observed to pass through the water at the same rate that it bubbles through the sulphuric acid, the furnace is to be allowed to cool down to the temperature of the atmosphere, the current of hydrogen being still continued. The reduced iron is then to be withdrawn, and inclosed in a dry stoppered bottle. *Br.*

In all essential details the two processes are identical. The drying of the hydrogen is unnecessary, but provision must be made to prevent the acid liquid in which hydrogen is generated from being mechanically carried over; this is effected by passing the gas through an empty vessel before it enters the reduction-tube, or through basic acetate of lead, which will retain also gaseous impurities with which the hydrogen may be contaminated from impurities of the zinc or acid. The reduction-tube, we think, should be filled with hydrogen gas before it is heated to redness. The heat converts the ferric hydrate used into ferric oxide, which is decomposed by the hydrogen with the liberation of iron and the production of water; $Fe_2O_3+3H_2$ yields Fe_2 and $3H_2O$. That the reduction has been completed is ascertained from the absence of aqueous vapor in the bubbles breaking through the water, or from the uniform rapidity with which the bubbles pass both through the water and through the liquid placed between the generator and reduction-tube. After the fire is withdrawn, the reduced iron would burn again to ferric oxide, if it were allowed to come into contact with oxygen while warm; the hydrogen must therefore be continually passed through the reduction-tube until the temperature has been lowered to that of the surrounding atmosphere.

Various other methods have been suggested for obtaining reduced iron, but they do not appear to be used on a large scale. For reduction in a current of hydrogen Peligot (1844) proposed ferrous chloride, and Woehler (1855) ferrous oxalate, or an oxide obtained by strongly heating a mixture of ferrous sulphate and sodium chloride, and washing out the soluble salt. A. Morgan (1854) recommended the calcination of a mixture of ferric oxide, potassium ferrocyanide, and potassium carbonate, each previously deprived of water. Zaengerle (1857) used ferrous oxalate instead of ferric oxide. After cooling, the mass requires to be well washed and dried.

Properties.—Reduced iron is a very fine gray powder, free from metallic lustre, but exhibiting metallic streaks when rubbed with firm pressure in a mortar, and yielding a lustrous scale when struck on an anvil with a hammer. It is wholly dissolved by dilute muriatic or sulphuric acid with the evolution of hydrogen, which is free from noxious odor, and does not impart a black color to filtering paper moistened with solution of lead acetate, and stretched over the orifice of the test-tube; the black color would be due to the presence of sulphur resulting from the sulphate which remains in incompletely washed ferric hydrate. The solution obtained should not assume a red color when tested with sulphocyanide of potassium, proving the absence of ferric or rather magnetic oxide; the presence of magnetic oxide is indicated by the black instead of gray color of the powder. Treated with iodine or bromine, dissolved in solutions of potassium iodide or bromide, the iron will be all dissolved, while the black oxide remains behind; the former is used as a test by the British, the latter by the German Pharmacopœia, both permitting 50 per cent. residue, which should be completely soluble in hydrochloric acid. When reduced iron is touched with a lighted taper, it ignites and burns to brown ferric oxide.

Tests.—The pharmaceutical purity of reduced iron is indicated by the behavior described above; but the exact amount of the most generally present oxide is not easily determined. For an interesting paper on this subject by Mr. Creuse, consult *Proceedings of the Amer. Pharm. Association*, 1874, p. 435. In this paper it is suggested to determine the amount of pure iron from the measure of the hydrogen given off. The presence of oxides, however, appears to interfere with the correctness of the results. Schacht (1877) regards the following as sufficient evidence of purity: It is "a very fine gray powder without gloss; when heated in the air it burns to ferric oxide. It is completely soluble in warm diluted pure muriatic acid, with the evolution of hydrogen, which is indifferent to lead paper. When treated for half an hour, at the ordinary temperature and with occasional agitation, with 25 times its weight of solution of ferric chloride, sp. gr. 1.30, it is completely dissolved."

FERRUM PULVERATUM or *pulverized iron* may be mistaken for reduced iron. It is made in Europe on a large scale from a good quality of cast iron, and therefore contains carbon. It has the general properties of reduced iron, from which it differs in being denser, in being of a distinct metallic lustre, and in not igniting when touched with a lighted taper; the hydrogen evolved by it has a distinct odor, but should contain traces only of sulphuretted hydrogen. The solution of iron in muriatic acid should not yield a dark color or precipitate with sulphuretted hydrogen (absence of lead, copper, etc.), and when oxidized with nitric acid and treated with ammonia in excess, the filtrate should be colorless (copper, etc.), and not be rendered turbid by hydrosulphate of ammonium.

Off. Prep.—Pil. ferri iodidi, *U. S.*

Medical Action and Uses.—This preparation was originally proposed as a substitute for subcarbonate of iron, as being less bulky, and, therefore, more likely to agree with the stomach; but not improbably there happened in this case what has often been observed when the nutritious elements of food were substituted for that form of it which nature provided. In point of fact it is even more likely to derange the stomach than the preparation mentioned, partly on account of the impurities it sometimes contains to the extent of fifty per cent., and partly because it is very apt to cause the formation in the stomach, and the eructation, of sulphuretted hydrogen. Moreover, when given in pills and pastilles, they often escape the solvent power of the digestive juices, and are evacuated in the same form in which they were swallowed. The only way in which it can be administered with an assurance of its solution and absorption is to give it at meal times, or immediately afterwards, in a wafer or suspended in a little water. It may be prescribed in the *dose* of from one to five grains.

FICUS, *U. S.*, *Br.*—FIG.

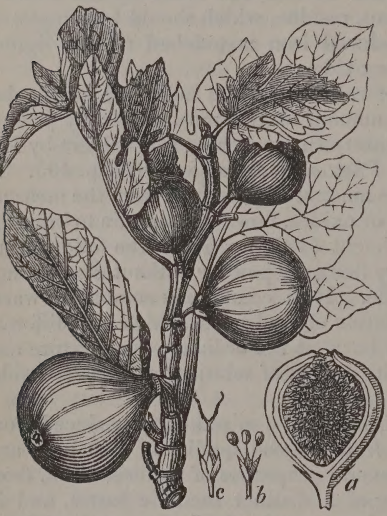
Caricæ, P. G.; *Ficus passa*, *Fici*, *Fructus caricæ.*—*Figue*, Fr.; *Feige*, G.

The fleshy receptacle, bearing fruits upon its inner surface, of Ficus carica, *Lin.* Steph. and Church, Med. Bot. plate 154; Bentley and Trimen, Med. Plants, 228.

Nat. Ord.—Urticaceæ, Artocarpeæ.

Origin.—The fig tree is indigenous to Western Asia, and has been cultivated from a very remote period. At present it is cultivated in most countries of the Old and New World which lie in the warmer temperate regions, in many of which it is also found wild. It attains a height of about 18 feet, is irregularly branched, has rough palmately lobed, irregularly toothed subcordate leaves, in the axils of which appear the fleshy hollow receptacles, upon the inner surface of which the minute flowers are situated, the few staminate flowers being placed near the mouth.

Fig. 73.



Ficus carica, *Lin.*—*a.* Section of fig. *b.* Staminate, *c.* Pistillate flower.

Description.—The receptacle, erroneously called fruit, is pear-shaped, short-stalked, and about 3 inches long; in the green state it contains a milky, acrid juice, which changes to saccharine, the color of the receptacle becoming yellowish and purplish. The orifice is surrounded by several fleshy scales, and the greater portion of the inner surface is covered in the ripe fig by numerous small yellowish akenes, popularly called seeds. Figs have a peculiar fruity odor, and a very sweet, somewhat mucilaginous taste. A warm and dry climate is best adapted for growing figs with the view of preserving them in the dry state.

They are dried either by artificial heat or by exposure to the sun, and packed in this condition (*natural figs*), or they are rendered pliant by kneading and squeezing, and then packed and pressed into boxes (*pulled figs*). In the latter condition they are always of a very irregular shape, yellowish, somewhat translucent, and covered with effloresced sugar. The large pulpy figs are known as *Turkey* or *Smyrna figs*, the small and drier ones as *Greek figs*.

Constituents.—Exclusive of the akenes, which, together with the cellular tissue, Bley (1831) found to constitute about 15 per cent. of the weight of figs, he obtained 16 per cent. of water, 62.5 per cent. of sugar (glucose), the remainder being, gum, fat, and saline constituents.

Off. Prep.—Conf. sennæ, *U. S.*, *Br.*

Medical Uses.—The saccharine and mucilaginous constituents of figs render them nutritive, and in their fresh state laxative. The laxative operation of dried figs is mainly due to the indigestibility of their seeds and tough skins, which also tend to occasion flatulence. They form an agreeable addition to the various ptisans employed in *catarrhal affections* of the air-passages and other mucous canals, and roasted figs have, from time immemorial, formed convenient cataplasms for *gum-boils*, *abscesses* of the *anus*, *vulva*, etc.

FILIX MAS, *U. S.*, *Br.*—MALE FERN.

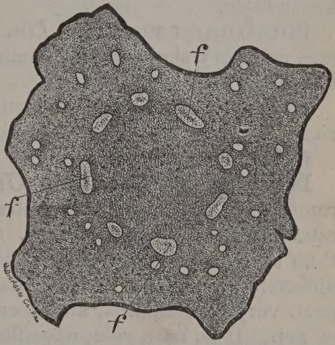
Rhizoma filicis, P. G.; *Radix filicis maris.*—*Male shield fern*, E.; *Rhizome* (*Racine*) *de fougère mâle*, Fr.; *Wurmfarnwurzel*, *Waldfarnwurzel*, *Johanniswurzel*, G.

The rhizome covered with portions of the stipes of Aspidium (Nephrodium, *Brown;* Polypodium, *Lin.*) filix mas, *Swartz.* Woodv., Med. Bot. plate 271.

Nat. Ord.—Filices.

Origin.—Male fern is indigenous to Canada, westward to the Pacific Ocean, thence south along the Rocky Mountains to Mexico and a considerable portion of South America; to some of the Polynesian Islands; to the greater portion of Asia north of the Himalaya Mountains; and to Europe and some parts of Africa. The rhizome is 6 to 12 inches long, has the old portion densely covered with the remnants of the stipes, and produces at the living end from 3 to 6 fronds, which are 1 to 3 feet high, lanceolate in outline, with linear-lanceolate, pinnate, or pinnatifid leaflets, and with oblong obtuse pinnules, which are serrate at and near the apex, and bear the fruit-dots in two rows near the midrib. The rhizome is collected in the autumn.

Fig. 74.



Transverse section of rhizome of Aspidium filix mas, *Sw.*—*f.* Fibro-vascular bundles.

Description.—As found in commerce it is 3 to 6 inches long, and with the closely imbricated remnants of the stipes 2 to 3 inches thick. The latter remain green in their lower portion for several years, and are, like the rhizome itself, densely covered with a brown chaff, consisting of thin transparent scales; between the stipes are the black wiry rootlets. The rhizome itself is fleshy, about 1 inch in diameter, internally of a pale-green color, and shows upon the transverse section near the surface 8 to 12 larger fibro-vascular bundles, arranged in a circle, outside of which are a number of smaller ones. The stipes have about 8 vascular bundles in a loose circle. It has a slight disagreeable odor and a sweetish, afterward somewhat bitter, acrid, and astringent taste. For medicinal purposes, the dead portions of the stipes and rhizome must be removed, and the green part only retained, which should be at once dried, powdered, and exhausted by ether for preparing the oleoresin.

Constituents.—Male fern has been frequently analyzed. Geiger (1826) obtained 6.9 per cent. of green fixed oil, which Luck (1851) found to consist of the glycerides of *filixolic* and *filosmylic acids*, the last of which is volatile. The tannin of older authors was separated by Luck into two acids, *tannaspidic* and *pteritannic acids*, the last only being soluble in ether, both coloring ferric salts green. Malin (1867) found only one tannin, *filitannic acid*, which on being boiled with dilute sulphuric acid is split into sugar and *filixred*, the latter in an impure condition, being Luck's tannaspidic acid. Peschier (1826) obtained from the ethereal extract granular crystals, which Luck named *filicic acid*. Jabowski (1867) gave it the formula $C_{14}H_{18}O_5$, and found it to be decomposed by potassa near the fusing point, into *phloro-glucin* and butyric acid. Pavesi's *aspidin* (1861) is a very impure filicic acid, which is probably the main active ingredient. Starch, gummy matter, sugar, and 2 to 3 per cent. of inorganic salts are the less important constituents.

Allied Drugs.—ASPIDIUM MARGINALE, *Willd.*, differs from male fern mainly in having a thicker almost coriaceous frond with somewhat scythe-shaped nearly entire pinnules, and the fruit dots close to the margin. The rhizome closely resembles the officinal drug, from which it is distinguished by its rather smaller dimensions and smaller vascular bundles, which are about six in number. It appears to be often collected in the United States, where it is indigenous, in place of male fern. J. L. Patterson (1875) obtained from it filicic acid and a tannin similar to if not identical with that of filix mas. C. H. Cressler (1878) found the oleoresin effectual in several cases of tapeworm.

ASPLENIUM FILIX FŒMINA, *Bernh.*, and ASPL. THELYPTEROIDES, *Mich.*, have thin rhizomes which are densely covered with black, thin, two-edged remnants of the stipes; and have numerous black roots, but little scaly chaff.

ASPIDIUM SPINULOSUM, *Swartz*, has a thin rhizome, with about six small fibro-vascular bundles, and with dark-brown nearly cylindrical stipe remnants, between which little or no chaff is found.

OSMUNDA REGALIS, *Lin.* The rhizome is about half an inch thick, densely covered with numerous brown stipe remnants, and of a mucilaginous, slightly bitter taste.

POLYPODIUM VULGARE, *Lin.* The rhizome is thin, flattish, with rather distant and very short stipe remnants on the upper side, and with hair-like roots on the lower side.

Aspid. marginale and Asplen. thelypteroides are indigenous to North America; the other species are found both here and in Europe.

Off. Prep.—Oleoresina filicis (Extr. filicis liquid.), *U. S.*, *Br.*

Medical Action and Uses.—Male fern was anciently known to be a remedy for *tænia* and other intestinal worms, but its reputation was more firmly established in the last century. It is more efficacious in removing the unarmed than the armed tænia, unless the latter be young. The methods employed by different physicians in the treatment of tænia by male fern are, for the most part, very complicated, and seem devised more in a spirit of charlatanism than of art. It is, as a rule, essential that the bowels should contain no accumulation of partially digested food or of feces, and that the vigor of the parasite should be reduced by as low and simple a diet as can well be borne, and chiefly in a liquid form, as milk or broth. Early in the morning, fasting, the patient should take from thirty to ninety grains of powdered male fern, at a single dose, or in divided doses at short intervals. The oleoresin of male fern, in the dose of from ten to twenty drops, may be administered along with the powdered root, or, in feeble persons, by itself. About an hour after the last of these doses an active purge of calomel with jalap or amboge is sometimes administered; but generally an ounce of castor oil will suffice. Some prefer Epsom salts. It is by certain authorities recommended to give a full dose of sulphuric ether shortly after the purgative medicine for the purpose of rendering the detachment of the parasite easier. Since the introduction into practice of the oleoresin of male fern, this preparation should be given, instead of the powder, in the *dose* of from half a fluidrachm to a fluidrachm, at intervals of an hour, for two or three times, and be followed by a purge. The oleoresin is conveniently administered in gelatin capsules. The *dose* of filicic acid is about thirty grains.

FŒNICULUM, *U. S.*—Fennel.

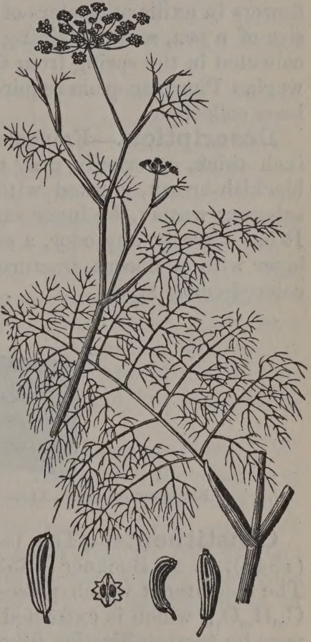
Fœniculi fructus, Br.; *Fructus fœniculi*, P. G.; *Semen fœniculi.*—*Fennel fruit, Fennel seed*, E.; *Fruits* (*Semences*) *de fenouil*, Fr.; *Fenchelsamen*, G.

The fruit of Fœniculum vulgare, *Gaertn.* (s. F. officinale, *All.*, s. Anethum fœniculum, *Lin.*).

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The fennel is indigenous to Southern Europe, and is frequently found wild in Western and Southeastern Europe and in Western Asia. Commerce is mainly supplied with the fruit from Germany and France. The plant is an herbaceous perennial, varying in cultivation considerably in size and in its fruit. The stem is three to six feet high, somewhat furrowed, green, and glaucous; the leaves are decompound or twice pinnate, with the pinnæ very narrow; the umbels are at the top of the stem, compound, large, and without involucre or involucel. All parts have an agreeable aromatic odor and a sweetish aromatic taste.

Fig. 75.



Fœniculum vulgare.

Description.—The fruit is oblong in shape, nearly cylindrical, and readily splitting at maturity into the two mericarps which often become somewhat curved. The face is broad and flat, the back rounded, and has five prominent obtuse ribs of a light-brown color, the intervening furrows being almost blackish-brown. There are usually six oil tubes, one under each furrow, and two, or in some varieties two pairs, on the face.

The commercial varieties are *Saxon* or *German fennel*, which is about one-quarter of an inch long, and of a brownish tint; and *Roman fennel*, which is nearly twice as large, is of a distinct greenish tint, and has a stronger and more pleasant odor. The latter is often referred to *Fœn. dulce*, D. C., but appears to be merely a variety of F. vulgare produced by cultivation.

Constituents.—Fennel contains about 12.5 per cent. of fixed oil, some sugar, and from 2 to 4 per cent. of volatile oil, to which the sweet taste of the fruit is chiefly due. (See Oleum fœniculi.)

Off. Prep.—Aqua fœniculi, *U. S.*, *Br.*; Tinct. rhei et sennæ, *U. S.*

Medical Action and Uses.—Employed by the ancients as a carminative and digestive stimulant, and to promote the secretions, it continues to be used for like purposes at the present day. It is still alleged to increase the secretion of milk, urine, perspiration, and mucus, and to be an active emmenagogue. It is most commonly used as an ingredient in carminative compounds, or as a simple infusion for the relief of *nausea* and of *colic*. It is very appropriate in hot infusion, as an adjuvant, in the treatment of *amenorrhœa* from uterine congestion, and for re-establishing the *lacteal secretion* when suppressed. An infusion of fennel may be made with sixty grains of the bruised seed in half a pint of boiling water. Of this a teaspoonful may be given at short intervals to an infant, and a wineglassful to an adult.

FRANGULA.—Frangula Bark.

Cortex frangulæ, P. G.—*Alder buckthorn, Black alder*, E.; *Bourdaine, Bourgène*, Fr.; *Faulbaumrinde*, G.

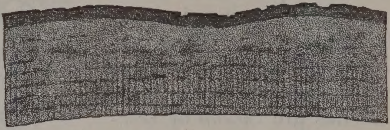
The bark of Rhamnus frangula, *Lin.*, s. Frangula vulgaris, *Reichenb.* Bentley and Trimen, Med. Plants, 65.

Nat. Ord.—Rhamnaceæ.

Origin.—The alder buckthorn is a shrub, about 10 to 15 feet high, which grows in wet places from the northern coast of Africa, throughout Europe, and extending eastward into Siberia. It has alternate elliptic, oval or obovate entire leaves, which are obtuse or slightly pointed at the apex; greenish hermaphrodite flowers in axillary clusters of three or five, and red, finally black berries of the size of a pea, and containing two or three roundish-angular seeds. The bark is collected in the spring from the younger trunks and large branches. The Norwegian Pharmacopœia requires it to be used not sooner than a year after it has been collected.

Description.—Frangula bark is in small quills, about one-twenty-fifth of an inch thick, externally gray or grayish-brown, or from the younger branches blackish-brown, marked with numerous small, whitish, transversely elongated suberous warts; the inner surface is smooth, orange-yellow or brownish-yellow. It has scarcely any odor, a sweet and bitterish taste, and breaks in the inner layer with a fibrous fracture, showing the yellow bast fibres, and a purplish-colored corky layer.

Fig. 76.



Rhamnus frangula, *Lin.*—Transverse section of bark magnified fifteen diameters.

Constituents.—The bark was analyzed by Gerber (1828), Binswanger (1849), L. A. Buchner (1853), Casselmann (1857), Phipson (1859), and others. The constituent which possesses most interest is *frangulin* or *rhamnoxanthin*, $C_{20}H_{20}O_{10}$, which is extracted from the bark by carbon bisulphide, and obtained pure by recrystallization from alcohol and ether. It is a lemon-yellow crystalline mass, of a slight silky lustre, without odor and taste; by sublimation it is obtained in yellow needles. It is insoluble in water, slightly soluble in cold alcohol and ether, and freely soluble in alkalies with a bright-purple color. It dyes silk, wool, and cotton, and is resolved by acids into sugar and frangulic acid, $C_{14}H_{10}O_5$. The bark contains also a yellow resinous principle, tannin, producing brown-green precipitates with iron salts, an amorphous bitter principle which appears to have a purgative action, and various ordinary principles. It yields five or six per cent. of ash. The odor of the fresh bark is due to a volatile principle which has not been isolated. Liebermann and Waldstein (1876) obtained *emodin* from old frangula bark.

Medical Action and Uses.—The fresh bark excites nausea, colic, vomiting, and violent purging, but by drying it loses in some degree its acrid qualities, and is then used in Germany as a domestic purgative. It is stated to be employed as a substitute for rhubarb, but its action is much harsher. A decoction of it is sometimes used in *dropsy;* and the same preparation, as well as an ointment prepared with the fresh bark, is employed in treating the *itch.*

FRASERA, *U. S.*—AMERICAN COLUMBO.

Radix fraseræ, Radix columbo americanæ.—Racine de colombo de Mariette (d'Amérique,) Fr.; *Fraserawurzel, Amerikanische Columbowurzel,* G.

The root of Frasera Walteri, *Mich.* (Fr. Caroliniensis, *Walt.*).

Nat. Ord.—Gentianaceæ.

Origin.—This is a tall biennial or triennial herbaceous plant, indigenous to the United States, where it grows in rich and moist soil west of the Allegheny Mountains, from New York southward, and in the Southern States. The plant is smooth, 5 to 10 feet high; the leaves are in whorls of about 6, sessile, entire, oblong, and parallel veined. The yellowish white flowers form a large pyramidal panicle, and bear a large roundish gland in the middle of each corolla lobe; the fruit is a flattened capsule containing several seeds. The root should be collected in the autumn of the second year.

Description.—In general aspect American colombo resembles gentian root, except that it is of a lighter and more distinctly yellow color internally, and of a light orange-brown externally. When dried in transverse slices, the outer layer of the bark projects above the shrunken tissue of the fleshy central portion, and this with the yellow tint gives it a faint resemblance to colombo, from which it is easily distinguished by the absence of the projecting vascular bundles in the interior, and of the radiating zone near the cambium. It is now generally dried in longitudinal slices, the bark overlapping. The tissue upon transverse section is pretty uniform in appearance, the woodbundles being nearly imperceptible in the fleshy parenchyma; the rather thick bark shows two different colored layers, and a dark brown cambium line separates it from the meditullium. When dry it has a slight odor; the odor of the infusion is similar to that of gentian; the taste is sweet and bitter, and free from astringency and aroma.

Constituents.—Frasera root was analyzed by J. W. Douglass (1840), W. R. Higinbotham (1857), and F. W. Thomas (1868), who proved the absence of starch, and the presence of pectinaceous and saccharine compounds in it. Douglass noticed the dark coloration produced in the infusion by ferric salts, and attributed it to tannin. G. W. Kennedy (1873) obtained from the root *gentisic acid* and *gentiopicrin.* American colombo is, therefore, very closely analogous to gentian, from which it appears to differ, chemically, in containing more of the yellow acid and less of the bitter principle than the latter.

Medical Action and Uses.—When fresh it is said to have emetic and purgative properties, and has been compared in its action to rhubarb. The dried root is reputed to have the tonic properties of simple bitters, and may be given in an infusion made with an ounce of the root to a pint of boiling water. *Dose,* one or two fluidounces.

FRAXINUS.—EUROPEAN ASH.

Frêne, Fr.; *Esche,* G.

Fraxinus excelsior, *Lin.* *Nat. Ord.*—Oleaceæ, Fraxineæ.

Description.—The European Ash, which is sometimes cultivated in the United States as a shade tree, attains a height of 120 to 150 feet, has a straight trunk, the flowers polygamous, without calyx or corolla, in lax racemes, and produces a two-celled one-seeded fruit, the apex of which is extended into a long many-nerved wing. *The bark,* which is collected from the branches in spring, is in quills, having a gray or greenish-gray color externally, numerous small gray or brownish-white suberous warts, and a smooth inner surface of a yellowish or yellowish-brown color. It is inodorous, has a bitter, astringent taste, and breaks with a smooth, and in the inner layer, fibrous fracture. *The leaves* are pinnate, composed of 11 or 13 nearly sessile leaflets, which are almost smooth, 2 or 3 inches long, vary in shape between elliptic-oblong and oblong-lanceolate, have a wedge-shaped and entire base, and are sharply serrate above.

Constituents.—The bark contains tannin, the bitter glucoside *fraxin* (see Hippocastanum), and a crystalline principle obtained by Keller by a process similar to that by which salicin may be obtained; it was at first named *fraxinin*, but was recognized as mannit by Stenhouse and Rochleder.

Garot (1853) found in the leaves malate of calcium; Mouchon's *fraxinit* is extract-like, and said to be purgative.

Medical Action and Uses.—No accurate description of the operation of this medicine has been published. Infusions of the leaves are said to be either diaphoretic or diuretic. The bark at one time enjoyed a certain vogue in Europe as a remedy for *intermittent fever*, and there seems to be no doubt that it was often used with success in cases which had proved rebellious to cinchona, so that it may be included in the large class of succedanea for Peruvian bark and its derivatives. The leaves are more or less purgative, and are said to operate like senna; but their more important use appears to have been in the treatment of *gout*. There seems to be conclusive evidence of their efficacy when administered in an infusion made with thirty grains of the leaves in half a pint of water, strained and sweetened, and taken twice or thrice daily. A similar method is reported to be successful in *articular rheumatism*. According to Pliny, serpents will avoid even the shadow of the ash, and he affirms as of his own knowledge that if a snake is inclosed in a circle of ash leaves in the centre of which are burning coals, it will plunge into the fire rather than touch the leaves. A similar fact or superstition exists in regard to the white ash (F. Americana). On the land where it grows no rattlesnake will be found; "and it is the practice of hunters and others having occasion to traverse the woods in the summer months to stuff their boots or shoes with white ash leaves as a preventive of the bite of the rattlesnake." We have several times known this precaution to be taken with full faith in its efficacy.

FUCUS VESICULOSUS, *Lin.*—BLADDER-WRACK.

Quercus marina.—*Sea wrack*, *Kelp-ware*, *Blacktang*, E.; *Fucus* (*Varech*) *vésiculeux*, Fr.; *Blasentang*, G.

Nat. Ord.—Algæ, Fucoideæ.

Description.—It grows on rocky shores of the Atlantic Ocean, attains a length of 2 or 3 feet, and has a flat branching thallus, ½ to 1 inch wide, with the margin entire, and a distinct midrib through its entire length. The vesicles are usually in pairs, separated by the midrib, spherical or oblong in shape, and occasionally attaining the size of a hazel-nut. In the fresh state it is of a brownish-green color, which becomes nearly black on drying. It has the peculiar odor of seaweeds, and a mucilaginous and saline taste.

Allied Species.—FUCUS NODOSUS, *Lin.*, is 4 to 6 feet long, and has a narrower frond or thallus without midrib, and with single vesicles, which are ovate or oblong, and usually large.

FUCUS SERRATUS, *Lin.*, has a veined and serrate frond without vesicles.

FUCUS SILIQUOSUS *Lin.*, s. Cystoseira siliquosa, *Agardh.* The frond is very narrow, 2 to 4 feet long, with short branches, articulated vesicles, and lanceolate flattened sporocarps.

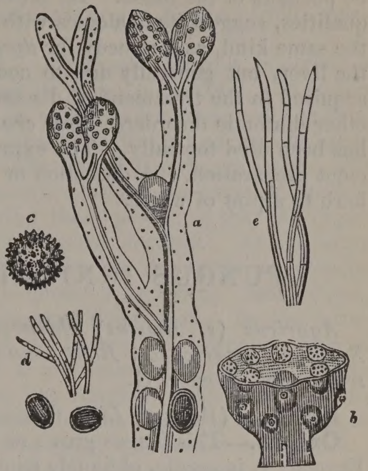
FUCUS NATANS, *Lin.*, s. Sargassum bacciferum, *Agardh*, is the *Gulf-weed* of the Atlantic Ocean, and is often found in immense masses floating in the sea.

The frond is terete, has linear and serrate branches, and globular aculeate vesicles.

Constituents.—These plants are very similar in composition. They contain mucilage, mannit, odorous oil, a bitter principle, and between 14 and 20 per cent. of ash calculated for the dried plant. Gödeschen, James, and others, found the mineral constituents of the bladder-wrack, as collected from different places, to vary to the same extent. Marchand (1865) obtained from the ash of the bladder-wrack 0.719 per cent. of iodine and 0.603 of bromine; from F. vesiculosus nearly the same amount; and from F. serratus 0.834 iodine, and 1.007 bromine.

Medical Action and Uses.—The medicinal virtues of this product depend apparently upon the iodine and bromine which it contains in common with other species of seaweed. It has been applied externally, bruised, to enlarged *scrofulous* glands, and internally it was at one time recommended as a means of lessening *obesity*. It was administered chiefly in a decoction made with from two to four drachms of the plant in a pint of water, and was alleged not to occasion atrophy of the mammæ or testes, while it reduced the fat in a notable degree. For this purpose it had a brief vogue, but is now almost forgotten.

Fig. 77.



Fucus vesiculosus, *Lin.*—*b*, section of a receptacle; *c*, conceptacle; *d* and *e*, filaments and spores.

FUMARIA.—FUMITORY.

Fumeterre, Fr.; *Erdrauch*, *Feldraute*, G.

Fumaria officinalis, *Lin.* *Nat. Ord.*—Fumariaceæ.

Description.—Fumitory is a low annual about twelve inches high, which is common in the fields throughout Europe, and more or less naturalized in most civilized countries. The entire plant is of a glaucous gray-green color; the stem is angular and much branched; the leaves are alternate, finely dissected compound, with spatulate or obovate-oblong, rather acute lobes; the flowers are in terminal and axillary racemes, have acute and sharply-toothed sepals, and a pale red and crimson or purplish corolla which is one-spurred at the base. The fresh plant has a somewhat heavy odor, and a saline, bitter, and rather acrid taste.

Constituents.—Winkler (1831) isolated *fumaric acid*, $C_4H_4O_4$, which had been obtained by Lassaigne (1819) from malic acid, $C_4H_6O_5$; the latter heated to 150° C. (302° F.) is almost completely resolved into fumaric acid and water. Fumaric acid crystallizes in colorless prisms, volatilizes partly unaltered above 200° C. (392° F.), and, when heated with hydriodic acid, or under the influence of nascent hydrogen, is converted into succinic acid. Peschier discovered the alkaloid *fumarina*. Pommier (1853) obtained it by exhausting the fresh herb with water acidulated with acetic acid, and precipitating with ammonia. It is white, crystalline, bitter, not freely soluble in water, but soluble in alcohol. The analysis of Merck proved the presence of the usual constituents of herbs.

Medical Action and Uses.—This is one of many medicines reputed to be purifiers of the blood. Its bitter taste, and its slightly laxative and diuretic qualities, suggest its analogies with dandelion. Its reputation, also, is partly of the same kind, as a remedy for *dyspeptic* derangements attributed to torpor of the liver, but generally due to constipation. But its greatest credit has been acquired in the treatment of diseases of the *skin* depending on scrofulous and other diathetic disorders. For *crusta lactea* a decoction of the plant in milk has been used topically. The expressed juice of the fresh plant is its most efficient preparation. A decoction or infusion may be made with an ounce of the herb to a pint of water.

FUNGUS IGNIARIUS PRÆPARATUS, *P. G.*

Agaricus (s. Boletus) chirurgorum s. igniarius.—*Spunk, Touchwood, Surgeon's agaric,* E.; *Bolet amadouvier, Amadou non-salpêtré,* Fr.; *Feuerschwamm, Zunder,* G.

Polyporus (Boletus, *Lin.*) fomentarius, *Fries.* *Nat. Ord.*—Fungi.

Origin.—This fungus grows on beech and oak trees in Southern and Middle Europe; it is sessile, obliquely triangular, brown-gray externally, and yellowish-brown internally. The hard rind is removed, and the fungus cut into thin slices, which are soaked in water, boiled in weak lye, washed, and beaten with mallets until soft. It is then ready for surgical purposes. For use as tinder it is soaked in a saturated solution of nitrate of potassium.

Description.—Surgeon's agaric is in thin, flat pieces, tasteless, of a faint odor, and rust-brown color, somewhat glossy, very soft and velvety.

Polyporus igniarius and *marginatus*, Lin., yield a similar but harder product.

Surgical Action and Uses.—On account of its combined lightness, elasticity, toughness, and porosity, this substance has long been used to arrest *hemorrhage* from slight wounds, and especially from leech-bites. It should be secured in its place by a bandage or other pressure. When prepared with nitrate or with chlorate of potassium it may be formed into cylinders and used as a *moxa.* Its physical qualities give it a superiority over all other substances to be insinuated between the ulcerated skin and an *ingrown toe-nail.* The success of this treatment depends upon preventing any movement of the parts by means of a narrow strip of adhesive plaster wound around the toe.

FUNGUS MUSCARIUS.

Fly fungus, Fly agaric, E.; *Agaric mouche, Fausse oronge,* Fr.; *Fliegenschwamm,* G.

Amanita muscaria, *Pers.*, s. Agaricus muscarius, *Lin.* *Nat. Ord.*—Fungi.

Origin.—This European fungus grows in autumn chiefly under pine trees; allied poisonous species are met with in most countries. Some species of the same genus are edible.

Description.—The stalk is three to six inches high, and about three-quarters of an inch thick, white. The cap (pileus) is flattish or convex, scarlet or orange-red, more or less covered with white warts, and on the under side with white lamellate gills (hymenium). It has a disagreeable odor, and a burning, acrid taste. Infused with milk, it is used for poisoning flies; hence the name.

Constituents.—The poisonous principle, according to Apoiger (1851), is a crystallizable acid, soluble in ether, and precipitated by acetate of lead. Leteiller (1866) called it *amanitin*, which is brown, amorphous, tasteless, insoluble in ether, soluble in water, and not precipitated by lead salts or gallic acid.

Sicard and Schoras (1865) announced that various toadstools contain a poisonous volatile alkaloid; the volatile alkaloid obtained by Apoiger had a very disagreeable odor, but was not poisonous. Schmiedeberg and Koppe (1869) separated a poisonous alkaloid *muscarina.*

Physiological Action. *On Animals.*—After subcutaneous injection of muscarina in a frog, the heart loses by degrees its power to contract, and at last stands still in diastole. Although it cannot be stimulated mechanically to contract, its power may be restored by atropia, daturia, digitalin, and various other agents. If the animal be already under the influence of atropia, muscarina will not produce its characteristic effects. In mammals large doses increase the frequency of the heart's pulsations while limiting their power, so that the organ grows more and more dilated, and the blood-pressure declines. At the same time, as might be anticipated, the blood accumulates in the lungs and venous system, causing more or less cyanosis, with symptoms of asphyxia. Small doses, on the other hand, quicken without embarrassing respiration. In the latter cases the temperature is somewhat raised; in the former it is lowered. One of the most constant effects is salivation, which is proportioned to the dose administered, sometimes vomiting, tardy diarrhœa, but frequent defecation and increased secretion of urine. The peristaltic action of the bowels is sometimes so vigorous as to be visible through the skin. The pupil is generally contracted.

On Man.—In large doses it occasions violent and fatal symptoms.

A case is on record in which several soldiers who had eaten of this fungus presented the following phenomena: anxiety, burning thirst, oppressed breathing, severe colic, a small and irregular pulse, cold sweats, sunken features, with a cyanotic hue of the nose, lips, hands, and feet; general twitching of the muscles, distension of the abdomen, fetid evacuations from the bowels, delirium, and great anguish until death. It is employed by many Siberian tribes to produce excitement and inebriation; and it imparts to the urine an intoxicating quality which continues for a considerable time after taking it. "A man, for example, may have intoxicated himself to-day by eating some of the fungus; by the next morning he will have slept himself sober; but by drinking a teacupful of his urine he will become as powerfully intoxicated as the preceding day." (Pereira.)

A very interesting case of poisoning by this fungus, which occurred at Calcutta, is related by Dr. Chevers. An accomplished gentleman, of temperate habits, having partaken of some mushrooms at breakfast, went to court, and was surprised to find that he could not control his actions; every thing and person appeared to him ludicrous; he laughed immoderately in open court, and ridiculed, in an absurd way, his superior officer. After some hours he recovered, but was naturally alarmed at his attack, of which he did not suspect the cause. His physician, to console him, promised to return to luncheon, at which, among other dishes, were stewed mushrooms. Of these he ate, and before the meal was finished he became very much excited; every person appeared ridiculous; the most ordinary remark seemed full of fun and wit, and his laughter was immoderate. Every object appeared to him perfectly beautiful. These exaggerated sensations continued for some hours, and were put an end to by the administration of ipecacuanha, which caused him to disgorge a considerable quantity of the fungi still undigested. No after ill effects were experienced. It will be observed that in this narrative there is absolutely nothing to suggest, or to be explained by, the results of the physiological experiments above described. But in the fatal cases above referred to, the cyanotic phenomena correspond to the effects produced in animals by lethal doses of muscaria.

Medical Uses.—At one time this fungus had a doubtful reputation for the cure of *epilepsy;* but it is no longer used in medicine.

GALANGA.—GALANGAL.

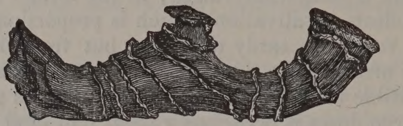
Radix galangæ minoris.—*Galanga*, Fr.; *Galgant*, G.

The rhizome of Alpinia officinarum, *Hance.* *Nat. Ord.*—Zingiberaceæ.

Origin.—The galangal plant resembles a flag, has stems about 4 feet high, and white flowers, veined with red, in terminal racemes. It is indigenous to the island of Hainan in the south of China, and probably also to the adjacent mainland.

Description.—The rhizome appears in commerce in sections about 2 inches long, $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter, frequently with 1 or 2 short branches. It has externally a rust-brown color, is longitudinally striate, and transversely marked with the short remnants of the leaf sheaths. It is rather tough, breaks with a somewhat fibrous fracture, is internally grayish-brown, and on a transverse section shows the nucleus sheath as a dark-colored circular line, and the tissue containing scattered oil-cells and wood-bundles, the latter being more numerous in the central portion. Galangal has an agreeable aromatic odor, which becomes more prominent on bruising the rhizome, and a pungent taste, somewhat resembling that of ginger.

Fig. 78.



Galangal.

Constituents.—Galangal contains about one-half per cent. of a pale-yellow or brownish-yellow volatile oil, which is lighter than water, and, according to Vogel (1844) has the composition $C_{10}H_{18}O$. The water distilled from galangal contains ammonium carbonate (Vogel). The pungent taste of the rhizome, according to Bucholz, is due to a soft resin which has not been further examined. Brandes (1839) obtained by means of ether a brown oleoresin containing crystals of *kæmpferid*, which, when pure, are yellowish, pearly, tasteless, and inodorous, and are colored by sulphuric acid first yellow, afterwards dark green.

Allied Drug.—ALPINIA GALANGA, *Willd.*, of Java, yields the *greater galangal*, *radix galangæ majoris*, which is rarely seen in our commerce. It is longer and thicker than the preceding, externally brown-red, internally grayish or buff colored.

Medical Action and Uses.—Galangal is an aromatic and, therefore, a local and general stimulant, resembling ginger in its qualities and effects. It was formerly held in high repute as a stomachic for promoting *digestion* and relieving *flatulence.* It was also employed for correcting nausea and preventing *vomiting* due to indigestible food, and also occurring as symptoms of febrile diseases of a typhoid type. Its somewhat acrid taste renders it unsuitable for administration in powder, which may, however, be prescribed in the *dose* of twenty or thirty grains. It is preferably given in an infusion made with an ounce of the bruised root to a pint of water. A tincture is also employed in the *dose* of a fluidrachm.

GALBANUM, *U. S.*, *Br.*—GALBANUM.

Gummi-resina galbanum.—*Galbanum*, Fr.; *Mutterharz*, *Galban*, G.

The gum-resin obtained from Ferula galbaniflua, *Boiss. and Buhse.* Bentley and Trimen, Med. Plants, 128.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—This plant is indigenous to Northern Persia. The stem is 4 or 5 feet high; the radical leaves are large, triangular, decompound pinnate, and pinnatifid, with the ultimate sections linear and obtuse; the stem-leaves are small; the fruit is somewhat winged near the face of the mericarps, the ribs are prominent and slender, and the oil-tubes solitary in each groove, and absent in the commissure or often there are two narrow ones. The plant, with the one noticed below, was originally (1844) described by Boissier under the name of *Fer. erubescens*, subsequently (1856) as *F. gummosa.*

Fer. rubricaulis, Boiss., grows in Southern, and, probably, also in Northern Persia, and has the leaves with wider segments and the oil-tubes narrower and more numerous than the preceding. *Fer. Schair*, Borszczow, a native of the Khirgise country, yields also a gum-resin similar to galbanum, which, however, does not appear to be collected. The gum-resin exudes spontaneously, and, as far as known, no incisions are made to promote the exudation. It enters commerce chiefly through Russia and from the Levant.

Description.—The best quality of galbanum is met with in tears, varying in size from a pin's head to a pea and larger; sometimes it is soft and semifluid. The tears adhere to one another, forming a more or less compact mass; they are of a reddish-, brownish-, or greenish-yellow color externally, internally white or yellowish, with a waxy gloss, and are somewhat translucent. It has a peculiar, unpleasant, balsamic odor, and a disagreeable, bitter, and acrid taste. Moistened with alcohol, a fine purplish color will be produced on the addition of a little strong muriatic or nitric acid.

Lump galbanum consists sometimes of soft or harder masses, in which some tears are distinctly observed; sometimes a mass is offered, which, from its odor and behavior, seems to be of a different origin.

Constituents.—According to the older analyses by Neumann, Pelletier, and others, galbanum contains 6 to 6.5 per cent. of volatile oil, 20 per cent. of gummy matter, and 60 to 66 per cent. of resin, besides 7 to 14 per cent. of impurities. The *volatile oil* is colorless, turns yellowish and thick on exposure, varies in specific gravity between .88 and .92, has the boiling point 160° to 165° C. (320° to 329° F.), is dextrogyre, and of the composition $C_{10}H_{16}$. The resin is yellowish-brown, soluble in ether, alcohol, and alkalies. On being heated it yields a beautiful indigo-blue volatile oil, which, according to Kachler (1871), consists of a colorless oil, $C_{10}H_{16}$, boiling at 240° C. (464° F.), and of a deep-blue oil, $C_{30}H_{48}O_3$, which boils at 281° C. (538° F.), appears to be identical with the blue portion of the oil of German chamomile, and yields with potassium a hydrocarbon, $C_{30}H_{48}$, the solution of which in much aqueous ether gives with an ethereal solution of bromine an azure-blue color, changing to green and brown. Galbanum resin, treated with fusing potassa, yields several volatile fatty acids, and *resorcin*, the solution of which is colored dark purple by ferric chloride (Hlasiwetz and Barth, 1864).

An aqueous infusion of galbanum, on the addition of ammonia, assumes a blue fluorescence, which disappears again on the addition of an acid. This reaction is due to *umbelliferon*, $C_9H_6O_3$, which may be obtained in colorless needles by heating galbanum with muriatic acid to 100° C. (212° F.), agitating the liquid with ether or chloroform, and evaporating the latter solution. Volatile fatty acids were also found by Moessmer (1861) in the emulsion remaining after distilling off the volatile oil.

Off. Prep.—Emplastrum assafœtidæ, *U. S.;* Empl. galbani, *Br.;* Empl. galbani comp., *U. S.;* Pilula assafœtidæ comp., *Br.;* Pil. galbani comp., *U. S.*

Medical Action and Uses.—Galbanum is generally described as partaking of the virtues both of asafœtida and ammoniac, affecting the nervous system like the former, and acting, like the latter, as a local irritant. Applied to the skin it occasions a papular eruption, and, if the true skin is exposed, causes it to ulcerate. Upon the system generally it probably acts as a stimulant, for in large doses it is said to cause fulness of the head and tension of the pulse. Moreover, its therapeutical virtues are limited to cases that call for stimulation; these are such as the resins and gum-resins are applicable to, and especially *chronic bronchitis, chronic intestinal, uterine, and vaginal catarrh, amenorrhœa,* etc. It is seldom given alone, and hence virtues are apt to be attributed to it that belong to its associated medicines. Thus, in the compound galbanum pill it is united with asafœtida and myrrh. Even for external use it is associated with other irritants (see Emp. galbanum comp.). The *dose* of galbanum is from five to twenty grains. It is best administered in emulsion.

GALEGA.—GOAT'S RUE.

Galega, Rue de chèvre, Fr.; *Geisraute,* G.

Galega officinalis, *Lin.* *Nat. Ord.*—Leguminosæ, Papilionaceæ.

Description.—Goat's rue is found in the countries bordering on the Mediterranean and northward to Central Europe. It has a perennial several-headed root, and an erect stem about 3 feet high; the leaves are furnished with 6 or 8 pairs of lanceolate or ovate-lanceolate, obtuse, and finely muronate leaflets 1 or 2 inches long, and with lanceolate stipules, which are sagittate on one side. The purplish or whitish flowers are in axillary racemes, and produce narrow, almost cylindrical, legumes. The herb is inodorous, and has a mucilaginous and somewhat bitter taste. Its constituents are unknown.

Medical Action and Uses.—Galega was at one time held to be diaphoretic, diuretic, and anthelmintic, and was used as a stimulant in nervous affections of an *hysterical* or *spasmodic* nature, in low *fevers,* and especially in the *plague.* It is said, also, to favor the *mammary secretion.* A native species, G. Virginiana, is said to possess analogous qualities. In Europe galega is no longer used, except in domestic medicine.

GALIUM.—CLEAVERS.

Bedstraw, E.; *Caille-lait, Gallait,* Fr.; *Labkraut,* G.

Nat. Ord.—Rubiaceæ, Stellatæ.

Description.—The following species have been used:—

GALIUM APARINE, *Lin.*, Cleavers, *E.;* Grateron, Rièble, *Fr.;* Klebkraut, *G.* It grows in thickets in North America, Europe, and Northern Asia, has a weak, retrorsely prickly, quadrangular stem, 3 or 4 feet long; linear-lanceolate and mucronate leaves in whorls of 6 or 8, which are prickly roughened on the mid-rib and margin; small whitish flowers and fruits composed of two united one-seeded carpels, which are armed with hooked prickles.

G. TRIFLORUM, *Mich.*, Sweet-scented bedstraw, *E.* It is indigenous to North America, resembles the preceding, but has elliptic-lanceolate slightly rough leaves in whorls of six, three-flowered peduncles, and acquires an agreeable odor on drying.

G. MOLLUGO, *Lin.*, indigenous to Europe, somewhat naturalized in the United

States, has a smooth stem, oblanceolate or oblong-linear, somewhat rough leaves in whorls of 8, and long panicles of whitish flowers yielding smooth fruits.

G. VERUM, *Lin.*, with whorls of 8 linear leaves, compact panicles of yellow flowers and smooth fruits, is a European plant, sparingly naturalized in the United States.

Constituents.—The plants contain either *galitannic* or *aspertannic acid*, both producing green precipitates with iron salts. They likewise contain *citric*, *oxalic*, and *rubichloric acids*, a bitter principle and the common principles of herbs (R. Schwarz, Vielguth). Von Cotzhausen (1876) determined the odorous principle of Galium triflorum to be *coumarin*, to which is also due the agreeable odor of the nearly allied Asperula odorata, *Lin.*, known in France as *aspérule odorante*, and in Germany as *Waldmeister.* The roots of several species of Galium contain red coloring matter resembling that of the allied Rubia tinctorum, *Lin.*

Medical Action and Uses.—This plant has been used in Europe chiefly as a diuretic in *dropsy*, and in *jaundice*, and in treating *scaly skin diseases*, especially of a *scrofulous* nature. It has even been alleged to cure *epilepsy* and *cancer* of the tongue. Notwithstanding the virtues attributed to it at various times, it does not seem to have established its claims to confidence.

GALLA, *U. S.*, *Br.*—NUTGALL.

Gallæ, P. G.; *Galla halepense, vel turcica, vel levantica, vel tinctoria, vel quercina.—Galls*, E.; *Noix de galle, Galle de chêne*, Fr.; *Galläpfel*, G.

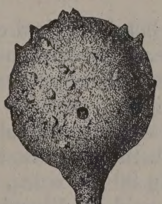
Excrescences on Quercus infectoria, *Olivier*, s. Q. lusitanica, *Webb*, var. infectoria, caused by the punctures and deposited ova of Cynips (Diplolepis, *Latr.*), gallæ tinctoriæ, *Oliv.* Steph. and Church, Med. Bot., plate 152.

Nat. Ord.—Cupuliferæ.

Origin.—The dyer's oak is a small tree, or oftener a shrub 4 to 6 feet high, and is found in the eastern section of the Mediterranean basin from Greece to Persia. The tender bark of the young branches is punctured by the female of the hymenopterous insect named above, and one or more eggs are deposited in the wound. The irritation produced by this operation causes the formation of an excrescence inclosing the larva, which undergoes therein its transformations. The term *gall* is generally used to designate such excrescences formed upon any part of a plant, in consequence of the puncture of an insect.

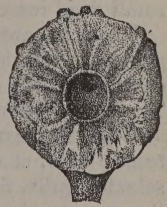
Description.—Nutgalls are nearly globular, about an inch or less in diameter, with a short stipe or a nearly smooth surface or, more frequently, more or less tuberculated in the upper portion. Their color externally is a deep blackish olive-green, which, if the gall remains upon the branch, gradually becomes lighter, and finally of a light yellowish-brown tint, their weight decreasing at the same time. Galls are hard, but are readily broken with a hammer, exhibiting a more or less dense granular fracture which has sometimes a waxy lustre. Internally, they are yellowish or pale brownish-gray, with a central nucleus or cavity, containing either the more or less fully developed insect, or pulverulent fragments of the cellular tissue. In the latter case, the insect has usually escaped through a cylindrical canal which it has bored from the cavity to the surface, the outer aperture being near the middle. The cellular tissue of the nucleus, if still pre-

Fig. 79.



Entire.

Fig. 80.



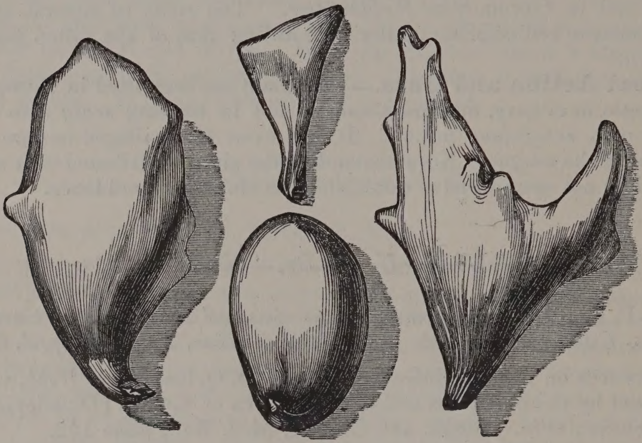
Section.

Nutgall.

sent, is mostly filled with small starch granules, and surrounded by a layer of thickened cells forming a shell, on the outside of which is the cellular tissue containing the tannin. This tissue has often a radiated appearance near the shell, and contains towards the surface small scattered bundles of vascular tissue. Nutgalls are nearly inodorous and have a very astringent taste.

Nutgalls are distinguished in commerce according to their color, the *blue* or *black galls*, of Syria (Aleppo), being preferred. *Smyrna galls* are usually of grayish olive-green, more spongy in texture, and intermixed with *white galls;* the latter are the least valuable. The galls which are produced upon the European and American oaks by different species of Cynips, are mostly of a lighter color and more spongy texture; but all have an astringent taste and contain tannin.

Fig. 81.



Chinese Nutgalls.

Allied Drugs.—CHINESE AND JAPANESE GALLS, although known from a much earlier period, were not a regular article of commerce until Pereira (1844) directed attention to them again. They are produced upon the leaves or leaf-stalks of *Rhus semialata*, Murr., by an insect provisionally named Aphis Chinensis. They are of a very irregular shape, usually thin as if stalked towards the base, much inflated above, irregularly lobed, and with few or many protuberances; they are of a reddish-brown color, but densely covered with a gray down, consist of a thin fragile shell, and contain in the interior numerous small dead insects.

VALONIA are the hemispherical cups of Quercus ægilops, *Lin.*, which is indigenous to Southeastern Europe and the Levant. They are about an inch in diameter, have thick spreading scales, and possess a strongly astringent taste. The cups of our indigenous species are likewise astringent.

Constituents.—The principal constituent of nutgalls is *tannin* or *gallotannic acid*, of which they contain about 60 per cent. Bowman (1869) assayed selected galls, finding 80 per cent., and in white galls only 30.7 per cent. 2 or 3 per cent. of gallic acid are likewise found, together with some sugar, resinous, and albuminous matter, and, as stated before, starch in the nucleus.

Pharmaceutical Uses.—In the preparation of tannic and gallic acids, and for Tinct. gallæ, Unguent. gallæ, *U. S.*, *Br.*, and Unguent. gallæ cum opio, *Br.*

Medical Action and Uses.—From the most ancient times, nutgall has been used in medicine for its astringency. This property is due to gallotannic acid, but the bitter extractive principle of nutgall gives it a tonic action. These qualities account for its efficacy in the treatment of chronic *diarrhœa.* It has been used as an *antidote* to tartar emetic and the vegetable alkaloids; and whatever degree of efficacy it then exerts is probably due to its constringing the stomach and delaying the absorption of its contents. An infusion made with from half an ounce to an ounce of coarsely powdered nutgall in a pint of boiling water, may be given in the dose of a wineglassful three or four times a day, for the purposes referred to; and it may be locally applied to the relaxed mucous membrane of the mouth, throat, vagina, and rectum. An ointment of nutgall is officinal.

GAMBOGIA, *U. S.*—GAMBOGE.

Cambogia, Br.; *Gutti*, P.G.; *Gummi-resina* (*Gummi*) *guttæ, s. gutti, Gutta gamba, Cambodia.—Gutte, Gomme-gutte*, Fr.; *Gummigutt, Gutti*, G.

A gum-resin obtained from Garcinia Hanburii, *Hook. f.* Bentley and Trimen, Med. Plants, 33.

Nat. Ord.—Guttiferæ.

Origin.—A medium-sized tree, with glossy laurel-like leaves, and small yellow diœcious flowers, the pistillate ones being on short pedicels. It was formerly regarded merely as a variety, *pedicellata* of Garc. morella, *Desrousseaux* (s. G. gutta, *Wight;* G. cambogioides, *Royle;* Hebradendron cambogioides, *Graham*), and is indigenous to Siam, Cambodia, and Cochin China. Flückiger and Hanbury observed that the milky juice is secreted in ducts, which are principally located in the middle bark, and to a less extent in the dotted vessels of the alburnum and in the pith. Gamboge is obtained from incisions made into the bark, the yellow latex being collected in the joint of a bamboo, where it is allowed to harden.

Description.—Gamboge is in cylindrical straight or bent sticks, 6 to 8 inches long and 1 to 2 inches in diameter, called pipes; the surface is striated longitudinally from impressions of the bamboo, and occasionally contains some splinters of it. Gamboge breaks easily, with a flattish conchoidal, smooth fracture, of a deep orange-red tint and a resinous lustre; thin splinters are slightly translucent. It yields a light yellow powder, and on being triturated with water a uniform bright yellow emulsion is readily obtained. It is inodorous, but the dust is sternutatory, and it has a disagreeable acrid taste. Inferior qualities of pipe gamboge are of a brown or gray tint, harder, of a dull earthy or irregular fracture, and less inclined to produce a uniform emulsion.

Cake gamboge has been collected in flat vessels, and is met with in irregular lumps, which otherwise resemble pipe gamboge, but are more liable to be adulterated.

Constituents.—Aside from accidental impurities, like cellular tissue, gamboge contains about 4 per cent. of moisture, the remainder being resin and 16 to 20 per cent. of gummy matter which is not identical with gum arabic. The resin is called *cambogic acid*, is soluble in alcohol, ether, and with a deep red color in dilute alkalies, and from the latter solution is precipitated unaltered by acids; its solutions yield a yellow precipitate with lead acetate, and brown ones with iron and copper salts. By fusing it with caustic potassa, Hlasiwetz and Barth (1866) observed the disengagement of vapors having the odor of lemon and melissa, and found in the residue, besides acetic and volatile fatty acids, also *phloroglucin, pyrotartaric* and two other acids. Gamboge is free from starch, and, if adulterated with it, an emulsion made with hot water will turn green by solution of iodine; or it may be recognized in the residue left after treatment with alcohol and cold water.

Off. Prep.—Pilulæ catharticæ comp., *U. S.;* Pil. cambogiæ comp., *Br.*

Physiological Action.—Experiments upon animals with gamboge do not render its operation clear. It produces few symptoms of local irritation, but little evidence of pain, fever, nervous motor derangement, or coma; and not uniformly either vomiting or purging. In man, applied to the raw skin, it acts as an irritant. Internally, in small doses, it appears to increase the glandular secretions; but in large doses causes colic and tenesmus. In doses of three or four grains it occasions liquid stools, with little or no colic. Its purgative virtue appears to reside in its resinous element. When given in small and repeated doses, it is said to cause diuresis. There is no evidence of its having ever produced fatal effects.

Medical Uses.—Gamboge is seldom employed, unless associated with other purgatives. It is reputed to be well adapted for relieving such congested states of the *liver* as arise from malarial causes. In these cases it is usually associated with calomel. As a *hydragogue*, acting by the kidneys as well as the bowels, its merits appear to be well established. For this purpose it should be given in small and repeated doses, such as a grain every hour, dissolved in sweetened water. It is often associated with jalap and with bitartrate of potassium. Its want of taste fits it for use by children. It is sometimes employed as a *vermifuge;* but for this purpose is best administered along with vermicide medicines.

Gamboge is administered in substance, in the average *dose* of from one to five grains. It is most efficient when given mixed with water and sugar. A convenient formula is the following: ℞. Gamboge, gr. x; Carbonate of potassium, ʒj; Cinnamon water, f℥ij.—Mix. S.—Thirty drops three times a day, in water.

GAULTHERIA, *U. S.*—GAULTHERIA.

Folia gaultheriæ.—Wintergreen, Teaberry, Partridgeberry, Boxberry, Checkerberry, E.; *Feuilles de gaulthérie (de palommier), Thé du Canada, Thé de Terre-neuve,* Fr.; *Canadischer Thee, Bergthee,* G.

The leaves of Gaultheria procumbens, *Lin.* (s. G. humilis, *Salisb.;* Gaultiera repens, *Rafin.*). Bigelow, Med. Bot., t. 22; Bentley and Trimen, Med. Plants, 164.

Nat. Ord.—Ericaceæ, Ericineæ.

Origin.—Teaberry is found in cool damp woods, usually in the shade of evergreens, in Canada and the United States. The plant is a small shrub, with a slender creeping stem and ascending branches, about 5 inches high, bearing the alternate evergreen leaves near the summit, axillary, nodding, whitish flowers, and 5-celled berry-like pods, which are inclosed in the bright-red fleshy calyx. The leaves are collected late in summer or in autumn.

Description.—The leaves are short petiolate, about 1½ inch long and ¾ to 1 inch wide, obovate or roundish-oval in shape, with a wedge-shaped base, coriaceous in texture, mucronate and slightly toothed, the teeth having the elongated points appressed to the thickish margin; they are smooth, of a glossy green color above, and paler beneath. The odor is agreeably aromatic, the taste astringent and aromatic.

Constituents.—We are not acquainted with a complete analysis of the leaves. They contain a volatile oil (see *Oleum gaultheriæ*) and tannin. Jefferson Oxley (1872) found, besides grape sugar, gum, coloring matter, and a principle analogous to gallic acid, *arbutin, urson,* and *ericolin,* principles which are likewise present in the leaves of Chimaphila and in Uva ursi.

Medical Action and Uses.—Gaultheria is stimulant and somewhat astringent. It has sometimes been employed as a substitute for Chinese tea in country places, where it is also popularly used as an *emmenagogue* and *galactagogue,* and in chronic *bowel complaints.* In the former cases a hot infusion of the leaves is best; in the latter a cold infusion.

GELATINA.—GELATIN.

Gelatine, Fr.; *Gelatin*, G.

Origin and Preparation.—When bone-cartilage, animal skin, tendons, and ligaments, are boiled for a long time with water, they become soluble therein, and, on cooling, the solution forms a jelly. During the boiling the animal tissues are placed upon a sieve, or perforated diaphragm, which is inserted above the bottom of the boiler. When sufficiently saturated, the solution is drawn off, and allowed to cool, the jelly being then cut into thin cakes, and these are placed upon nettings to dry. When made from carefully selected material (fresh bones) it constitutes the *gelatin* of commerce, known also as *artificial isinglass*. The offal of slaughter-houses and of tanneries yields an impurer gelatin, known as *colla*, s. *colla animalis*, s. *glutinum;* glue, *E.;* colle, colle forte, *Fr.;* Leim, *G.* The United States import annually about 150,000 lbs. of gelatin.

Properties.—Gelatin is met with in commerce in very thin, rectangular, transparent pieces, bearing the impressions of the netting upon which it has been dried; or in smooth sheets, which are either thin and transparent, or thicker, more or less porous and opaque. It is not unfrequently cut into shreds, and the transparent kind is often variously colored. Glue is in similar pieces, but usually thicker, and varies in color between pale-yellowish and dark-brown, or nearly black in the commonest varieties, and has an offensive animal odor, which is more apparent after it has been dissolved in hot water. To be adapted for dietetic or pharmaceutical purposes, gelatin should not alter in color after being digested in hot water, and the solution should be free from smell.

It is to a small extent soluble in cold glycerin, dissolves freely in hot water, forming, on cooling, a tremulous, transparent jelly, and is insoluble in alcohol and ether. Its solution in water is not precipitated by dilute solutions of alum, ferric chloride, or subacetate of lead (distinction from *chondrin*), but yields precipitates with tannin, chlorine water, corrosive sublimate, and platinic chloride. The tissues yielding gelatin likewise unite with tannin, forming leather. Gelatin dissolves in acetic and in dilute mineral acids, the solutions being known as *liquid glue*. When its solution in water is boiled for a long time it loses the property of gelatinizing on cooling. By dry distillation gelatin yields carbonate of ammonium and a number of volatile bases, which are contained in *Dippel's animal oil*. Boiled with solution of potassa, or with sulphuric acid, ammonia, *glycocol* $C_4H_9NO_2$, and *leucin* $C_6H_{13}NO_2$, are obtained among other products.

Composition.—Gelatin, also called *glutin*, consists of about 50 per cent. of carbon, 18 of nitrogen, 6.5 of hydrogen, 25 of oxygen, and 0.5 of sulphur.

Chondrin, which is obtained from the permanent cartilages by boiling with water, has a similar composition, but contains less nitrogen and more oxygen. In addition to the differences pointed out above, it is distinguished from gelatin by being precipitated by acetic and the mineral acids.

Pharmaceutical Uses.—Gelatin is employed as a reagent for *estimating tannin*, a convenient solution for the purpose being made by dissolving about 50 grams of it, together with 8 or 10 grams of alum, in a liter of distilled water; before use, the strength of the solution must be determined with a fresh solution of pure tannin. It should, however, be remembered, that the different tannins require, for complete precipitation, different amounts of gelatin, so that the results obtained are not absolutely correct. The pectic acid of oak bark, according to P. Büchner (1867), is likewise precipitated by a solution containing both gelatin and alum.

Gelatin is used for preparing the ordinary *court plaster* (see p. 516), and for the coating of pills (see *Pilulæ*). Dried in very thin layers it has been recommended, under the name of *devorative* or *folding capsules*, for the administration of powders, the thin sheets being used in precisely the same manner as paper, except that after the introduction of the powder they are permanently closed by moistening the edges, and are swallowed together with the powder, after having been softened by being dipped in water. *Medicated gelatin* is prepared by pouring a concentrated solution of gelatin, in which the medicinal substance has been dissolved, upon a polished and perfectly level surface; the sheet thus obtained is then divided into squares or disks in such a manner that each represents a definite weight of the medicine. *Gelatin capsules* are made by dipping oblong moulds of the desired size and shape into a gelatin solution; after the surface has been sufficiently coated, the capsule, while still pliant, is removed, filled with the powder or liquid, and the orifice closed by a drop of solidifying gelatin; or, for extemporaneous use, an empty capsule is slipped over the open end of another containing the medicine.

Within a few years so-called *medicinal pearls*, containing ether or other liquid, have been introduced. Hager recommends them to be made of gelatin, gum arabic, sugar, and honey, rolled out into sheets, one of which, while still rather soft, is placed upon an iron plate containing suitable cavities, into which the mass sinks; the liquid is then introduced, the orifices are closed by another sheet of the gelatin compound, the whole covered by a second iron plate having depressions exactly corresponding to those of the first, and, after screwing the plates together, their position is reversed. The pearls are finally separated by subjecting the entire arrangement to powerful pressure.

Gelatin has also been used as a base for the preparation of *medicated suppositories*, vaginal as well as rectal, and for *bougies*. The material consists of about three parts of gelatin, which, after having been soaked in water, is dissolved in seven parts of glycerin. The medicating substance should be soluble in the vehicle. Substances containing tannin are evidently not adapted for this mode of medication.

Liquid glue may be made in various ways, either by dissolving glue in acetic acid, or by adding to a strong aqueous solution of glue, nitric acid, equal to one-sixth or one-seventh of the weight of the glue. A solution of glue in spirit of nitrous ether is stated to be very serviceable, particularly if a little caoutchouc has been added to it. A solution of phosphoric acid in water, nearly neutralized by ammonium carbonate, has likewise been recommended for preparing liquid glue.

Medical Action and Uses.—Physiological experiments prove that gelatin alone cannot support animal life; but that it may become nutritious when combined with other substances, as in soup prepared from meat. In the form of calves-feet jelly it is much used during convalescence from acute disease; but its utility probably depends in great part upon the sugar, wine, and spices that season it. It has been given by enema as a lenitive in *ulceration of the rectum;* and a coating of it has been applied to *cutaneous eruptions* to protect them from the air. It is also employed in baths in chronic diseases of the skin to remove the crusts or epidermic scales, or simply to render the skin soft and pliable. For this purpose about a pound of gelatin dissolved by boiling in water is added to the bath when it is used.

GELSEMIUM, *U. S.*—YELLOW JASMINE.

Radix gelsemii.—*Yellow jessamine*, E.; *Racine de jasmin jaune*, Fr.; *Gelber Jasmin-Wurzel*, G.

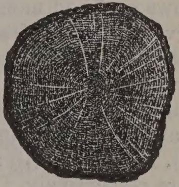
The root of Gelsemium sempervirens, *Ait.*, s. Gels. nitidum, *Mich.*, s. G. lucidum, *Poir.*, s. Bignonia sempervirens, *Lin.* Bentley and Trimen, Med. Plants, 181.

Nat. Ord.—Loganiaceæ.

Origin.—The yellow jessamine is indigenous to the Southern United States, growing in moist woods from Vrginia to Florida and Alabama, and flowering early in spring, from March to May. It has a high climbing stem, with opposite, ovate-lanceolate, entire, smooth and coriaceous leaves, and solitary or axillary clusters of very fragrant flowers, which have a bright yellow, funnel-form, five-lobed corolla, 1 to 1½ inch long, and produce a flattened two-celled fruit containing 4 to 6 winged seeds in each cell. The root and the subterraneous stem are the parts used in medicine.

Description.—The rhizome is about an inch in diameter, is externally brown-yellow, with purplish-brown longitudinal lines, and breaks with a tough fibrous fracture, showing silky bast fibres in the inner bark, a porous yellowish wood, which is traversed by whitish medullary rays and a darker colored central pith. The roots are somewhat thinner, similar in color externally, beset with numerous thin fibres, and marked by irregular longitudinal wrinkles and small scars. A transverse section shows a thin yellowish-brown bark, covering a hard pale yellowish meditullium without a central pith, but radially striate by numerous whitish medullary rays. Fragments of the thin purplish overground stem are occasionally present in the commercial article. The drug has a peculiar heavy aromatic odor, which is more marked when a larger quantity is examined. The taste of the bark is not unpleasantly bitter; that of the wood is but slight.

Fig. 82.



Gelsemium sempervirens, *Ait.*—Transverse section of root.

Constituents.—An analysis made by M. H. Kollock (1855) proved the existence of an alkaloid, *gelseminia*, besides volatile oil, starch and gummy pectinaceous and resinous principles. The existence of the alkaloid was corroborated by C. L. Eberle (1868) and Prof. Wormley (1870); the latter obtained it (1877) by acidulating a concentrated tincture with acetic acid, precipitating the resin by water, concentrating the aqueous filtrate, removing from the solution *gelseminic acid* by ether, liberating the alkaloid by carbonate of sodium, and extracting it by ether or chloroform. It is amorphous, white, intensely bitter, strongly alkaline, and slightly soluble in cold water, in which its salts dissolve quite readily. It has no very characteristic color reactions with concentrated acids; sulphuric acid produces a red color, changing to purple when heated, nitric acid a greenish, and muriatic acid a yellowish color. C. A. Robbins (1876) obtained for it the empirical formula $C_{11}H_{19}NO_2$, and observed that ceroso-ceric oxide imparts to the sulphuric acid solution a rose-cherry red color.

Robbins ascertained also the *gelseminic acid* to be identical with *æsculin*, $C_{15}H_{16}O_9$, a principle present in the bark of the horse chestnut (*Æsculus hippocastanum*, Lin.), in quassia, red saunders, etc. It crystallizes in colorless prisms, is little soluble in cold water and ether, possesses a bitterish taste, and yields with alkalies in extremely dilute solutions a characteristic fluorescence, being yellow in transmitted, and blue in reflected, light, and destroyed by acids. Æsculin is a glucoside, being split by dilute acids into glucose and *æsculetin*, $C_9H_6O_4$, which is colored yellow by alkalies, and dark green by ferric chloride.

Wormley obtained on an average 0.2 per cent. of the alkaloid, and 0.4 per cent. of æsculin. The ash of air-dry root amounts to 4 per cent. (Kollock).

Off. Prep.—Extractum gelsemii fluidum, *U. S.*

Physiological Action. *On Animals.*—Gelsemia induces paralysis both of sensation and motion, sometimes of the one first, and sometimes of the other; lowers the force and rate of the pulse and respiration, reduces the temperature, dilates the pupils, projects the eyeballs, and does not suspend the heart's action until after respiration has ceased. Death is apt to be preceded by intermittent tetanoid convulsions, which cannot be immediately reproduced like those excited by strychnia. One-eighth of a grain given subcutaneously to a strong cat caused death in an hour and a half, with symptoms of great prostration (Wormley).

On Man.—Applied topically to the eye gelsemia dilates the pupil. The characteristic symptoms of excessive and poisonous doses of gelsemium are these: Great prostration and muscular relaxation and incoördination affecting the entire system, and conspicuously paralysis of the upper eyelids and of the lower jaw (after recovery muscular debility continues for several days); the tongue is also affected; in more than one case there have been signs of spasm of the pharynx and larynx, causing extreme distress, and suggesting the phenomena of hydrophobia; the pupils are dilated; vision is double or greatly impaired; the face is congested; the mind usually clear, but in some fatal cases coma exists; the skin is warm and dry, until the approach of death, when it grows cool and moist; the general sensibility is blunted, according to some observers; the respiration is slow, irregular, and gasping, and the pulse is generally stated to be slow, small, feeble, irregular, and intermittent, but other observers declare that it is little or not at all effected. Death takes place through gradual arrest of the respiration, and usually without convulsions. In three fatal cases occurring in adults, the doses of the fluid extract were respectively, f℥j, fʒiij, and fʒij; in three similar cases observed in children the fatal doses were respectively, fʒij, fʒj, and fʒj. After death the blood remains liquid, and is dark colored; the stomach is congested, and the brain rather pale.

Medical Uses.—Gelsemium appears to be one of those too numerous remedies which have been used in a great variety of sthenic febrile diseases, upon no better ground than their power of lowering the pulse and depressing the nervous system. Incalculable mischief has been produced by them, and more is likely to be occasioned by gelsemium in febrile affections. Some of those persons who have most loudly eulogized this agent as an antipyretic, have been at great pains to explain, in opposition to the popular doctrine, that heat is death, and cold is life; that we have only to reduce the fever temperature to the normal standard or below it, to cure febrile disease, and that, therefore, gelsemium will cure fever. Unfortunately for this mode of medical reasoning, gelsemium does not reduce the temperature, except in so far as it threatens to destroy life through its poisonous operation. But such is probably not the reduction that its advocates had in view. Among a host of incongruous diseases which are said to have been "cured" by this agent, the one in regard to which very positive testimony exists, is acute or rheumatic *neuralgia*, especially of the first and second branches of the fifth nerve. For this purpose from *three to ten* minims of the fluid extract, or three times that quantity of the tincture may be given every two hours. The proper *antidote* for poisoning by gelsemium is morphia hypodermically administered.

GENISTA.—DYERS' BROOM.

Dyers' green-weed, Woad-waxen, E.; *Genêt des teinturiers*, Fr.; *Färberginster*, G.

The young branches of Genista tinctoria, *Lin.* *Nat. Ord.*—Leguminosæ, Papilionaceæ.

Description.—Dyers' broom is a low shrub, indigenous to Asia and Europe, and has been naturalized in the eastern part of the United States. The young erect branches are striately angled and have alternate sessile lanceolate entire bright-green leaves with a ciliate margin and one or one and a half inch in length. The bright yellow flowers are in elongated racemes and produce linear flat legumes, each containing from five to eight globular-obovate yellowish seeds. The recent plant, when bruised, has a rather refreshing odor and a mucilaginous, afterwards bitter and acrid taste.

Constituents.—Analyzed by Cadet de Gassicourt, the usual constituents of plants were found; but the principle giving the bitter and acrid taste was not isolated. The volatile oil is of a yellowish-green color, and the yellow coloring matter is stated to resemble that of the *weld* (*Reseda luteola*).

Medical Action and Uses.—The flowers and the seeds are both emeto-cathartic. In Russia dyers' broom was formerly vaunted as a remedy, or rather a prophylactic, for *hydrophobia.* It is hardly necessary to add that the belief in it was groundless. Much better founded was its reputation in *dropsy.* In the early part of the present century the French government published a formula for the cure of dropsy which consisted of the powdered seeds of this plant. It was given in the *dose* of a drachm in six ounces of white wine, followed in an hour by two ounces of olive oil to mitigate its operation.

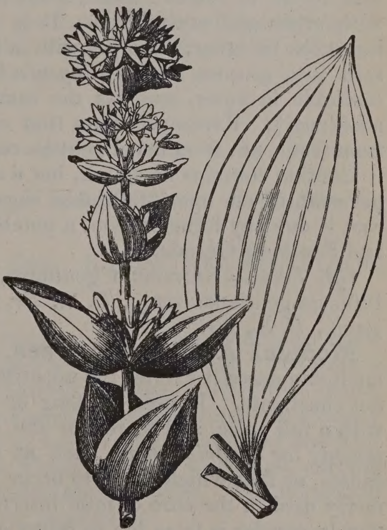
GENTIANA, *U. S.*—GENTIAN.

Gentianæ radix, Br.; *Radix gentianæ*, P. G.; *Radix gentianæ rubræ* (*vel luteæ vel majoris*).—*Gentian root*, E.; *Racine de gentiane* (*de gentiane jaune*), Fr.; *Enzianwurzel*, *Bitterwurzel*, *Rother* (*Gelber*) *Enzian*, G.

The root of Gentiana lutea, *Lin.* Steph. and Church, Med. Bot., plate 132. *Nat. Ord.*—Gentianaceæ.

Origin.—Gentian is indigenous to the mountainous regions of Southern and Central Europe, as far north as Central Germany. It has a thick hollow stem, two to four feet high, opposite, entire, five- to seven-nerved leaves, and axillary clusters of pedicellate flowers with a bright-yellow five-lobed spotted corolla, and producing a one-celled capsule containing numerous seeds.

Fig. 83.



Gentiana lutea.

Description.—The fleshy and branching one-headed to several-headed root attains a length of two to three feet and a diameter of about an inch or less, but appears in commerce always in shorter pieces, the thicker ones being longitudinally sliced before drying. Beneath the abrupt or concave, somewhat conical heads they are closely annulated, the lower portion being deeply wrinkled longitudinally, with an overlapping bark in the longitudinally split pieces. It is of a yellowish-brown color, the surface darker and grayish, the fracture short, of a slight waxy lustre, and with numerous minute brown dots. The transverse section shows a faint radiating arrangement only near the dark cambium line, and a fleshy meditullium, which is about six times thicker than the bark. The root is very hygroscopic, contains 14 to 18 per cent. of water, and is tough and flexible in moist weather. It has a faint, but heavy characteristic odor, which is more prominent in a hot infusion; its taste is sweetish, then intensely bitter, but free from astringency or acridity. Between 30,000 and 60,000 lbs. of gentian are annually imported.

The roots of other European species of Gentiana are occasionally collected with or in place of the one recognized by the Pharmacopœia; they closely resemble the latter, and have the same medicinal properties:—

Gent. purpurea, Lin., with yellowish-purple flowers, is indigenous to the Pyrenees, Alps, Apennines, Norway, and Northern Asia, and has a many-headed (8 to 10), shorter and thinner root which is darker brown internally. *G. pannonica*, Scop., with reddish or blackish purple flowers, indigenous to the mountains of Austria, has a scarcely annulated shorter, thinner, and darker root than the officinal. *G. punctata*, Lin., with straw-yellow purplish punctate flowers, is found in the Alps and eastward to the Balkan mountains; it is likewise many-headed and of a grayish-yellow brown color.

Constituents.—Kromayer (1862) was the first who isolated the pure bitter principle, which in many previous analyses had been obtained in an impure extract-like form. The crystalline *gentianin* of Henry and Caventou (1821) was in 1837 proven, by Trommsdorff and by Leconte, to be a yellow crystalline principle, subsequently named *gentisin*, *gentisic*, and *gentianic acid*, contaminated with some of the bitter matter. On washing the alcoholic extract of gentian with cold water to remove the bitter principle, afterwards with some cold ether to remove fat, and crystallizing the residue from alcohol, *gentisic acid* $C_{14}H_{10}O_5$, is obtained in bright-yellow tasteless crystals, requiring 5000 parts of water, 2000 parts of ether, and nearly 500 parts of cold alcohol for solution; it is soluble in alkalies and by ferric chloride colored deep olive-brown. J. Ville (1877) regards it as a kind of tannin and calls it *gentiotannic acid*. Hlasiwetz and Habermann (1875) obtained from it, by fusion with caustic potassa, *phloroglucin*, *acetic*, and *gentisinic acid*, the latter being $C_7H_6O_4$, and isomeric with protocatechuic acid.

Gentiopicrin $C_{20}H_{30}O_{12}$, the bitter principle of gentian, is contained in the aqueous solution of the alcoholic extract, from which it is absorbed by animal charcoal; this is boiled with alcohol, the solution concentrated, treated with lead oxide to remove color, freed from lead by sulphuretted hydrogen, agited with ether and crystallized. It is very soluble in water and ordinary alcohol, insoluble in ether, dissolves with alteration in alkalies and by dilute acids is split into glucose and *gentiogenin* $C_{14}H_{16}O_5$, which is yellowish-brown, bitter, insoluble in water, and has the same composition as *physalin* (from Physalis alkekengi). Kromayer states that crystallizable gentiopicrin is obtainable only from fresh, not from dried gentian root.

Gentian contains no starch, but a considerable amount of pectin and 12 to 15 per cent. of an uncrystallizable sugar, to which the hygroscopic nature of the root is due; by fermentation, a potable spirit is obtained from it in Switzerland and Southern Germany.

Off. Prep.—Extractum gentianæ, *U. S.*, *Br.;* Ext. gentianæ fluid., *U. S.;* Infusum gentianæ comp., *U. S.*, *Br.;* Mistura gentianæ, *Br.;* Tinct. gentianæ comp., *U. S.*, *Br.*

Medical Action and Uses.—Gentian is a pure and simple bitter. In moderate doses it excites the appetite and strengthens the digestion, and does not constipate. If used too long or too freely it is apt to occasion headache, with a full pulse, and to render the sweat and urine bitter. It is a valuable remedy for *gastric atony*, such as accompanies general debility from various causes, or that which is apt to occur in persons of a gouty habit. It was formerly used in the cure of mild intermittent fevers. The nominal *dose* of gentian in powder is from ten to thirty grains; but it is always prescribed in the form of extract, fluid extract, compound infusion, or compound tincture, all of which are officinal.

GENTIANA CATESBÆI, *U. S.*—BLUE GENTIAN.

Racine de gentiane américaine, Fr.; *Amerikanische Enzian-Wurzel*, G.

The root of Gentiana Catesbæi, *Elliott* (G. puberula, *Mich.*).

Nat. Ord.—Gentianaceæ.

Origin.—Several of the blue flowering gentians of North America are botanically very similar, and some confusion has existed concerning their identity, which is best shown by placing the species and their synonyms together, as at present recognized by Gray. We thus have—

(1) G. puberula, *Mich.;* G. saponaria var. puberula, *Gray's Man., edit. I.;* G. Catesbæi, *Ell.*, and G. Elliottii, *Chapm.*

(2) G. saponaria, *Lin.;* G. Catesbæi, *Walt.*

(3) G. Andrewsii, *Griseb.;* G. saponaria, *Frœl.;* G. fimbriata, *Vahl.*

The first species is indigenous to the States south of North Carolina, and to most States from the Alleghenies to the Mississippi; the second is met with from the mountains of North Carolina to Southern Pennsylvania, and westward to Illinois; the third species is common in the Middle States and northward. We believe that the blue gentian root, as found in commerce, is collected indiscriminately from the above three species.

Description.—The subterraneous part of these plants consists of an indistinctly annulated head about half an inch long, and one-eighth of an inch thick, which, at its base, is usually divided into a number of fleshy, nearly simple rootlets, about three inches or more in length. When dry they are of a pale, brownish color, with a distinct yellow or orange hue, and short and deep longitudinal wrinkles, devoid of fibres, quite brittle, and breaking with a short or somewhat spongy fracture, which is pale yellow. The bark is thick, and the ligneous cord quite thin. The odor and taste are gentian-like. We have found it occasionally mixed with a root of unknown origin, of similar dimensions and appearance, but having a gray hue, a tough fibrous bark, and a sweetish, scarcely bitter taste.

Constituents.—From experiments made with the root we conclude that its constituents are probably identical with those of *G. lutea.*

Medical Action and Uses.—Blue gentian is employed to some extent in popular practice, in the southern portion of the United States, for the same diseases and in the same manner as European gentian.

GERANIUM, *U. S.*—GERANIUM.

Cranesbill root, E.; *Racine de bec-de-grue tacheté, Racine de pied-de-corneille*, Fr.; *Fleckstorchschnabel-Wurzel*, G.

The rhizome of Geranium maculatum, *Lin.* Bigelow, Med. Bot. I. t. 8; Bentley and Trimen, Med. Plants, 42.

Nat. Ord.—Geraniaceæ.

Origin.—This perennial herb is very common in rich woods in most parts of Canada and the United States, and it flowers from April to July. The stem is from one to two feet high; the hairy leaves, when old, become blotched with white, and are palmately 5- or 7-lobed, with wedge-shaped divisions, which are coarsely toothed above; the light purple flowers are in loose terminal umbels; the fruit is long-beaked, with five one-seeded carpels, which separate when ripe, curving upward together with the style which separates from the beak. The horizontal rhizome should be collected late in summer or in autumn.

Description.—It is two to three inches long, a quarter to half an inch in diameter when fresh, little branched, but tuberculated with the remnants of the stems, longitudinally wrinkled, with indistinct nodes, dark-brown externally, red-brown internally. It breaks with a nearly smooth fracture, showing a thin bark, and the small, yellowish, broadly wedge-shaped wood bundles arranged in a circle near the cambium, and inclosing a large central pith. It has no odor; its taste is purely astringent. The rootlets are mostly on the lower side, are much shrunken, fragile, and branched into hairlike fibres.

Constituents.—The analyses of Staples (1829), and Bigelow (1833), indicate, besides tannin, the presence of starch, pectin, sugar, mucilage, etc.

Bowman (1869) found 13 to 17 per cent. of tannin, which has not been further investigated.

Allied Plants.—Geranium Robertianum, *Lin.*, *Herb Robert*, grows in shady thickets and woods in Europe, in the United States and Canada; has an erect branching stem, deeply 3- or 5-divided leaves, with the divisions twice pinnatifid, and the lobes ovate and mucronately toothed, and rose- or purplish-colored flowers. It has a strong, rather unpleasant odor, and a bitterish, saline, and astringent taste.

Erodium cicutarium, *L'Her.* (Geranium, *Lin.*), Storksbill, indigenous to the Levant and Southern Europe, is sparingly naturalized in the United States. It has a low spreading stem, pinnate leaves, with the leaflets sessile and pinnatifid, and pale-reddish flowers. The odor of the bruised plant resembles that of carrot.

Erodium moschatum, *Ait.*, is found near the Mediterranean and in Southern Africa, and resembles the preceding, but has a rather strong, musk-like odor.

Off. Prep.—Extractum geranii fluidum, *U. S.*

Medical Action and Uses.—Cranesbill is a pure astringent, and may be profitably used in the treatment of subacute and chronic *diarrhœa.* A decoction of it in milk is employed in *cholera infantum.* A decoction, made by boiling an ounce of the root in a pint and a half of water to a pint, is sometimes used in *aphthæ* of the mouth and fauces, in relaxed conditions of the *throat*, *vagina*, and *rectum*, to restrain internal *hemorrhages*, and to cure *leucorrhœa*, *gleet*, etc. The *dose* may be stated at from twenty to forty grains of the powdered rhizome; or from one to two fluidounces of the decoction. The fluid extract is officinal.

GEUM, *U. S.*—WATER AVENS.

Radix caryophyllatæ aquaticæ, Radix benedictæ sylvestris.—Racine de benoite aquatique (de benoite des ruisseaux), Fr.; *Sumpfnelkenwurzel, Wasser-Benedikten-Wurzel*, G.

The rhizome with the rootlets of Geum rivale, *Lin.*

Nat. Ord.—Rosaceæ, Dryadeæ.

Origin.—This perennial plant grows in wet meadows and moist woods in hilly localities of North America, from Pennsylvania northward, and is likewise indigenous to Central and Northern Europe and Northern Asia. It has a stem 1 to 2 feet high, with lyrate or interruptedly pinnate root-leaves, and trifoliate or 3-lobed stem-leaves, the leaflets or lobes being obovate or cuneate oblong; the bell-shaped calyx is purplish-brown, the 5 petals are clawed, purplish-yellow, and veined.

Description.—The rhizome is nearly horizontal, 2 to 3 inches long, about $\frac{1}{4}$ inch thick, somewhat branched, tuberculate above from the bases of the stems, and there densely beset with red-brown hairy leaf-sheaths. It is externally blackish-brown, breaks with a rather short and waxy fracture, has a thin purplish-brown bark, brown-gray pith, and small distant light-colored wood-wedges. It has a very faint, somewhat clove-like odor, and a bitterish astringent taste.

Water avens has not been analyzed; its constituents are probably similar to those of the yellow-flowered *Geum urbanum*, Lin., or *avens*, which grows in Europe in woods and shady places, and has an oblique or perpendicular rhizome 1 or 2 inches in length, abrupt below or passing into the main or tap-root; it is hard, dark brown, tuberculate, and beset with dark-brown membranous scales; the numerous thin fibres are pale brown and 3 to 4 inches long; the wood is in 5 or 6 broad and rounded wedges, and incloses a large purplish pith. It has a distinct clove-like odor, and a bitter astringent taste. It is known in Europe as *radix caryophyllatæ.*

Constituents.—Avens, according to Buchner (1844), contains a small quantity of a volatile oil, possessing acid properties, about 3 per cent. of tannin, and a bitter principle which appears likewise to possess acid properties. The remaining constituents, sugar, fat, resin, etc., are not of medicinal importance.

Medical Action and Uses.—Water avens is very like in its action to avens, G. urbanum. Both are very astringent, and more or less tonic. Like other agents with these qualities it is apt to derange the digestion and cause vomiting if too freely given. It has been employed in all forms of disease of the mucous membranes depending upon relaxation and attended with excessive and altered secretions, including atonic *dyspepsia*, *diarrhœa*, *bronchorrhœa*, *leucorrhœa*, etc. It has also been used in chronic *rheumatism*, *scrofula*, slight *intermittent fevers*, and in *menstrual derangements* depending on debility. The *dose* is represented by about thirty grains of the powdered root; but it is best administered in a decoction made by boiling an ounce of the root in a pint of water, which may be given in *doses* of one or two fluidounces.

GILLENIA, *U. S.*—GILLENIA.

Indian physic, *Indian hippo*, *American ipecac*, *Bowman's root*, E.; *Racine de gillénie*, Fr.; *Gillenienwurzel*, G.

The rhizome with the rootlets of Gillenia trifoliata, *Moench* (Spiræa trifoliata, *Lin.*), and of Gillenia stipulacea, *Nutt.* (Spir. stipulata, *Willd.*).

Nat. Ord.—Rosaceæ, Spiræeæ.

Origin.—Both species are perennial herbs indigenous to the United States, the first being found almost exclusively east of the Alleghenies from New York south to Georgia, the other is found from New York westward and southward to Alabama. The plants are 2 to 3 feet high, branched, with nearly sessile trifoliate doubly serrate or incised leaves, and loose corymbs of pale rose-colored or white flowers, the calyx of which is tubular and constricted at the throat, the 5 unequal petals being long linear-lanceolate. The two plants are readily distinguished by their stipules, which, in *G. trifoliata*, are awl-shaped and entire, and in the larger *G. stipulacea* are large, leaf-like, ovate, and incised. The officinal portion is the rhizome and rootlets.

Description.—The rhizome of *G. stipulacea*, which is usually found in commerce, is nearly horizontal, about 1 inch thick, very knotty from the numerous branches and remnants of stems. The larger rootlets are $\frac{3}{8}$ inch thick near the base, tortuous, irregularly branched; the smaller rootlets are undulated, and have a knotty or annulated appearance from the semicircular constrictions of the bark on one side, and the depressions on the opposite side. The rhizome and rootlets of *G. trifoliata* are smaller and less knotty, the rootlets often smooth or indistinctly annulated. Both have a reddish- or grayish-brown color externally, and are hard and very woody, breaking with some difficulty except through the brittle bark. The bark of the rhizome is thin, the wood about 8 times thicker, of a whitish color, with several annual rings inclosing a thin pith, and traversed by fine medullary rays. The bark of the root is of uneven thickness, in its outer layer brownish-red, the inner layer reddish-white, with numerous minute red resinous dots. The odor is very slight; the taste of the bark is bitter, not unpleasant, exciting the flow of saliva; the wood is tasteless.

Constituents.—The various analyses made of gillenia have established the presence of starch, tannin, gum, albumen, fat, and resin, etc. The bitter principle, *gillenin*, not quite pure yet, has been obtained by W. B. Stanhope (1856) in the form of a whitish powder, having a slight odor and a very bitter taste, neutral to test-paper, soluble in water, alcohol, ether, and dilute acids, and colored blood-red by nitric acid. Its watery solution is stated to be precipitated by subacetate of lead, tartar emetic, and potassa, but not by tannin; ½ grain caused much nausea. It was prepared by washing the alcoholic extract with water, treating the residue with very dilute sulphuric acid, adding magnesia, evaporating, and exhausting the dry mass with alcohol.

Medical Action and Uses.—The popular title of American ipecacuanha sufficiently indicates the prominent virtue of this medicine. It is a mild emetic. The *dose* is twenty or thirty grains. The allied species, G. stipulacea, has identical qualities. Gillenin, when pure, will produce nausea and vomiting in *doses* of from one-half to one grain. Injected into the femoral vein of a dog it excited vomiting.

GLECHOMA.—GROUND IVY.

Herba hederæ terrestris.—Lierre terrestre, Fr.; *Gundermann, Gundelrebe*, G.

Glechoma hederacea, *Lin.*, s. Nepeta glechoma, *Benth.*

Nat. Ord.—Labiatæ, Nepeteæ.

Description.—Ground ivy is a creeping and trailing perennial, which is common in Europe and naturalized in various parts of North America. The ascending branches are from 6 to 10 inches long, quadrangular, and have opposite petiolate leaves, which are 1 or 1½ inch long, round-reniform, deeply crenate, green, and underneath often purplish. The blue or purplish flowers are in small axillary clusters, from 2 to 5 in number. The plant has a slight balsamic odor, and a bitter, somewhat acrid, taste.

Constituents.—These are doubtless similar to those of other plants of the same natural order, and comprise volatile oil, resin, etc.

Medical Action and Uses.—Ground ivy is said to act poisonously upon horses and sheep. It has been chiefly used in medicine in the treatment of *chronic bronchitis*, and its virtues in this affection are attested by medical evidence as well as by popular faith. It was at one time reputed to be a cure for consumption, by which was meant not that incurable disease which depends upon tuberculosis, but chronic bronchitis with muco-purulent sputa. It had also some reputation in catarrhal affections of the *urinary* organs, and in atonic *dyspepsia*. Externally the herb has been applied in poultices, or merely in a contused state to indolent ulcers. An infusion may be made with an ounce of the herb to a pint of boiling water, and given in wineglassful doses.

GLYCERINA, *U. S.*—GLYCERIN.

Glycerinum, Br., P. G.—*Glycerine*, E.; *Glycérine*, Fr.; *Glycerin, Oelsüss*, G.

Formula $C_3H_8O_3$. Molecular weight 92.

A sweet principle obtained from fat and fixed oils.

Origin.—Glycerin, which is not found in the free state, except in some rancid fats, exists in combination with the so-called fatty acids, forming compound ethers, which constitute most of the animal and vegetable, solid and liquid, fats. It is formed in small quantities during the fermentation of saccharine liquids. Scheele, who discovered it, in 1779, called it *sweet principle of oils*.

Preparation.—To obtain glycerin, fat must be decomposed into its proximate constituents, either by a caustic alkali, as in the manufacture of soap, or by oxide of lead, as in the preparation of lead plaster, or by the action of water at an elevated temperature under high pressure. The latter process, which was patented in 1854 by R. A. Tilghman, yields the acids of the fat and an aqueous solution of glycerin. Water which has been agitated with recently prepared lead plaster is likewise such a solution, and the liquor from which soap has been separated contains glycerin, saline matters, and various organic impurities, which may be removed by treatment with the necessary precipitants and with charcoal, the solutions being finally evaporated and distilled with steam under pressure.

Properties.—Glycerin is a syrupy liquid having the specific gravity 1.28 at 15° C. (59° F.) (Pelouze); the officinal glycerin has a density of 1.25. It is colorless, inodorous, very sweet, without action upon litmus, and soluble in all proportions in water and alcohol, but not in ether. In contact with the air, glycerin distils only partially unchanged, the greater portion being destroyed with the production of very acrid *acrolein* among the empyreumatic liquids. Its boiling point is 290° C. (554° F.). At a red heat it takes fire and burns without leaving any residue. It dissolves all deliquescent salts, is a solvent for many organic and inorganic compounds which are soluble in water or alcohol, and prevents the precipitation of some salts by alkalies and other reagents. Under certain circumstances, for which continued agitation and a very low temperature appear to be essential, glycerin will congeal into a solid crystalline mass.

Chemically, glycerin is a triatomic alcohol, and forms with acids three series of ethers in which 1, 2, or 3 atoms of hydrogen are replaced by the corresponding number of univalent acidulous radicals. The so-called neutral fats are saturated ethers, like *tripalmitin*, $C_3H_5O_3.3C_{16}H_{31}O$. A similar compound is *nitroglycerin* or *glonoin*, $C_3H_5O_3.3NO_2$, which is obtained on adding glycerin by drops to a mixture of concentrated nitric and sulphuric acids immersed in a freezing mixture, and afterwards pouring into water. Nitroglycerin is a heavy colorless oily liquid, which is insoluble in water, very poisonous, and violently explosive. It forms the basis of *dynamite* and similar explosive mixtures.

When heated with an excess of phosphoric anhydrid, $2H_2O$ are abstracted, and the glycerin is converted into *acrolein*, C_3H_4O, which is a light, very refractive, and volatile oily liquid, the vapors of which are extremely irritating to the eyes.

Glycerin dissolved in water and kept, with yeast, at a temperature of about 25° C. (77° F.) is converted into *propionic acid;* and with chalk and old cheese at 40° C. (104° F.) it yields *alcohol* and *butyric acid.* When slightly diluted with water, and heated to just above 100° C. (212° F.) in the presence of oxalic acid, the latter will be decomposed into *carbonic* and *formic acids.* $C_2H_2O_4$ yields $CO_2+CH_2O_2$; the formic acid may be afterwards obtained by *repeatedly* diluting with water and distilling. Glycerin unites with the alkalies and alkaline earths to compounds soluble in water, the former also in alcohol; the latter are not precipitated by carbonic acid. It unites also with sulphuric and other acids.

Impurities and Adulterations.—Glycerin is now rarely adulterated, but much being prepared for uses in the arts, where purity is not necessary, impure glycerin may at all times be met with in the market. Water, mucilage, glucose, and perhaps cane-sugar syrup would be used as adulterants. The first is detected by the specific gravity of the sample; the others by the brown color produced on mixing the sample with twice its bulk of concentrated sulphuric acid. Since cane-sugar syrup which has been exposed to the light for some time contains appreciable quantities of glucose, glycerin adulterated with either kind of sugar will yield a red precipitate when heated to boiling with a drop of solution of copper sulphate and an excess of potassa.

The impurities may consist of saline matters should the glycerin have not been distilled, or of odorous compounds if insufficiently purified by distillation. The odor becomes apparent on warming the glycerin or rubbing it well upon the hand. Most of these compounds reduce nitrate of silver and produce a more or less deep color when glycerin is diluted with a little distilled water, and after the addition of a few drops of nitrate of silver heated to boiling. The same reagent will detect chlorides by the white precipitate produced. Diluted glycerin should not be colored or rendered turbid on being tested with sulphuretted hydrogen or sulphydrate of ammonium (metallic salts), ammonium oxalate (calcium), or barium chloride (sulphuric or oxalic acid). The presence of butyric acid is readily determined by warming a mixture of glycerin with one-fourth its measure each of alcohol and sulphuric acid, when butyric ether, recognized by its odor of pineapples, will be given off. The most important tests for practical purposes are those with sulphuric acid and nitrate of silver. Goddefroy (1874) has recommended the heating of glycerin in an open crucible to boiling, and then igniting it, when it should burn without diffusing the least smell or leaving the least residue.

Pharmaceutical Uses.—Glycerin forms the base of the officinal *glycerita* (*glycerina*), and is a constituent of a number of officinal fluid extracts; also of Linimentum potassii iodidi cum sapone, *Br.* It is used for preserving pill masses in a plastic condition, and for preventing fermentation and other changes in aqueous liquids containing organic matter in solution.

Medical Action and Uses.—The purest glycerin is irritating on account of the avidity with which it abstracts moisture from the tissues; but commercial glycerin has sometimes a similar defect from containing nitric, sulphuric, or organic acids, and other impurities. It is alleged that glycerin mixed with the food of animals tends to fatten them while it diminishes the proportion of urea excreted. If given in larger doses than can be digested, it may be detected in the urine, but it cannot be recognized in the feces or the sweat. In excessive doses (such as f℥ss for every two pounds and a half of the animal's weight) its effects resemble those of alcoholic poisoning, including the gastric lesions found after death. Injected hypodermically the same symptoms and lesions are produced.

Its richness in carbon suggested its use as medicinal food, and especially as a substitute for cod-liver oil; but, as in so many other instances, a little clinical experience showed the so-called scientific inductions to be untrue. On theoretical grounds, also, it has been used in the treatment of *diabetes*, but without striking advantage, although when the amount of sugar excreted is very small the use of glycerine may cause it to disappear from the urine, at least in its usual form. It has been thought to retard emaciation in this disease. Its medicinal virtues depend almost entirely upon its having no tendency to evaporate, and to its undergoing no change by exposure to the air. Hence it may be advantageously used in all cases in which oil has, from time immemorial, been employed; and, owing to its solubility in water, with more effect. Thus it has been applied, with good results, to the rectum in *dysentery*, to the larynx, trachea, and bronchia (by atomization and inhalation), in various diseases of the *air passages* exciting cough and spasm, or causing their obstruction. Mixed with water or pure, according to circumstances, it forms the best solvent for hardened *cerumen* and epithelial scales, and the best agent for keeping the *tympanum* moist. It has been much used in the treatment of recent *wounds*, but with far less satisfactory results than are obtained by dry dressings that exclude the air. When these cannot be employed, glycerin may be profitably substituted. Its affinity for moisture tends, in certain cases, to limit the secretion of pus by drying and constringing the secreting surface. This is strikingly the case in *leucorrhœa*. The addition of an astringent, tannic acid, for example, increases the efficacy of the glycerin, which should be applied upon a tampon of lint. A similar application may be used for *fissure of the anus*, and for fissured *nipples*. For the latter, however, a mixture of compound tincture of benzoin and glycerin is preferable. *Fissured tongue* is curable by a solution of forty grains of borax in about an ounce of glycerin and four ounces of water. Pure glycerin applied to *carbuncles*, *boils*, and *abscesses* is said to promote their cure; but it is unsuited for application over a large surface, owing to its affinity for the moisture of the air. It allays *itching* in most affections attended with this symptom, and hence is an appropriate ingredient of ointments and washes used in their treatment. To prevent the *laryngeal mirror* from becoming obscured by the condensation of vapor upon its surface, it has been recommended to pass lightly over it a cloth wet with glycerin. *Dryness of the mouth* from fever or any other cause may be lessened by a mixture of glycerin and water far better than by water alone.

The solvent powers of glycerin have suggested the glycerites as officinal forms of certain medicines, but many others are prescribed extemporaneously. A solution of iodide of potassium in two parts of glycerin, with the addition of one part of iodine, makes an almost caustic preparation. A solution of one part of iodine in five parts of glycerin is used as a resolvent of enlarged and indurated glands, as a revulsive over inflamed joints, abscesses, etc. One part of glycerin and eight parts of sulphate of zinc form an energetic caustic. Vaccine lymph may be preserved from decomposition by mixing it with glycerin.

GLYCERITA, *U. S.*—GLYCERITES.

Glycerina, Br.; *Glycerata*, *Glycerolata.*—*Glycerins*, *Glycerols*, E.; *Glycérés*, *Glycerats*, *Glycérolés*, Fr.; *Glycerite*, *Glycerolate*, G.

This class of preparations consists mostly of solutions in undiluted glycerin, which are readily made by trituration in the mortar. Two of the officinal glycerites require different manipulations which will be noticed in the proper place. These preparations were suggested in 1854 by Cap and Garot, and soon after became favorably known and have become much used.

GLYCERITUM ACIDI CARBOLICI, *U. S.*—GLYCERITE OF CARBOLIC ACID.

Glycerinum acidi carbolici, Br.; *Glycerine of carbolic acid*, E.—*Glycérolé d'acide phénique*, *Glycérine phéniquée*, Fr.; *Phenol- (Phenyl-) Glycerit*, G.

Preparation.—Take of Carbolic Acid two troyounces; Glycerin half a pint. Rub them together in a mortar until the acid is dissolved. *U. S.*

Take of Carbolic Acid one ounce; Glycerin four fluidounces. Rub them together in a mortar until the acid is dissolved. *Br.*

Off. Prep.—Aqua acidi carbolici, *U. S.*

Medical Uses.—This is a convenient form for the application of carbolic acid in certain *eruptions of the skin*, such as scabies, prurigo, etc., in which the itching is tormenting.

GLYCERITUM ACIDI GALLICI, *U. S.*—GLYCERITE OF GALLIC ACID.

Glycerinum acidi gallici, Br.—*Glycerine of gallic acid*, E.; *Glycérolé d'acide gallique*, Fr.; *Gallussäure-Glycerit*, G.

Preparation.—Take of Gallic Acid two troyounces; Glycerin half a pint. Rub them together in a mortar; then transfer to a glass or porcelain capsule, and heat gently until the acid is dissolved. *U. S.*

Take of Gallic Acid one ounce; Glycerin four fluidounces. Rub them together in a mortar; then transfer the mixture to a porcelain dish, and apply a gentle heat until complete solution is effected. *Br.*

Medical Uses.—This preparation taken internally has the advantage over gallic acid in substance of being more readily absorbable. The *dose* is from twenty to sixty minims.

GLYCERITUM ACIDI TANNICI, *U. S.*—GLYCERITE OF TANNIC ACID.

Glycerinum acidi tannici, Br.—*Glycerine of tannic acid* (*of tannin*), E.; *Glycérolé de tannin*, *Glycerine tannique*, Fr.; *Tannin-Glycerol*, G.

Preparation.—Take of Tannic Acid two troyounces; Glycerin half a pint. Rub them together in a mortar; then transfer to a glass or porcelain capsule, and heat gently until the acid is dissolved. *U. S.*

Take of Tannic Acid one ounce; Glycerin four fluidounces. Rub them together in a mortar; then transfer the mixture to a porcelain dish, and apply a gentle heat until complete solution is effected. *Br.*

Medical Uses.—This glycerite is not so often used internally as that of gallic acid; but as a local application to *suppurating surfaces* of limited extent it is more efficient, *e. g.*, to the nostrils in chronic *coryza* and *ozæna*, to the *ear* in chronic catarrh, to the *throat* in chronic relaxation of its mucous membrane, etc. It is a useful dressing for certain chronic but irritable cutaneous eruptions, *e. g.*, *eczema*, *impetigo*, *intertrigo*, etc.

GLYCERITUM AMYLI.—GLYCERITE OF STARCH.

Glycerinum amyli, Br.—*Glycerine of starch*, *Glycamyl*, *Plasma*, E.; *Glycéré d'amidon*, *Glycérat simple* (*d'amidon*), Fr.; *Stärke-Glycerit*, G.

Preparation.—Take of Starch one ounce; Glycerin eight fluidounces. Rub them together until they are intimately mixed, then transfer the mixture to a porcelain dish, and apply a heat gradually raised to 240° F., stirring it constantly until the starch particles are completely broken and a translucent jelly is formed. *Br.*

This preparation was introduced into British pharmacy by G. F. Schacht in 1858, and soon after became known in the United States. To obtain a uniform jelly-like mass, the starch should be first rubbed into a fine powder, free from lumps, and then heated with the glycerin until all starch granules are ruptured, and the liquid is thickened to a translucent mass free from white spots.

For the same purpose T. B. Groves (1867) introduced a preparation under the name of *glycelæum*, which, besides glycerin, contains fixed oil; it is made by triturating half an ounce of fine almond meal with one ounce of glycerin, and then incorporating with it three ounces of olive oil, gradually added. The oil may wholly or in part be replaced by volatile oil or oleoresins. The preparation is a soft semi-gelatinous paste, which admits of the further addition of powders, and when mixed gradually with water, forms readily an emulsion.

Medical Uses.—This preparation forms a transparent, unchangeable, and unirritating compound. It has been much used in ophthalmic surgery, especially when medicinal agents were to be applied to the *conjunctiva*. Ordinary ointments are still to be preferred in affections of the eyelids. It answers the purpose of a light poultice in erythema, erysipelas, furuncle, intertrigo, and various other local inflammations of the skin.

GLYCERITUM PICIS LIQUIDÆ, *U. S.*—GLYCERITE OF TAR.

Glycerol of tar, E.; *Glycérolé de goudron*, Fr.; *Theerglycerol*, G.

Preparation.—Take of Tar a troyounce; Carbonate of Magnesium in powder two troyounces; Glycerin four fluidounces; Alcohol two fluidounces;

Water ten fluidounces. Having mixed the glycerin, alcohol, and water, rub the tar in a mortar, first with the carbonate of magnesium, and then with six fluidounces of the mixed liquids gradually added, and strain with expression. Rub the residue in like manner with half the remaining liquid, and strain as before. Repeat the process again with the remaining liquid. Put the residue into a percolator, add gradually the expressed liquids previously mixed, and afterwards a sufficient quantity of water to make the liquid, which passes, measure a pint. *U. S.*

This is essentially the formula proposed by J. B. Moore in 1869. The glycerite is of a rich reddish-brown color, and perfectly transparent when recently prepared, but gradually deposits blackish resinous matter, which should be filtered off.

Medical Uses.—Glycerite of tar is a convenient substitute for tar ointment in pruriginous and squamous affections of the skin.

GLYCERITUM SODII BORATIS, *U. S.*—GLYCERITE OF BORAX.

Glycerinum boracis, Br.—*Glycerine of borax*, E.; *Glycérolé de borax*, Fr.; *Borax-Glycerol*, G.

Preparation.—Take of Borate of Sodium two troyounces; Glycerin half a pint. Rub them together in a mortar, until the borate of sodium is dissolved. *U. S.*

Take of Borax in powder one ounce; glycerin four fluidounces. Rub them together in a mortar until the borax is dissolved. *Br.*

Medical Uses.—In this preparation the glycerin forms a convenient substitute for the honey usually employed along with borax in *aphthous* and other ulcerative affections of the *mouth*, *nipples*, *vulva*, etc., but is probably less efficient. It is more suitable for *pityriasis* of the scalp.

GLYCYRRHIZA, *U. S.*—LIQUORICE ROOT.

Glycyrrhizæ radix, Br.; *Radix liquiritiæ glabræ*, P. G.; *Radix glycyrrhizæ hispanicæ.*—*Licorice root, Spanish liquorice root*, E.; *Réglisse, Bois de réglisse, Bois doux, Racine douce*, Fr.; *Spanisches Süssholz, Spanische Süssholzwurzel*, G.

The root (and underground stem) of Glycyrrhiza glabra, *Lin.*, s. Liquiritia officinalis, *Mœnch.* Woodv., Med. Bot., t. 152; Bentley and Trimen, Med. Plants, 74.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This perennial is indigenous to the countries on the northern shore of the Mediterranean and further east to the Caucasus and Northern Persia. A well-marked variety, Gl. glandulifera, *W. and K.*, with the leaves glandular hairy beneath, and the legumes glandular prickly, grows from Hungary eastward through Southeastern Europe and further on into Persia. The typical form is cultivated in England, France, and Germany, and also to a limited extent in the United States. The stout roots penetrate deeply into the ground, while long horizontal rhizomes or runners are produced near the surface. The herbaceous overground stems are about 4 feet high, and have impari-pinnate leaves with oval-oblong mucronate leaflets, which are glutinous beneath, and racemes of white and purplish flowers producing brown legumes containing about 4 seeds. The roots and rhizomes are collected together and assorted before being brought into commerce. About 11,000,000 pounds of liquorice root are annually imported into the United States.

Description.—Liquorice root consists of long cylindrical pieces varying in thickness from ¼ to 1 inch, which are longitudinally wrinkled, covered with a grayish-brown warty cork, and break with a fibrous fracture. Transverse section shows a bark, about one-sixth the diameter of the root in thickness, underneath the cork of the grayish-yellow color of the wood and in its inner layer radiately striate from the long, narrow, and somewhat wavy bast wedges. The woody meditullium consists of tough fibro-vascular tissue, appearing porous from the large vessels, and forming narrow wedges separated from one another by still narrower medullary rays. The rhizome has the same appearance and structure, and, in addition, a thin central pith. Liquorice root has a peculiar odor and a strongly sweet somewhat acrid taste.

RADIX LIQUIRITIÆ MUNDATA S. RUSSICA, RADIX GLYCYRRHIZÆ ECHINATÆ, Russian liquorice root, is generally stated to be obtained from Glycyrrhiza echinata, *Lin.*, which is indigenous to Italy, Southern Russia, and further east to Central Asia. Flückiger and Hanbury presume it to be derived from *Glyc. glabra* var. *glandulifera.* It consists chiefly of the main root, and is about a foot long and 1 to 3 inches thick, often hollow above, usually deprived of the brownish corky layer, and furnished with a light, grayish-yellow, thin bark, covering a more porous wood which is often fissured in the direction of the medullary rays. It has a very sweet taste, and yields a lighter-colored powder than the former kind.

Constituents.—Robiquet (1809) obtained from liquorice root *starch*, *asparagin*, *albumen*, a *resinous oily matter*, to which the slight acrid taste of the root is due, and *glycyrrhizin.* Roussin (1875) found the latter to be present in the root, in combination with ammonia, as *glycyrrhizate of ammonium*, which he obtained pure from the cold infusion by precipitating with sulphuric acid, washing the precipitate well with water, dissolving it in strong alcohol, and adding ether, whereby a blackish mass is precipitated; the clear liquid is then carefully mixed with small quantities of alcoholic solution of ammonia. The precipitate is yellowish, very light, and by evaporating its aqueous solution is obtained in brittle, translucent, shining scales. *Glycyrrhizin*, prepared by the same process, with the exception of the final treatment with ammonia, was found by Gorup-Besanez (1861) to have the composition $C_{24}H_{36}O_9$, to be soluble in alcohol, ether, and hot water, and on boiling with dilute acids, to be split into glucose and a bitter resinous substance named *glycyrretin*, which is insoluble in water, but dissolves in alcohol and alkalies. By fusing it with potassa, Weselski and Benedikt (1876) obtained *paraoxybenzoic acid*, $C_7H_6O_3$.

Allied Drugs.—ABRUS PRÆCATORIUS, *Lin.*, or *Indian liquorice* (Bentley and Trimen, Med. Plants, 77), is a small twining shrub, growing wild and much cultivated in tropical countries, where the bright scarlet seeds, which are marked with a black spot at the hilum, are employed like beads. The long woody root is about ½ inch or less in diameter, externally pale reddish-brown, internally yellowish; it has a thin bark, a peculiar disagreeable odor, and a bitterish acrid flavor, leaving a faintly sweet after-taste (Pharmacographia). In India, it is used in place of liquorice root. Berzelius (1827) found the leaves to contain a sweet principle similar to that of liquorice.

Off. Prep.—Confectio terebinthinæ, *Br.*; Decoct. sarsaparillæ (sarsæ) comp., *U. S.*, *Br.*; Extract. glycyrrhizæ, *Br.*; Extract. glycyrrh. fluid., Extract. sarsaparillæ fluid. comp., *U. S.*; Infusum lini (lini comp.), *U. S.*, *Br.*; Pilula ferri iodidi, *Br.*; Pil. hydrargyri, *U. S.*, *Br.*; Pulv. glycyrrhizæ comp., *Br.*; Syrup. sarsaparillæ comp., *U. S.*

Medical Action and Uses.—Liquorice root is demulcent, laxative, and locally is slightly stimulant; it is supposed to promote the secretions of the congested mucous membrane of the air-passages. The infusion is a useful drink in *febrile catarrhal affections*, especially those attended with much thirst, and in febrile and irritative disorders of the *bowels* and *urinary organs.* In these cases, it is usually prepared with flaxseed, rice, barley, or gum-water. It is said that an infusion of liquorice root may be used by diabetic patients without aggravating the disease. Liquorice root is a constituent of a very excellent laxative prepared as follows: ℞. Senna, liquorice root, of each, ℥ij; Fennel seed, sulphur, of each, ℥j; Refined sugar, ℥vj. Mix, and reduce by trituration to an impalpable powder. *Dose*, a small teaspoonful in half a tumbler of water, at bedtime. Liquorice root is also used to correct the acrid or bitter flavor of certain medicines, such as quinia, colocynth, aloes, quassia, seneka, mezereon, guaiacum, and sal-ammoniac; but for this purpose the extracts and the syrup are more convenient.

GNAPHALIUM.—Life-everlasting.

Pied de chat, Immortelle, Fr.; *Katzenpfötchen, Immerschön*, G.

The flowers and flowering herb of different species of Gnaphalium and allied genera.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—Gnaphalium polycephalum, *Lin.*, grows in fields and woods of North America. It is a woolly annual, with lanceolate nearly entire leaves, and with the numerous ovate and obovate flower-heads in dense corymbose clusters terminating the branches; the involucral scales are dry, scarious, and whitish, the tubular florets yellowish. The plant is quite fragrant, and has a bitterish and aromatic taste.

Gnaph. margaritaceum, *Lin.*, s. Antennaria margaritacea, *R. Br.*, grows in similar localities with the preceding, chiefly northward, and has larger roundish-ovate heads, which are of a pearly whiteness and slight odor.

Gnaph. (Helichrysum, *D. C.*), arenarium, *Lin.*, grows in Europe and Asia. The heads are globular-oblong, $\frac{1}{6}$ inch long, of a lemon- or orange-yellow color and agreeable odor.

Gnaph. dioicum, *Lin.*, s. Antennaria dioica, *Gaertn.*, is indigenous to Europe. The barren flower-heads are hemispherical and whitish, the fertile ones more top-shaped and reddish or purplish. The species is very closely related to Antennaria plantaginifolia, *Hook.*, which is common in North America.

Constituents.—These plants appear to contain a little volatile oil and bitter principle.

Medical Action and Uses.—In Europe, the leaves and flowers of several species, which have, when chewed, an agreeable aromatic and slightly bitter and astringent taste, are used in infusion in chronic *bronchitis* and *diarrhœa*, and in poultices to unhealthy *ulcers*. All the species are employed under similar circumstances. They may be given in an infusion made with half an ounce of the plant to a pint of water.

GOSSYPII RADICIS CORTEX, *U. S.*—Bark of Cottonroot.

Cottonroot bark, E.; *Écorce de racine de cottonnier*, Fr.; *Baumwollen-Wurzelrinde*, G.

The bark of the root of Gossypium herbaceum and of other species of Gossypium.

Nat. Ord.—Malvaceæ.

Origin.—The different species of Gossypium are indigenous to the tropical and subtropical countries of Asia and Africa, and have been cultivated from a very early period, whereby many characteristic varieties have been produced. They are herbaceous or shrubby plants or small trees, with three to five-lobed leaves and showy axillary flowers, having a three-leaved involucre, a cup-shaped calyx, five petals, numerous stamens, and producing a three to five-celled capsule, which opens by as many valves; the numerous seeds are densely covered with long woolly hairs. According to A. W. Chapman, the long staple or Sea Island cotton cultivated in the United States is referred to *Goss. nigrum*, Haworth, and the short staple or upland cotton to *Goss. album*, Haw. The seeds of *Goss. religiosum*, Lin., are invested with a yellow wool. Cottonroot is conical, nearly simple or little branched, hard and woody, and covered with a thin bark which is officinal.

Description.—Cottonroot bark is in bands or quilled pieces, one-half line thick, covered with a brownish-yellow, satiny, very thin cork, by the abrasion of which irregular dull brownish-orange patches appear. The cork forms slight longitudinal ridges, which are often confluent into elongated meshes and marked with black circular dots or short transverse lines. The inner surface is whitish or reddish-white, of a nearly silky lustre, and finely striate in a longitudinal direction by the thin medullary rays. The bast fibres are long and tough, arranged in tangential rows, and are separated without difficulty in very thin layers. The bark breaks with difficulty in a transverse direction, but is readily torn longitudinally. It is without odor, and without taste, with the exception of a very slight acridity and faint astringency. It bears a pretty close resemblance to mezereon bark, except in color and taste.

Constituents.—The bark contains *starch*, and when fresh, according to W. A. Taylor (1876), a *chromogen* which dissolves in alcohol with a pale-yellow color, gradually changing to a bright brownish-red. The same change takes place on keeping the bark for some time, which then yields a red tincture with alcohol. This substance was examined by Prof. Wayne (1872) and W. C. Staehle (1875), who regard it as of a resinous nature. The latter obtained about 8 per cent. of this substance, which is soluble in 14 parts of alcohol, 15 of chloroform, 23 of ether, and 122 of benzole; also in alkalies, from which solutions it is again precipitated by acids. The potassa solution diluted with water is of a sage-green tint. *Glucose* was likewise observed and the aqueous solution of the alcoholic extract contained a principle which gave a purplish-black precipitate with ferric chloride. C. C. Drueding (1877) obtained also a yellow resin soluble in petroleum-benzin, fixed oil, little tannin, and 6 per cent. of ash. (See also Extr. gossypii cortic. fluidum.)

Substitutions.—In 1875 a false cottonroot bark, evidently obtained from the root of a tree, was found in the market; it was one-eighth to one-quarter inch thick, pale-brown to rust-brown in color, covered with a soft fissured cork, inodorous and of a slight astringent afterwards bitterish and acrid taste, and yielded with alcohol a brown tincture. Its origin has not been ascertained.

Off. Prep.—Extractum gossypii radicis fluidum, *U. S.*

Medical Action and Uses.—The only virtue of cottonroot consists in its action upon the uterine system. It is reputed to have long been used by the female negroes of the Southern States for producing abortion. There appears to be little doubt that it acts like ergot upon the uterus, and that it displays its virtues in *dysmenorrhœa* and scanty menstruation, and particularly in *suppression of the menses* produced by cold. It is generally used in the form of decoction, prepared by boiling four ounces of the bark in two pints of water to the reduction of one-half. Of this a wineglassful is given every twenty or thirty minutes as an oxytocic. The fluid extract, which is officinal, is a more convenient form of the medicine, and may be prescribed in the dose of from thirty to sixty minims. Cotton-seed tea is a mucilaginous liquid which forms an appropriate drink in *dysentery*. The seeds have also been recommended as galactagogue, but the evidence of their value in this respect is insufficient.

GOSSYPIUM, *U. S.*, *Br.*—COTTON.

Bombyx, *Lana* (*Lanugo*, *s. Pili*) *gossypii.*—*Coton*, Fr.; *Baumwolle*, G.

The hairs of the seed of various species of Gossypium (see above).

Description.—Cotton consists of narrow thin-walled simple cells, which are about one-half to one and a half inch long, and appear under the microscope as flattened hollow and twisted bands, which are slightly thickened at the edges, finely and spirally striate and nearly cylindrical at the apex. It is without odor or taste, insoluble in the ordinary solvents, but soluble in ammoniacal solution of oxide of copper. It consists of nearly pure cellulose, and yields with nitric acid an explosive nitro-compound (see Pyroxylon), which is used in preparing collodion.

COTTON-SEED OIL.—By expressing the seeds from which the cotton has been removed, a dark-brown red fixed oil, containing a large percentage of albuminous matter, is obtained, which is bleached by treatment with alkalies and with sulphuric acid, and finally obtained of a pale-straw color and of a bland nut-like taste. W. H. Weatherly (1861) states that one bushel of shelled seeds yield about two gallons of crude oil, and that it may be used in some preparations as a substitute for the more expensive almond and olive oils, but not in the preparation of plasters. The oil is colored deep brown-red by concentrated sulphuric acid, and is not solidified when left in contact with solution of mercurous nitrate. Cotton-seed oil is stated to be used for adulterating olive oil, and even to be fraudulently substituted for it.

Surgical Uses.—Cotton has long been employed as a dressing for *burns*, *scalds*, *blisters*, *excoriations*, *erysipelas*, and other superficial inflammations. If the burn, scald, or blister be superficial, there is no better dressing. No other application more speedily and completely allays the pain of the injury. Even when the tissue of the skin is more deeply interested, the dressing is unsurpassed. It should consist of very thin layers of carded cotton, successively applied, and secured by a bandage, and should not be removed until the cure is complete. Carbolized cotton, that is, cotton impregnated with carbolic acid, has sometimes been employed. The fibre has been used as a substitute for lint, and also for sponge, after being thoroughly freed from the unctuous matter which in its natural condition renders cotton inapt for absorbing the secretions. As a dressing for *surgical wounds* cotton is said to be one of the most perfect preventives of *purulent infection*, as well as of prolonged suppuration, if it is properly applied in the manner described above. Washed cotton is especially applicable to this purpose, and is still more efficient if it has been washed in carbolic acid water.

GRANATI FRUCTÛS CORTEX, *U. S.*—POMEGRANATE RIND.

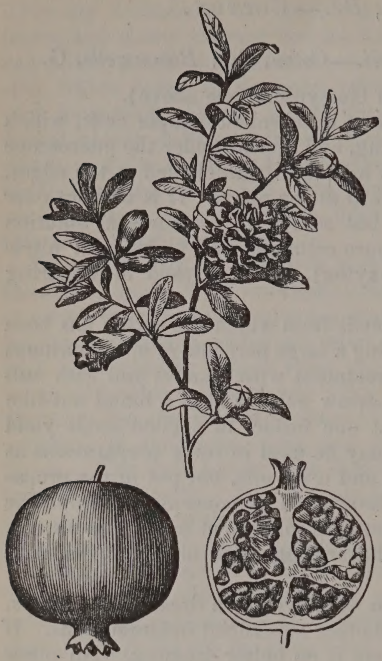
Cortex granatorum, *Cortex malicorii*, *Pericarpium granati.*—*Pomegranate bark*, E.; *Écorce de grenade*, *Cuir de pomme de grenadier*, Fr.; *Granatenschalen*, G.

The rind of the fruit of Punica granatum, *Lin.* Steph. and Church, Med. Bot., plate 57; Woodville, Med. Bot., 190; Bentley and Trimen, Med. Plants, 113.

Nat. Ord.—Granataceæ.

Origin.—The pomegranate is indigenous to Southwestern Asia from Northern India to Palestine; it has been cultivated from remote antiquity, and is now met

Fig. 84.



Punica granatum, *Lin.*

with in all subtropical countries. It is a shrub or small tree with lanceolate or oblong, pointed, entire and shining leaves, bearing one to three large crimson-colored flowers in the axils of the upper leaves, and producing a depressed globose fruit, of the size of an orange, irregularly divided by a transverse dissepiment into two unequal parts, the lower and smaller of which is about three celled, and the upper five to nine celled. The numerous seeds are oblong, irregularly angular from pressure, each invested with a fleshy pink-colored translucent coating. The rind of the fruit and the bark of the root are employed in medicine. The flowers and the sweet acidulous seed-coating are likewise used in oriental countries.

Description. — Pomegranate rind forms irregular curved fragments, which are about one line thick, externally somewhat tubercular and rough, of a brownish color with a yellowish or reddish tint, internally of a lighter color, marked with meshes indicating the depressions caused by the seeds. Some of the pieces are crowned by the thick, tubular, six- to nine-toothed persistent calyx, inclosing the remains of the style and numerous stamens. They break with a short granular fracture, are nearly devoid of odor, and possess a strongly astringent taste.

Constituents.—Examined by Reuss, pomegranate rind was found to contain about 28 per cent. tannin, 21 extractive, and 34 gummy matter. Bowman (1869) obtained 23.8 per cent. of tannin, which gives with ferric salts a blue-black precipitate. Flückiger obtained 5.9 per cent. of ash, calculated for the rind dried at 100° C. (212° F.), also some sugar.

Medical Action and Uses.—Pomegranate rind is an astringent, and, although possessed of some anthelmintic virtues, is employed in a gargle in relaxed states of the *fauces*, and in the treatment of chronic *diarrhœa*, *leucorrhœa*, passive *hemorrhages*, and cancerous and other *ulcers* of the uterus and rectum.

GRANATI RADICIS CORTEX, *U. S.*, *Br.*—BARK OF POMEGRANATE ROOT.

Cortex radicis granati, P. G.—*Écorce de la racine de grenadier* (*de balaustier*), Fr. ; *Granatwurtzelrinde*, G.

The bark of the root of Punica granatum, *Lin.* (See above.)

Description.—The bark of pomegranate root is met with in commerce in curved pieces or quills, 2 to 4 inches long, and scarcely ½ line thick, which are externally of a yellowish-gray color, marked with longitudinal or reticulate corky ridges, or irregular warts, and conchoidal depressions; the inner surface is smooth, finely striate, of a grayish or reddish-yellow color, frequently with fragments of the whitish wood adhering. It breaks with a short, granular fracture, which is of a greenish-yellow hue, and not perceptibly radiate in the inner layer; has no odor, and a purely astringent taste.

Constituents.—The principal constituent is tannin, of which Wackenroder (1824) found about 22 per cent., and which was recognized as peculiar by Stenhouse (1843). By fractional precipitation of the decoction with lead acetate, Ramdohr (1867) obtained some gallotannic acid, which could be converted into gallic acid, and *punico-tannic acid*, $C_{20}H_{16}O_{13}$, which is insoluble in alcohol and ether, reduces silver and alkaline copper solutions, and precipitates gelatin, tartar emetic, and ferric salts, the latter black. When boiled with dilute acids, it is split into sugar and *ellagic acid*, $C_{14}H_6O_8$. Stenhouse did not succeed in obtaining indications of the presence of gallic acid. Boutron-Charlard and Guillemette (1835) isolated *mannit*, which Latour de Trie (1830) had named *granatin*, and Guiart (1831) *granatomannit*. Cenedella (1835) obtained also sugar, mucilaginous and pectin compounds. Tanret (1878) has announced the discovery in the root-bark and stem-bark of an alkaloid, which, in honor of Pelletier, he proposes to call *pelletierina;* it is obtained by mixing the bark with milk of lime, displacing with water, and exhausting the percolate with chloroform. When pure it is colorless, oily, aromatic, and very soluble in water, alcohol, ether and chloroform; it precipitates the salts of most metals, and unites with acids to form crystallizable salts. 4 parts of the alkaloid were obtained from 1000 parts of the bark.

Adulterations and Substitutions.—The bark of the stem or branches, which is reputed to be less active, is often substituted for the root-bark; it closely resembles the latter, but has no conchoidal depressions upon the thinner cork, upon which, however, small lichens are not unfrequently observed. *The bark of boxwood* has an exfoliating corky layer, a yellowish-brown color, and a sweetish-bitter taste; its infusion is not affected by ferric salts. *Barberry bark* is readily distinguished by the bright yellow color of its tissue (see Berberis, p. 282).

Off. Prep.—Decoctum granati radicis, *Br.*

Medical Action and Uses.—The bark of the root has long been celebrated as an efficient *tænifuge* and *tænicide.* Its specific operation upon the system is manifested by giddiness, dimness of vision, drowsiness, faintness, numbness of the limbs, and even convulsions. The bark is most efficient when fresh. It is best administered in a decoction prepared as follows: Take two ounces of the fresh bark hashed, and let it soak overnight in a pint and a half of water, and then by gently boiling reduce it to a pint. Strain off the liquor, expressing the grounds, and give it lukewarm in three doses, at intervals of an hour, before the patient has broken his fast. If the first dose is vomited, the others should still be administered, and will generally be retained. No purgative or other treatment need precede or follow; it is, however, more prudent to administer an ounce of castor oil as soon as the gurgling and colic provoked by the decoction begin to appear. The bark of the trunk and of the branches of medium size has recently been shown to equal the bark of the root in medicinal virtues.

GRATIOLA.—HEDGE-HYSSOP.

Gratiole, Fr.; *Gnadenkraut*, G.

Gratiola officinalis, *Lin.* *Nat. Ord.*—Scrophulariaceæ.

Description.—The stem grows from a creeping rhizome to the height of 6 to 12 inches; has opposite, sessile, lanceolate, finely serrate, three-nerved leaves, and whitish or reddish two-lipped flowers, with yellow hairs in the tube. The plant is inodorous, and has a very bitter, somewhat acrid, taste.

Constituents.—E. Marchand (1845) obtained the white crystalline bitter principle *gratiolin*, which is little soluble in water and ether. Walz afterwards

(1852, etc.) proved it to be a glucoside, splitting under the influence of acids into sugar, into amorphous *gratiolaretin* and scaly *gratioletin.* Walz also isolated the reddish amorphous bitter principle *gratiosolin*, which is soluble in water and alcohol, and is likewise a glucoside. *Gratioloic acid* crystallizes in white scales of a fatty odor.

Physiological Action.—Experiments upon animals and observations upon man show that gratiola is a powerful local irritant, and that when taken internally it causes retching, vomiting, colic, purging, even bloody stools, and inflammation of the stomach and bowels, especially of the rectum. In enema it has occasioned so much pelvic irritation as to excite nymphomania, probably in predisposed persons. In one such case it is reported to have been fatal. In smaller, not purgative, doses it is said to be diuretic.

Medical Uses.—The chief, if not the only, use to which gratiola is applied in medicine is the treatment of *dropsy* by hydragogue purgation, as jalap, colocynth, and elaterium are employed. As it tends only to remove the dropsical effusion, and not its organic cause in the kidneys, heart, liver, etc., the chief point to be regarded is that the effects of the medicine should not be so violent as to induce the patient's collapse. Like other drastics, gratiola has been employed in the treatment of insane *melancholy* and in *mania;* and also to expel *intestinal worms.* For the last purpose the infusion has been used as an enema, prepared with half a drachm of the root in half a pint of water. As a drastic purgative the *dose* may be stated at from ten to twenty grains.

GRINDELIA.—GRINDELIA.

Nat. Ord.—Compositæ, Asteroideæ.

Description.—This genus consists of herbaceous or suffruticose perennials which are indigenous to the western part of North America and to Mexico. They are characterized by their heads being many-flowered; the ray-florets yellow, ligulate and pistillate; the disk-florets tubular, five-toothed and perfect; the involucre hemispherical, with the scales imbricated in many rows, often with squarrose tips; the receptacle flat and alveolate, and the akenes smooth and crowned with a pappus, consisting of a few rigid deciduous awns. The following species have attracted attention:—

GRINDELIA ROBUSTA, *Nutt.*—It is a polymorphous species, very smooth, pale, usually stout, with the leaves varying from broadly spatulate or oblong to lanceolate, the upper ones being often clasping, with a heart-shaped base; obtuse at the apex, and more or less sharply serrate. The akenes are from one to three-toothed at the apex, and have 2 or 3, rarely 5, awns for the pappus. The variety *latifolia* is the robust and broad-leaved form, the leaves being often 3 to 4 inches long. The variety *angustifolia* has rather fleshy and narrower leaves, the upper ones being nearly entire, and all narrowed at the base. The variety (?) *rigida* is more glutinous, the leaves rigid and coriaceous, some of them sharply serrate. All these plants have the tips of the involucral scales at length rigidly spreading. The plant is common along the Pacific coast and inland on the mountains.

GR. HIRSTULA, *Hook. and Arn.*, is pubescent or tomentose; the stem often reddish or purplish, the leaves varying between spatulate, oblong, and lanceolate, the upper ones clasping. It is met with along the coast northward to Puget Sound.

GR. GLUTINOSA, *Dunal*, is said to be introduced in sandy ground near the coast of California. It is glabrous, has the leaves rounded at the apex, the involucral scales with short tips, and the pappus of 5 to 8 rigid awns, with thin serrulate edges.

GR. SQUARROSA, *Dunal*, is found from Arctic America southward to California, Texas and Nebraska, and is very common on the plains. It is glabrous and viscidly resinous; the leaves rather rigid, glaucous and punctate, varying between spatulate-lanceolate and oblong, the upper ones sessile, partly clasping, rather obtuse, and finally toothed; the involucral scales with very long reflexed, squarrose, subulate points.

The plants have a balsamic odor, and a pungently aromatic and bitterish taste.

Constituents.—As far as may be judged from the sensible properties, these species contain volatile oil and resin, the latter not unfrequently coating the involucre and leaves, rendering them glutinous; hence the name *gum plant* commonly applied to them. A *fluid extract* may be prepared from it, using strong alcohol as the menstruum.

Medical Uses.—The herb of this plant is reported to be useful in *whooping cough* and *bronchitis*, and of singular efficacy in *asthma*. We have been informed of several cases occurring in aged persons, in which half a teaspoonful of the fluid extract afforded almost instantaneous relief. The *dose* for a child two years old is stated to be ten drops every two hours of the fluid extract. It is added that no unpleasant symptoms have been observed after large doses. Definite accounts of its action and uses are still wanting. It is alleged that the tincture or fluid extract of G. squarrosa has been used topically in cases of poisoning by rhus toxicodendron.

GUAIACI LIGNUM, *U. S.*, *Br.*—GUAIACUM WOOD.

Lignum guajaci, P. G.; *Lignum sanctum* (*vel benedictum, vel vitæ*).—*Lignum vitæ*, E.; *Bois de gayac* (*de gaïac*), Fr.; *Guajakholz, Pockholz, Franzosenholz*, G.

The heart-wood of Guaiacum officinale, *Lin.* Steph. and Church, Med. Bot., plate 90; Bentley and Trimen, Med. Plants, 41.

Nat. Ord.—Zygophyllaceæ.

Origin.—This, and the allied *Gua. sanctum*, Lin., are indigenous to the West Indian Islands and to the northern coast of South America. The former is about 40 feet high, has evergreen pinnate leaves with 2, rarely 3, pairs of smooth oval and obtuse leaflets, blue flowers, and 2-celled capsules, each cell containing one black seed. *G. sanctum* is smaller, has leaves with 4 or 5 pairs of oblong mucronulate leaflets, and a 4- or 5-celled fruit with red seeds. The wood of both species consists of heavy dark-colored heart-wood, surrounded by a yellowish zone of sap-wood, which is generally relatively broader in the second species.

Description.—The heart-wood is of a brown color, turning olive-green on exposure, and is composed of alternately darker and lighter zones, which form incomplete circles, and resemble annual rings, the tissue being well filled with resin. The central pith is quite indistinct, the medullary rays are very fine, the vessels scattered. The wood is very heavy, of specific gravity 1.3, hard, tenacious, and splitting very irregularly, caused by the much-interwoven wood-bundles. In the shops it is usually seen in the form of raspings and shavings, which should be free or nearly so from the lighter sap-wood. Guaiacum wood has a slight aromatic odor, which is more apparent on warming or rubbing it, and a somewhat acrid taste. The shavings acquire a dark blue-green color on being moistened with nitric acid or other oxidizing agents.

Constituents.—The wood contains from 20 to 25 per cent. of resin, which is the most important constituent, and yields about 3 to 4 per cent. of aqueous extract.

Off. Prep.—Decoct. sarsaparillæ (sarsæ) comp., *U. S.*, *Br.*; Syrup. sarsaparillæ comp., *U. S.*

GUAIACI RESINA, *U. S.*, *Br.*—GUAIAC.

Resina guajaci, P. G.; *Guaiacum.—Guaiacum resin*, E.; *Résine de gaïac*, Fr.; *Guajakharz, Guajak*, G.

The resin of the wood of Guaiacum officinale, *Lin.* (See Guaiaci lignum.)

Origin.—The resin is obtained partly as a natural exudation or from incisions, partly by setting fire to a billet of the wood which has been grooved or pierced lengthwise near the centre, the resin, as it melts, running from the opening.

Description.—The resin is in separate or agglutinated tears, varying in size from $\frac{1}{4}$ to 1 inch in diameter, or more generally in irregular masses, intermixed with fragments of wood and bark. It is of a greenish- or reddish-brown color, brittle, breaks with a somewhat conchoidal fracture having a glassy lustre, and is transparent in thin splinters. It yields a whitish powder, which turns rapidly green on exposure to the air, has the specific gravity 1.2, fuses at about 85° C. (185° F.), emitting an agreeable odor, suggesting that of vanilla, and at a higher temperature gives off irritating vapors. Its taste is not strong, but distinctly acrid. The resin is soluble in caustic potassa, and in nearly all the ordinary solvents for resins, except carbon bisulphide, benzol, and oil of turpentine. The solutions, as well as the powder, are colored green or blue by nitric acid, chlorine, ferric chloride, and other oxidizing agents; the same color is produced by ozone, and upon the inner surface of the paring of a raw potato. Guaiacum resin should be soluble in alcohol, leaving but a slight residue. Sometimes it is very impure, containing as much as 16 per cent. of wood and bark.

Constituents.—On boiling guaiac resin with milk of lime, *guaiacic acid* and *guaiac yellow* are dissolved. If the residue is treated with hot alcohol, the tincture evaporated, and this residue dissolved in hot solution of caustic soda specific gravity 1.3, the sodium salt of *guaiaretic acid* will crystallize on cooling, and the mother-liquor contains *guaiaconic acid* and *beta resin*, which, after the removal of the alkali, are separated by ether, in which the former only is soluble.

Guaiacic acid, $C_{12}H_{16}O_6$, was discovered in guaiac wood by Thierry (1841), and is present in very minute quantity; it crystallizes in white needles, is sublimable and soluble in water, alcohol, and ether. *Guaiaretic acid*, $C_{20}H_{26}O_4$, discovered by Hlasiwetz (1859), crystallizes in warts and scales, is of a faint vanilla odor, and is soluble in alcohol, ether, chloroform, benzol, etc., and sparingly soluble in cold water and ammonia. *Guaiaconic acid*, $C_{38}H_{40}O_{10}$, discovered by Hadelich (1862), is light brown, amorphous, insoluble in water, benzol, and carbon bisulphide, easily soluble in alcohol, ether, chloroform, and acetic acid; it acquires a transient blue color with oxidizing agents. Hadelich's *guaiacbeta resin* is a red-brown powder; his *guaiac yellow*, which was first noticed by Pelletier, has a bitter taste, and forms pale-yellow octohedra, which dissolve in oil of vitriol with a handsome blue color, and in alkaline liquids with a deep-yellow color. Hadelich obtained about 70 per cent. of guaiaconic acid, 10 per cent. each of guaiaretic acid and beta resin, and nearly 4 per cent. of gum, the remainder being the other constituents, including some impurities and 0.8 per cent. of ash.

On subjecting guaiaretic acid to dry distillation, a thick yellow oil is obtained consisting of *guaiacol*, $C_7H_8O_2$, which is a colorless oil of agreeable odor, forming with alkalies crystallizable salts; *guaiacene*, C_5H_8O, which is thin, oily, of a bitter almond odor and hot aromatic taste; and *pyroguaiacin*, $C_{19}H_{22}O_3$, which crystallizes in inodorous and tasteless scales, is colored green by ferric chloride, and is probably the substance to which guaiac resin owes its behavior towards oxidizing agents. By dry distillation guaiac resin yields *creosol*, $C_8H_{10}O_2$, in addition to the decomposition products mentioned; it and the allied guaiacol are colored green by caustic alkalies, and blue by alkaline earths; both have been observed in creasote. (See page 466.)

Off. Prep.—Mistura guaiaci, *Br.;* Pilul. antimon. comp. (hydrarg. subchlor. comp.), *U. S., Br.;* Tinctura guaiaci, *U. S.;* Tinct. guaiaci ammoniata, *U. S., Br.*

Physiological Action.—Guaiacum was for a long time regarded as a diaphoretic, because the syphilitic patients to whom its decoction was largely administered, and who were placed in conditions favorable to diaphoresis, sweated abundantly. It appears to be a stimulant whose action may be artificially directed to the skin. In excessive and concentrated doses it excites a burning pain in the throat and stomach, vomiting, purging, palpitation, congestion of the head, confusion of mind, and giddiness. These effects are produced by the decoction of the wood, and cannot, therefore, be due to the resin, which is insoluble in water; but from its strong taste and smell, it can hardly be without action upon the economy, and is, probably, like its congeners, a vascular stimulant.

Medical Uses.—Guaiacum is most renowned for the cure of constitutional *syphilis*, and the records of its use during nearly three hundred years were accepted as true until the scepticism of the nineteenth century condemned it. The vain and frivolous methods of using it which prevailed in recent times fully account for its want of success in the hands of modern physicians. While it was in vogue, the treatment by it was serious. The patient was obliged to observe a very strict regimen, to drink enormous quantities of a stronger and of a weaker decoction of the wood, to live upon a very sparing and simple diet, and in every manner to promote perspiration. The question of its efficiency has a very subordinate interest since the introduction of iodide of potassium. Like other vascular stimulants, guaiacum resin has been found efficient in promoting menstruation in all atonic conditions of the uterine system, and hence in *dysmenorrhœa* as well as in *amenorrhœa* of that origin. For the same reason, doubtless, it is a valuable remedy for chronic muscular *rheumatism.* For these purposes the ammoniated tincture is to be preferred. In simple *tonsillitis* and in *diphtheria* it is alleged to be very efficacious; but the former disease gets well spontaneously, and the evidence of the value of guaiac in the latter is inconclusive.

Guaiacum wood is prescribed only in decoction (see Decocta), simple or compound, of which the latter is most efficient. The resin may be given in doses of from ten to thirty grains. The guaiacum mixture (Br. Ph.) is a convenient form for its administration.

When the red coloring matter of the blood is brought into contact first with tincture of guaiacum and then with peroxide of hydrogen, the guaiacum is instantly turned blue. In the testing of suspected stains in this manner "it will be safe to say that if there is no bluing of the guaiacum resin in the presence of the peroxide, the mark or stain is not owing to blood." (*Taylor.*)

GUANO.—Guano.

Origin.—Guano consists of the partially decomposed excrements of the penguin and other sea-birds, which congregate in large numbers on the barren and uninhabited islands on the western coast of South America, and in other localities. It is principally exported from the islands off the coast of Peru.

Description.—It is in the form of crystalline or amorphous masses, or more frequently of an irregular powder having a grayish or pale-brown color, and an offensive, usually ammoniacal odor. Its spec. grav. is about 1.64; its reaction is mostly alkaline, though occasionally acid. It contains hygroscopic water varying between 6 and 20 per cent., which is expelled by the heat of a water-bath; when exposed to a higher temperature it blackens and burns, leaving a white ash varying in amount between 25 and 38 per cent.

Constituents.—The organic constituents of guano are chiefly *uric acid*, *ammonium urate*, and various oxalates. The chief inorganic constituents are phosphates of calcium, magnesium, and the alkalies, some sulphates, chlorides, and a very little sand; occasionally also ammonium carbonate. B. Unger (1845) discovered in guano the alkaloid *guania* $C_5H_5N_5O$, which has since been proved to exist also in the pancreatic juice of mammals; it forms a white crystalline powder which is insoluble in water, alcohol, ether, and ammonia, but soluble in acids and in potassa solution.

In estimating the value of guano as a manure, the amount of the following constituents, besides moisture and ash, is determined: ready-formed ammonia (present as ammonium salts), latent ammonia (generated in the soil from nitrogenous compounds), uric acid, and phosphates.

Medical Action and Uses.—Under the singular delusion that the ammonia in guano possesses some special mode of action different from that of officinal ammonium compounds, this substance was mixed with potter's clay, and used as a dressing for several *diseases of the skin*, and afterwards in baths and lotions. But it speedily exhibited the irritating effects proper to the salts of ammonia in common use, and is now quite abandoned. It will almost exceed belief that this bird-dung should have been introduced into a syrup and administered internally.

GUARANA.—Guarana.

Pasta guarana, P. G.—*Guarana*, Fr., G.

The powdered and prepared seeds of Paullinia sorbilis, *Martius*. Bentley and Trimen, Med. Plants, 67. *Nat. Ord.*—Sapindaceæ.

Origin.—Paullinia sorbilis is a climbing shrub, with pinnate leaves, composed of five oval-oblong toothed leaflets; small flowers in narrow spicate panicles, and pyriform beaked capsules containing one to three shiny blackish-brown subglobular seeds. It is indigenous to the northern and western provinces of Brazil.

Preparation.—The dry seeds are powdered, moistened by water or by exposure to the dew, and then kneaded into a kind of stiff paste, which is formed into globular or cylindrical masses; these are well dried near a fire, or by exposure to the sun.

Description.—Guarana is met with in subglobular, cylindrical, or elliptic cakes, which have an uneven surface, are hard, of a reddish-brown color, somewhat lighter internally, and breaking with an uneven, slightly glossy fracture. It has a peculiar slight odor, and an astringent and bitter taste.

Constituents.—Martius found guarana to contain starch, gum, a greenish fat, tannin which precipitates iron salts dark green, and a crystalline substance, *guaranin*, which was afterwards proved to be identical with *caffeina* (page 308), by Martius and by Berthemot and Dechastelus (1840). The latter obtained 4 per cent., Stenhouse 5.07 per cent. of caffeina. Saponin and volatile oil are likewise present in guarana.

Allied Plants.—Paullinia cupana, *Kunth*, which grows near the Orinoco River, has flattish, convex seeds; these are mixed with cassava and water, and subjected to fermentation, yielding a saffron-yellow liquid, which is used as a beverage.

Pharmaceutical Uses.—Kennedy (1876) proposed a *fluid extract of guarana* to be made as follows: 16 troyounces of guarana in moderately fine powder are moistened with a portion of a mixture composed of 8 fluidounces of strong alcohol and 4 fluidounces each of glycerin and water. The mass is packed in a glass percolator, the remainder of the mixture poured on, and the whole macerated for twenty-four hours, when it is displaced with diluted alcohol until exhausted. The first 12 fluidounces of the percolate are reserved, and the weaker portion evaporated to 4 fluidounces, and mixed with the reserved portion.

Physiological Action.—Among the conclusions drawn from his experiments by Mantegazza are these: that guarana, by its tannin, tends to retard putrefaction; that, like caffeine, it first excites frogs, then impairs their power of coördination, and ultimately throws them into spasms; and that it slows the action of their hearts. In various warm-blooded animals it produced similar effects, but it rendered the rabbit only somewhat dull and languid, and in dogs occasioned a sort of intoxication and excentricity of movement. According to the same authority, in man it gives rise to gayety, restlessness, increased quickness of perception and mental activity, wakefulness, a slight fall in the pulse-rate, impaired appetite, and vesical irritation. Like others, he associates guarana in the same category with maté, coffee, and tea, giving it the first place as a promoter of cerebral action. It is curious to contrast these definite and striking results with those of Dr. Macdowall, of West Riding Insane Asylum, Eng. He experimented upon himself and two male attendants, and it soon became evident to him that even in very large doses its effect upon the body in a state of health is almost, if not quite, inappreciable. It does not even cause constipation. In large doses it appears to dispel drowsiness after a late dinner, just as tea and coffee do.

Medical Uses.—The curative powers of this agent when first introduced appeared to be not less wonderful than in the case of other new remedies. It was a specific for diarrhœa and dysentery, gonorrhœa, leucorrhœa, and passive hemorrhages; was lauded as a stomachic tonic, and even put forward as remarkably efficacious in lumbago. Of all these virtues of the drug none survive; and the only affection in which it continues to be found useful is one which its congeners, tea, and especially green tea, and coffee, have never lost the reputation of relieving, *headache.* The particular forms of headache in which it is useful are the nervous sick headache which recurs frequently in the same person, and especially in females at the menstrual periods, and that which follows a debauch, when the head throbs, and the eyes are bloodshot. Like the other more popular remedies, guarana gradually loses its power over these attacks, and even appears to render them more frequent and severe. It may be administered in substance in the dose of from fifteen to sixty grains in powder; but in this form it is repulsive, and the doses mentioned are better given in infusion. The most efficient preparation is, however, the alcoholic extract dissolved in alcohol to form a tincture, in the proportion of one part to thirty. From two to five grains of the extract may be given at a dose. A fluid extract and a syrup have been made, and are convenient forms for administration.

GUTTA PERCHA, *U.S.*, *Br. Add.*—GUTTA PERCHA.

Gutta taban.—Gutta percha, Fr., G.

The concrete exudation, obtained by incisions, of Isonandra gutta, *Hooker.* Loudon's Journal of Botany, 1848.

Nat. Ord.—Sapotaceæ.

Origin and Preparation.—The taban is a stately tree, 60 to 80 feet high, with few branches, with evergreen oblong or obovate, entire, glossy, and underneath brownish leaves and small white flowers aggregated in little clusters near the top of the branches. It is common in the jungles of the Malay peninsula and of the Malayan Archipelago; it is now extinct in Singapore, having been destroyed in the collection of the juice. To obtain the gutta percha, the tree is felled, and circular incisions are made through the bark at distances of 6 to 12 inches along the whole trunk, from which the milky juice slowly exudes, and hardens on exposure. The yield from one tree is stated to be from 6 to 10 pounds; others claim a yield of over 20 pounds. Several other sapotaceous trees yield similar products.

Description.—Gutta percha is grayish or yellowish, frequently of a red-brown color, from fragments of bark and other impurities. It is hard and rather horny, in thin pieces somewhat flexible, between 45° and 60° C. (113° to 140° F.) sufficiently soft to be rolled into sheets, and quite plastic near the temperature of boiling water. Its specific gravity is about 0.98, but heavier than water after the removal of all air cavities (Payen). It is insoluble in water, alcohol, and fixed oils, dissolves in boiling ether, in chloroform, benzol, carbon bisulphide, and oil of turpentine. If purified by treatment with water and hydrochloric acid, and then repeatedly dissolved in boiling ether and washed with cold ether and alcohol, a fine white powder is obtained, of the composition $C_{20}H_{32}$, which is probably the composition of the recent juice (Baumhauer, 1859). It absorbs and combines with oxygen from the air, yielding an amorphous resin $C_{20}H_{32}O$, and a crystalline one $C_{20}H_{32}O_2$, which are contained in commercial gutta percha sometimes to the amount of 20 per cent. Subjected to dry distillation, various gases, water, and volatile acids are obtained, and two oils, one yellow, the other red-brown, both of the composition $C_{10}H_{16}$.

Pure gutta percha is inodorous and tasteless; ignited it burns with a bright flame.

Off. Prep.—Liquor gutta-perchæ, *U. S.*, *Br.*

Surgical Action and Uses.—The qualities which render this substance of value in the surgical and mechanical treatment of diseases, are its flexibility when warm, its firmness at ordinary temperatures, and its solubility in menstrua which do not alter its essential qualities. The facility with which it is bent and moulded, when warm, adapts it for use in making splints, whose size, shape, and weight can readily be changed. It has, in a great degree, supplanted the old and costly carved splint, to which, indeed, it is in all respects superior. Its lightness, firmness, smoothness, and unalterable character render it admirably adapted for the manufacture of syringes, specula, bougies, pessaries, stethoscopes, etc. Like collodion, the solution of gutta percha in bisulphuret of carbon or in chloroform may be used to retain the edges of incised *wounds* in apposition; and also as a protective of the *abraded skin* against mechanical injury or the *absorption of poisons*. The solution in chloroform, which is officinal, is a very convenient agent for protecting portions of the skin from the air, while it exerts a slight degree of compression which is modified by the elasticity of the film formed by the dried solution. It has been used with more or less advantage in the treatment of *lepra* and *psoriasis*, to prevent pitting in *smallpox*, and to limit the efflorescence in *erysipelas;* but the results are not conclusive of its utility. Gutta percha is also used as a convenient vehicle with which to incorporate certain caustics, as potassa and chloride of zinc, with the purpose of limiting and mitigating their action.

HÆMATOXYLON, *U. S.*—LOGWOOD.

Hæmatoxyli lignum, Br.; *Lignum Campechianum*, P. G.; *Lignum cœruleum.*—*Bois de Campêche*, *Bois d'Inde*, *Bois de sang*, Fr.; *Blauholz*, *Campecheholz*, G.

The heartwood of Hæmatoxylon Campechianum, *Lin.* Woodv., Med. Bot., plate 17. Bentley and Trimen, Med. Plants, 86.

Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—The logwood is indigenous to the shores of the Gulf of Campeachy and to other parts of Central America; it has been introduced into, and perfectly naturalized in Jamaica, St. Domingo, and other West Indian islands. The tree is 30 to 40 feet high, has many spreading crooked branches, alternate leaves with 4 pairs of obcordate leaflets, small yellow flowers in lax racemes, and two-seeded legumes. The tree is felled when about ten years old, the bark and light-colored sap-wood are removed, the red heart-wood alone entering commerce.

Description.—Logwood is met with in logs about three feet long, which, from exposure, are externally of a blackish-purple or red, internally of a brown-red color. Irregular concentric circles of darker and lighter red color, resembling annual rings, are observed upon cross-section; the vessels are distinct to the naked eye, the medullary rays very fine. The wood is heavier than water, specific gravity about 1.06, has a slight odor and a sweetish and astringent taste. In the shops, it is found in the form of chips and ground into a coarse powder, upon both of which a greenish lustre (*hæmatein*) is often observed.

Constituents.—Analyzed by Chevreul (1812), it was found to contain a little volatile oil, brown extractive containing tannin, fatty or resinous and glutinous matter, and a crystalline substance which he named *hæmatin*, but which is now more properly called *hæmatoxylin*. According to Erdmann (1842), it is best obtained from powdered extract of logwood, by mixing it with much sand and exhausting with ether; the ether is mostly recovered by distillation, and the residue mixed with some water and crystallized, a little sulphurous acid or solution of a sulphite being added to prevent oxidation; the yield is about 12 per cent. When pure, hæmatoxylin is $C_{16}H_{14}O_6$, and crystallizes with 1 or $3H_2O$ in colorless or pale yellow prisms, which have a strongly sweet taste of liquorice, acquire a red color on exposure to the light, and are freely soluble in hot water, in alcohol, and ether. The aqueous solution is slightly precipitated by solution of isinglass, and produces with baryta solution, lead acetate and copper salts white or grayish precipitates, which rapidly turn blue. Ammonia dissolves hæmatoxylin, the solution being rose-red, then purple, and finally blackish-red; the fixed alkalies produce similar solutions, and the color ultimately becomes yellowish-brown. The blackish ammonia solution contains *hæmatein-ammonia*, from which acetic acid separates *hæmatein*, $C_{16}H_{12}O_6$; this is soluble in alcohol and hot water, slightly so in ether, and forms a blackish-violet crystalline powder, having a green metallic lustre. Hæmatein-ammonia causes, in a warm solution of a small amount of alum and with ferric chloride, deep violet precipitates, with lead acetate, a brown one.

Off. Prep.—Decoctum hæmatoxyli, Extractum hæmatoxyli, *U. S.*, *Br.*

Medical Action and Uses.—Logwood is mildly astringent, and has been reputed to possess tonic virtues. It darkens the feces, sometimes turns the urine of a blood-red color, and gives it a sweetish taste. It constipates less than the pure astringents. It is used to check *diarrhœas*, *hemorrhages*, and *sweats;* its mildness renders it appropriate for infantile diarrhœas. Externally, it is said to display antiseptic and healing qualities in the treatment of *gangrenous* and *ill-conditioned sores.*

HAMAMELIS.—WITCH-HAZEL.

Hamamelis virginica, *Lin.* *Nat. Ord.*—Hamamelaceæ.

Description.—The witch-hazel is a shrub, from six to ten feet high, growing in damp woods and thickets in Canada and the United States. It has a rather crooked stem with flexuose branches which are covered with a smooth brown bark, the older bark being brown-gray and somewhat fissured, and internally whitish and smooth. The leaves are alternate, about four inches long, oval or obovate, slightly heart-shaped at the base, wavy-toothed on the margin, and, at least when young, stellately pubescent. The flowers are in clusters of three or four, with an involucre of three ovate leaflets, have a four-cleft calyx and four long linear, greenish-yellow petals, and appear in September and October, the nut-like two-celled and two-beaked capsule containing two black oily edible seeds, not ripening until September the next year.

The bark and leaves have been medicinally employed; the former has a bitter, astringent, and somewhat pungent taste; the latter are astringent and bitter.

Constituents.—H. K. Bowman (1869) ascertained the bark to contain 8.10 per cent. of tannin, which was determined by means of gelatin.

Medical Action and Uses.—The accounts published of the remedial virtues of witch-hazel seem to be as hard to accept as the popular faith in it as an infallible divining rod. Yet through the extravagant statements concerning it there runs a thread of reason; for all the conditions it is said to relieve are those of morbid excitement, such as *inflammations*, *congestions*, and *hemorrhages*, and even the action of the gravid uterus in threatened *miscarriage*. To the tannin it contains, and to a peculiar bitter principle, some of its alleged sedative virtues may be attributed. It was used by the American aborigines in decoction as a wash, and also in a poultice, for various local swellings and inflammations, including hemorrhoids and ophthalmia; and when the negro slaves endeavored to produce abortion by means of cotton root, miscarriage is said to have been prevented by the use of hamamelis. It may be used in a decoction made with an ounce of the bark to a pint of water, and given in wine-glassful doses every three or four hours, or oftener, according to the urgency of the case. We have known a decoction or infusion to be used as a lotion with apparent benefit in *crusta lactea*. A fluid extract is prepared of which the dose is a fluidrachm, diluted; and an ointment may be made with this extract evaporated to dryness, or with the fresh bruised bark boiled in lard. The last is used in hemorrhoids.

HEDEOMA, *U. S.*—HEDEOMA.

American pennyroyal, E.; *Herbe de pouliot américain*, Fr.; *Amerikanischer Poley*, G.

The leaves and tops of Hedeoma pulegioides, *Pers.* (Cunila pulegioides, *Lin.*, Ziziphora pulegioides, *Desf.*). Barton, Med. Bot., t. 41. Bentley and Trimen, Med. Plants, 200.

Nat. Ord.—Labiatæ, Satureieæ.

Origin.—Pennyroyal is an annual herb indigenous to North America from Canada, south through the United States. It grows in barren and sandy fields, on hills, and along the open border of woods, always in dry places.

Description.—It has an erect, obscurely quadrangular, branched and hairy stem, about ten to twelve inches high; opposite, shortly petioled, oblong ovate and obscurely serrate leaves, which are about one-half inch long and glandular dotted on the lower side, and axillary cymules of about three flowers. The calyx is tubular ovoid, hairy in the throat and somewhat two-lipped; the upper lip divided into three lanceolate teeth, the two lower teeth subulate. The corolla is small, not much exceeding the calyx, pale-blue, with purplish spots, two-lipped, the upper lip erect and emarginate, the lower lip spreading and nearly equally three-lobed. It has two sterile and two fertile somewhat exserted stamens, a bifid style, and produces four small smooth akenes at the base of the persistent calyx. It has a strong aromatic mint-like odor and a warm and pungent taste.

Constituents.—Its virtues depend upon the volatile oil (see Oleum Hedeomæ). Its other constituents are probably those generally found in plants of this natural order.

Mentha pulegium, Lin. (*Pulegium vulgare*, Mill.), the European pennyroyal, is a perennial herb, found in moist sandy localities in Central and Southern Europe. It has an ascending branching stem, oval obtuse and crenately serrate leaves, many-flowered axillary cymes, forming globular whorls and a purplish-colored four-lobed corolla. It resembles the former in odor, while the taste is somewhat bitter and acrid.

Hedeoma piperita, Benth., *Hed. Drummondii*, Benth., and some other species are found near the Rocky Mountains, and may possess similar properties.

Medical Action and Uses.—Hedeoma is an aromatic stimulant. It may be prescribed for the same purposes as other medicines of its class, *e. g.*, to relieve flatulent *colic* or *painful digestion*, to correct the nauseating or griping operation of certain purgatives, etc. For these purposes it is less eligible than mint, anise, etc. In the form of hot infusion it is much used to dissipate the congestions tending to diarrhœa and to inflammations of *throat* or *bronchia*, also in muscular rheumatism, etc., and, in conjunction with the hot hip- and foot-baths, to bring on retarded or suspended *menstruation*. An infusion made with half an ounce of the plant to a pint of water, may be given in the *dose* of two fluidounces or more, every hour.

HELENIUM.—Sneezeweed.

Helenium autumnale, *Lin.* *Nat. Ord.*—Compositæ, Senecionideæ.

Description.—The sneezeweed or *sneezewort* is an herbaceous perennial which is common in damp places in the United States, from Maine to Florida and Texas and westward to California and Oregon. It is of a grayish-green color, nearly smooth, three to five feet high, has a branching quadrangular, winged stem, and lanceolate serrate leaves which are pointed above and narrowed towards the base. The flower-heads are rather large, numerous, and have the involucral scales in two rows, the outer one foliaceous and reflexed; the ray-florets are ligulate, drooping, yellow, veined, and obtusely three-toothed at the apex. It flowers in August and September. The plant has scarcely any odor, and possesses a very bitter taste.

Constituents.—It was analyzed by F. J. Koch (1874), who found the usual principles met with in herbs. It contains but little tannin; the bitter taste is due to a principle which was obtained in an amorphous condition, is soluble in ether, alcohol, and boiling water, and on being boiled with dilute sulphuric acid, is resolved into sugar and an amorphous bitter substance having an acid reaction.

Allied Plants.—Hel. parriflorum, *Nutt.*, indigenous to Georgia, has lanceolate, nearly entire, scarcely decurrent leaves, and smaller flower-heads than the preceding.

Hel. tenuifolium, *Nutt.*, has numerous linear or filiform entire leaves and small flower-heads. It is found in the Southern United States from Georgia westward to Louisiana and Arkansas. The properties of these two species appear to be similar to those of the first.

Medical Action and Uses.—Common sneezewort is so called on account of the acrid qualities of its flowers and leaves, which when dried and powdered have been used as an errhine. H. tenuifolium is said to be very poisonous to animals, producing in them muscular twitchings, passing into violent convulsions, and terminating in death. In four negroes it produced spasms with more or less delirium and loss of consciousness (Galloway).

HELIANTHEMUM, *U. S.*—Frostwort.

Herbe de heliantheme de Canada, Fr.; *Canadisches Sonnenröschen*, G.

The herb of Helianthemum canadense, *Michaux*, s. Cistus canadensis, *Lin. Nat. Ord.*—Cistaceæ.

Frostwort, or *rockrose*, is a perennial herb indigenous to dry and rocky hills and sandy or gravelly soil of Canada and the United States south to Florida.

Description.—The rigid slender stem is about 12 inches high, has alternate elliptic or linear lanceolate entire leaves, which are nearly an inch long and woolly beneath. The flowers are of two kinds: the earlier ones, appearing in June, are solitary, stalked, with five unequal hairy sepals, and the same number of large yellow petals which unfold in sunshine only once. Somewhat later smaller apetalous and nearly sessile flowers make their appearance in axillary hoary clusters. The fruit is a three-valved one-celled capsule, which is shorter than the calyx, and contains few brown seeds. The herb, which varies much in habit, is inodorous, and has a bitterish astringent taste.

A closely allied species, *Hel. corymbosum*, Mich., is mainly distinguished by the petal-bearing and apetalous flowers being in crowded cymes near the top of the branches, the former being on elongated, filiform stalks. It grows from New Jersey southward, near the coast, in similar localities with the former.

It has received the names of *frostwort* and *frostweed* from the crystals of ice which shoot from the cracked bark of the base of the stem during freezing weather in autumn.

Constituents.—Frostwort has not been analyzed. It seems to contain tannin and a bitter principle.

Medical Uses.—The bitter, astringent, and slightly aromatic taste of this plant may explain its alleged utility in *scrofula*, *diarrhœa*, and secondary *syphilis*. A strong decoction of it is apt to produce vomiting, but is employed as a gargle in sorethroat, especially as it occurs in scarlatina, and also as a wash for prurigo. An extract is prepared which may be given in the dose of two grains.

HELIANTHUS.—Sunflower.

Helianthe, Grand soleil, F.; *Sonnenblume*, G.

Helianthus annuus, *Lin.* *Nat. Ord.*—Compositæ, Senecionideæ.

Description.—The sunflower is indigenous to tropical America, and cultivated in most civilized countries, in many of which it has become naturalized or grows spontaneously. It has a straight stem, from 10 to 15 feet high, which contains a large white pith. The leaves are alternate, petiolate, 10 inches long, broadly ovate or heart-shaped, three-ribbed, serrate and rough. The flower-heads are from 8 to 12 inches in diameter, with bright yellow ligulate ray-florets, and a flat brownish disk. The akenes are obovate-oblong, somewhat quadrangular, flattened, varying in color between whitish and black, at the base embraced by the chaff, and crowned with a very deciduous pappus of two chaffy scales. On being triturated with water, the kernels yield a bland emulsion.

Constituents.—Wittstein (1876) obtained from the fresh plant deprived of the fruit, 1.9 per cent. of ash, nearly two-thirds of which were carbonate of potassium, and from the fruit between 16 and 28 per cent. of fixed oil. The oil is pale yellow, limpid, bland, has the sp. gr. 0.962, and dries slowly on exposure to air. The kernels contain also, according to Ludwig and Kromayer, *helianthic acid*, $C_7H_9O_4$, which reacts dark green with ferric salts, is soluble in water and alcohol, and not precipitated by gelatin or ferrocyanide of potassium. The dried pith, according to John, contains 9 per cent. of potassium nitrate.

Allied Plants.—The numerous species of this genus have yellow flowers, rough, and frequently opposite leaves, and generally possess little odor. The following is occasionally cultivated for culinary purposes :—

Helianthus tuberosus, *Lin.*—Jerusalem artichoke, *E.*; Tompinambour, *Fr.*; Erdartischocke, *G.* Indigenous to Brazil. The tubers are thick, oblong, externally reddish, internally white, and resemble the artichoke in flavor, but are less pleasant. Examined by Braconnot, Payen, and others, they were found to contain 76 to 77 water, 14.7 sugar, 1 to 3 per cent. albumen, etc.

Medical Uses.—Sunflower is scarcely a medicinal agent. The oil may be used for many of the purposes of olive oil; the seeds for fattening poultry, and, after expression of the oil, for cattle; the pith of the stalk for making moxas; and the growing plant for drying damp soils, on account of its remarkable power of absorbing water.

HELLEBORUS, *U. S.*—BLACK HELLEBORE.

Raxix hellebori nigri, Radix melampodii.—*Ellébore noir,* Fr.; *Schwarze Nieswurzel, Weihnachtswurzel, Winterrose,* G.

The rhizome with the rootlets of Helleborus niger, *Lin.* Woodville, Med. Bot. 169; Bentley and Trimen, Med. Plants, 2.

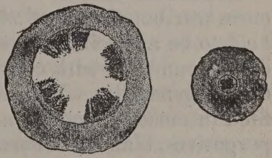
Nat. Ord.—Ranunculaceæ, Helleboreæ.

Origin.—Black hellebore, also called *Christmas rose*, is a native of Europe, and is met with in mountainous woods from Southern Germany and Central France southward to Italy and eastward to Greece. It flowers in winter, from December to March. The plant is acaulescent, has coriaceous, smooth, pedately seven to nine-lobed leaves, pale green, mottled with red, petioles and flower-stalks, and bears a single flower with five large white or pinkish sepals, and ten or more small greenish petals. The fruit consists of five to nine follicles, having the black shining seeds in two rows.

Description.—The rhizome, with branches, has an irregular knotty appearance, is 1 to 3 inches long, $\frac{1}{4}$ to $\frac{1}{2}$ inch thick; the branches annulate from leaf-sheaths, and terminating with a concave, or when more recent with a convex, scar. The numerous rootlets are long, but being very brittle, are always more or less broken off in the commercial article, about $\frac{1}{10}$ inch thick, longitudinally wrinkled, and like the rhizome of a brown-black color. The transverse section of the rhizome shows a thick brownish-gray bark occupying about one-sixth of the diameter, a somewhat thicker whitish pith, and 6 to 10 small wedge-shaped wood-bundles placed in a circle and separated by broad medullary rays. The rootlets have a thick bark, and a central slightly pentagonal or hexagonal wood. In the dry state, black hellebore has scarcely any odor; its taste is sweetish, then bitterish acrid.

In several European countries the rhizome and roots of Helleborus viridis, *Lin.*, are officinal and considered to be more efficacious. They are gathered together with the radical leaves, in the autumn or in early spring, before flowering; the leaves serve merely for identification, and are to be removed when used. The plant, which is indigenous to Central and Southern Europe, and grows wild on Long Island, produces its greenish flowers in March or April, and has pedately seven-lobed radical leaves with the lobes lanceolate acute and serrate. The rhizome is smaller, about 2 inches long and $\frac{1}{4}$ inch thick, above knotty, from the numerous stem-remnants, and annulate by the leaf-scars; the numerous nearly simple rootlets are 4 inches long, brittle, and usually broken off in the commercial article. In color, odor, and taste it resembles black helle-

Fig. 85.



Helleborus viridis, *Lin.*—Transverse section of rhizome and root.

bore. The transverse section of the rhizome shows a woody ring consisting of 4 broad and short wedges, each consisting of several smaller ones, and separated from one another by broad medullary branches, and inclosing a large pith. The rootlets have a thick bark and a central obtusely four-branched ligneous cord.

Constituents.—The two rhizomes appear to have the same constituents. Aside from those more generally met with, like resin, gum, etc., they contain *helleborin* $C_{36}H_{42}O_6$, discovered by Bastick (1852), and *helleborein*, $C_{26}H_{44}O_{15}$, discovered by Husemann and Marmé (1865); the latter principle is more abundant in black, the former in green hellebore. On exhausting the concentrated tincture with hot water, and filtering from the resin and oil, helleborin will crystallize; it is very poisonous, scarcely soluble in cold water, little so in ether and fixed oil, and freely soluble in alcohol and chloroform; its alcoholic solution has a burning taste, and it yields grayish amorphous and tasteless *helleboresin*, $C_{30}H_{38}O_4$, on being boiled with solution of zinc chloride. *Helleborein* is obtained from the decoction by precipitating with basic lead acetate, then with sodium sulphate, and finally with tannin; the latter precipitate is decomposed by oxide of lead, the dry mass exhausted with alcohol, the tincture concentrated and mixed with ether. It forms colorless nodules of minute needles, is readily soluble in water, less so in alcohol, and insoluble in ether, and has a sweetish taste and a poisonous action. Boiling with dilute acids converts it into sugar and greenish amorphous and tasteless *helleboretin*, $C_{14}H_{20}O_3$.

Hellebore contains no tannin; an organic acid present is probably identical with aconitic acid.

Adulterations.—Green hellebore, which should not be confounded with *veratrum viride*, is considerably higher in price than the black, and not often met with in the American market. The black hellebore of commerce is often mixed with the rhizomes and roots of other, mainly ranunculaceous plants, the most frequently occurring being *Actæa spicata*, Lin., which was formerly known as *Radix Christophorianæ s. aconiti racemosi;* the rhizome has a close resemblance to cimicifuga (see page 99), but merely the dimensions of black hellebore; its rootlets have the woody column arranged in four rays. The rhizome of *Adonis vernalis*, Lin., is subconical, almost simple, tufted above, not annulated, and has brittle rootlets with a cross-shaped wood. At one time we observed a black, forked, monocotyledonous rhizome of unknown origin offered as black hellebore.

Off. Prep.—Extractum hellebori, Tinctura hellebori, *U. S.*

Physiological Action.—Experiments on animals show that, however introduced into the system, hellebore is a violent gastro-intestinal irritant, producing vomiting and purging, with copious bilious evacuations, and killing through exhaustion and convulsions. On man, small and repeated doses of hellebore produce liquid alvine evacuations, and increase the menstrual and hemorrhoidal flows. In larger doses it causes vomiting, colic, spasm of the throat, thirst with heat in the abdomen, and exhaustion, cold sweats, and collapse with spasms. In the fatal cases reported nothing is said of its having purged.

Medical Uses.—The reputation of this medicine rests chiefly upon the cures attributed to it of *mania* and *melancholy*, for which it was, in some sort, held to be a specific. Possibly it may have been useful in cases of mental disorder connected with constipation and congestion of the liver and the abdominal organs generally. Yet the form of insanity which it seems most to have benefited in modern times is acute mania with febrile excitement. Like all drastic purgatives, black hellebore is sometimes curative of *amenorrhœa* either of the congestive or the atonic form; and is often a palliative of *ascites* by removing more or less of the dropsical fluid through the bowels. For this purpose it is inferior to jalap. The *dose* of the powdered root, as a purgative, is from five to twenty grains. A decoction may be prepared by boiling sixty grains of the bruised root in a pint of water; of which a fluidounce may be given every two or three hours until it operates.

HEMIDESMI RADIX, *Br.*—HEMIDESMUS ROOT.

Indian sarsaparilla, Nunnari, E.; *Racine de hemidesmus,* Fr.; *Hemidesmus-Wurzel,* G.

The root of Hemidesmus indicus, *P. Br.* (Periploca indica, *Willd.;* P. emetica, *Retz.;* Asclepias pseudo-sarsa, *Roxb.*). Wight, Icon. Plant., Ind. Orient., ii. p. 594; Bentley and Trimen, Med. Plants, 174.

Nat. Ord.—Asclepiadaceæ.

Origin.—This slender climbing shrub is a native of the Indian peninsula, in all parts of which it grows in uncultivated places. It has opposite entire leaves, varying between linear-lanceolate and ovate, the broadest being on the upper branches; axillary clusters of small purple flowers, long linear follicles and numerous seeds with tufts of slender hairs.

Description.—The root is met with in pieces about 6 inches long and $\frac{1}{4}$ to over $\frac{1}{2}$ an inch thick, cylindrical, tortuous, longitudinally wrinkled, and transversely fissured, forming annulations. It is covered with a thin dark-brown corky layer, followed by a whitish mealy thin bark, containing in its inner layer scattered laticiferous vessels. The cambium line is dark, wavy, and the wood yellowish, with narrow medullary rays, which are best observed in the thin roots. Hemidesmus root has an agreeable odor, suggesting that of tonka, and a sweetish, slightly acrid, not unpleasant taste.

Constituents.—The root contains starch, and in the suberous layer some tannin. Scott (1843) obtained a stearopten by distillation with water. Its other constituents are unknown.

Off. Prep.—Syrupus hemidesmi, *Br.*

Medical Action and Uses.—In India, whence it was introduced into England, this medicine has some reputation for efficacy in the constitutional disorders supposed to be benefited by sarsaparilla. But its syrup, which is also officinal, is, like the syrup of sarsaparilla, chiefly used as a flavoring ingredient of mixtures.

HEPATICA, *U. S.*—LIVERWORT.

Herbe de hépatique, Fr.; *Edelleberkraut,* G.

The leaves of Hepatica triloba, *Chaix* (Hep. nobilis, *Moench;* Anemone hepatica, *Lin.*).

Nat. Ord.—Ranunculaceæ, Anemonideæ.

Origin.—A perennial, acaulescent herb, flowering in March and April, and indigenous to Europe, and North America south to Georgia, growing in shady woods. The flowers are on villous scapes 4 to 6 inches long, and have a three-leaved involucre, and 6 to 9 petal-like, blue or purplish, or sometimes white sepals. The radical leaves are the portion used.

Description.—The leaves are subcoriaceous, smooth, dark-green, and shining above, paler beneath, broadly heart-shaped or somewhat kidney-shaped in outline, and divided into three lobes, which are obtuse or rounded (*Hep. Americana,* De C.), or pointed (Hep. acutiloba, *De C.*). A similar distinction is also observed in the involucral leaves, the two forms being probably mere varieties of one species, the acute-lobed preferring a northern exposure. The leaves are inodorous, and have an insipid, slightly astringent, and bitterish taste.

Constituents.—As far as may be judged from the sensible properties, liverwort does not appear to contain any important characteristic principle. Mucilage, sugar, and a small amount of tannin are present.

Medical Action and Uses.—It passes for being tonic and deobstruent. It once had a transient vogue in the treatment of chronic *bronchitis* and *phthisis.* But its medicinal value is very small, and hardly entitles it to a place in the materia medica.

HERACLEUM.—COW-PARSNIP.

Heracleum lanatum, *Lin.* *Nat. Ord.*—Umbelliferæ, Orthospermæ.

Description.—The cow-parsnip, also called *masterwort*, is a woolly perennial herb, growing from 5 to 10 feet high in most of the northern and middle parts of the United States, westward to the Pacific. The root is many headed, fleshy, nearly simple, or composed of many thinner branches, half an inch or less in diameter, brownish-yellow externally, white internally, with a rather thick bark, containing resin-cells. The leaves are large, ternately dissected, on very broad and sheathing petioles, the segments often 10 inches long, the middle one usually three-lobed. The umbels are from 12 to 15 inches broad, with an involucre of oblong lanceolate leaves, and involucels composed of 5 or 8 lanceolate, slender, acuminate leaves. The flowers are white. The fruit is one-third of an inch long, oval, flattened on the back, broadly winged on the margin, each mericarp with 5 slender ribs, the lateral ones being close to the margin, and in the upper half with 6 clavate oil tubes, two of which are on the commissure. All parts of it have a rank odor and a pungently acrid taste. The root, leaves, and fruit have been employed.

HERACLEUM SPHONDYLIUM, *Lin.*, the cow-parsnip of Europe and Northern Asia, is a similar but smaller plant, and possesses similar properties.

Constituents.—These plants appear to contain volatile oil and resin; their acrid principles have not been investigated.

Medical Action and Uses.—In their fresh state the leaves applied to the skin may produce vesication, and have been used as counter-irritants. Some of the European species are still more irritant, and contain a juice which has been applied to warts as an escharotic. The American plant has been used in *epilepsy* apparently depending upon gastro-intestinal irritation. It was given both in substance and in infusion, and was thought to correct *dyspeptic* disorder. A drachm of the root, or its equivalent in infusion, may be taken several times a day.

HEUCHERA, *U. S.*—ALUM ROOT.

Racine d'heuchère d'Amérique, Fr.; *Amerikanische Sanickel-Wurzel*, G.

The root of Heuchera americana, *Lin.* *Nat. Ord.*—Saxifragaceæ.

Origin.—This is a perennial herbaceous plant, with a tuft of orbicular-heart-shaped, slightly lobed, and crenately-toothed hairy leaves, and glandular hairy scapes about 2 feet high, bearing loose panicles of small flowers with short, white, narrow petals and exserted stamens and styles. It is common in rich woodlands of the United States from the New England States west to Wisconsin and the Mississippi and south to Georgia. It flowers in June, and the root is probably best collected in September.

Description.—The root is about 6 inches long, about $\frac{1}{2}$ inch thick, with several short cylindrical heads terminating with a concave scar, tapering, and somewhat branched below and beset with some thin radicles. In its fresh state it is fleshy; when dry, irregularly shrivelled, tuberculate, the brittle fibres usually broken off. It is externally of a purplish-brown color, has a thin bark, and a thick meditullium of a pale reddish, sometimes brownish, tint, and breaks with a short, somewhat spongy or granular, not fibrous, fracture, often showing internal cavities. It is inodorous, and has a strongly astringent, slightly bitterish taste. The rootlets agree with the main root in color and taste, but have a thick bark and thin spongy centre.

Constituents.—The root has not been fully analyzed. H. K. Bowman (1869) found it to contain from 18 to 20 per cent. of tannin.

It is not unlikely that the root of *Heuchera villosa*, Mich., and probably other species, may possess virtues similar to those of the officinal.

Medical Action and Uses.—Alum root, as its name implies, is astringent. In decoction it is sometimes used in domestic medicine as a remedy for *diarrhœa* and *menorrhagia*, and as an application to *ulcers*, *hemorrhoids*, etc.

HIERACIUM.—HAWKWEED.

Épervière, Fr.; *Habichtskraut*, G.

Nat. Ord.—Compositæ, Cichoraceæ.

Description.—The following species have been used:—

HIERACIUM VENOSUM, *Lin.* *Rattlesnake-weed.*—It is a perennial herb, common in dry woods and plains of North America, with oblong-obovate, purple-veined, entire, and scarcely petiolate radical leaves about 2 inches long, and with a naked or one-leaved smooth scape about 18 inches long, bearing a loose paniculate corymb of yellow flower-heads, which have slender peduncles, a nearly cylindrical involucre, and linear akenes with a tawny, fragile, bristly pappus. The plant is inodorous, and has a somewhat bitter and acrid taste.

HIER. GRONOVII, *Lin.*, likewise a North American species and growing in similar localities, has a wand-like simple stem which is leafy and hairy below. The leaves are petiolate, lance- or obovate-oblong; the peduncles slender and, like the involucre, glandular-pilose. The akenes are tapering at the summit. This and the next species are sometimes used for toothache.

HIER. SCABRUM, *Lin.*—It is stouter than the preceding, rough hairy, more branched; the involucre glandular-hirsute, and the akenes not taper-pointed.

HIER. PILOSELLA, *Lin.* Piloselle, Oreille de souris, *Fr.;* Mäuseöhrchen, *G.*—A European plant with white hairy leaves about an inch long, and a hairy, naked, or one-leaved scape. Its taste is bitter and astringent.

HIER. MURORUM, *Lin.* Pulmonaire des Français, *Fr.;* Gelbes Lungenkraut, *G.*—It has ovate, pale green, sometimes spotted radical leaves, and a hairy, few-leaved stem about 3 feet high, bearing several yellow flower-heads. Its taste is slightly bitter and astringent. It has been used as a vulnerary and in pectoral complaints.

Medical Uses.—Although hawkweed has been used in several diseases, such as scrofula and chronic catarrh, its chief claim to notice rests on its reputed power of curing the bites of venomous snakes. The late Dr. Griffith in his *Medical Botany* relates the following: "Some years ago a person brought a collection of rattlesnakes to this city, and professed to be in possession of a certain cure for the symptoms arising from their bite, which he offered to divulge for a moderate compensation. This being paid him, he suffered himself to be bitten several times, and, after the poisonous effects had displayed themselves, was completely relieved by taking a few ounces of the decoction of a plant which was identified as *Hieracium venosum.* The same snake was suffered to bite a small puppy, which died from the poison in about five hours. These experiments were made in the presence of a number of distinguished medical and scientific persons."

HIPPOCASTANUM.—HORSECHESTNUT BARK.

Cortex hippocastani, Cortex castaneæ equinæ.—*Écorce de marronnier (chataignier) d'Inde*, Fr.; *Rosskastanienrinde*, G.

From Æsculus hippocastanum, *Lin.*

Nat. Ord.—Sapindaceæ, Hippocastaneæ.

Origin.—The horsechestnut is a well-known stately tree which is a native of Persia and Northern India, but is at present cultivated as an ornamental tree, and grows spontaneously in many countries of the temperate and sub-tropical zones. The bark of the smaller branches is the part employed. The seeds, which have a bitter and acrid taste, contain a large quantity of starch, which may be obtained pure by prolonged washing with water.

Description.—The bark is thin, externally of a gray color, has some small scattered warts, and shows opposite leaf-scars, which have the lower rounded margin marked with 5 or 7 small warts. The inner surface is smooth and whitish, the internal color brownish. The inner bark is rather tough, breaks with a fibrous fracture, has a slight odor, and a bitter astringent taste.

Constituents.—The tannin of horsechestnut bark colors iron salts green. Besides some fat, chlorophyll, and other common compounds, the bark contains *æsculin*, $C_{15}H_{16}O_9$, and *fraxin (paviin)*, $C_{32}H_{36}O_{20}$, both principles being inodorous, of a slight bitter taste, and showing a blue fluorescence when dissolved in water, particularly in the presence of alkalies. Æsculin is obtained by precipitating the decoction with solution of alum and excess of ammonia, evaporating the filtrate to dryness, exhausting the residue with boiling strong alcohol, and recrystallizing. It forms small white needles containing $2H_2O$, which are insoluble in ether, and have an acid reaction upon litmus. On boiling with dilute acids it is split into glucose and *æsculetin*, $C_9H_6O_4$, which dissolves in alkalies with a golden-yellow color, and colors ferric salts dark green. Baryta solution produces the same decomposition, and then yields *glucinic*, *apoglucinic*, and *æsculetinic acids*. Fraxin is obtained by precipitating the alcoholic tincture with an alcoholic solution of acetate of lead, diffusing the precipitate in water, decomposing by sulphuretted hydrogen, evaporating over sulphuric acid to dryness, and removing the tannin by washing with ice-cold water; it dissolves in alkalies with a yellow color, colors ferric chloride green, and then produces a lemon-yellow precipitate.

The integuments of the seeds contain some æsculin and *quercitrin*, which are likewise present in the flowers, but the leaves contain yellow *queræscitrin*. The cotyledons contain, besides starch, some fixed oil, *Oleum hippocastani*, which was obtained by Genevoix (1859) to the amount of $\frac{1}{10}$ per cent. by extracting with ether; it is of a yellow color, has a turnip-like odor, and congeals near the freezing point of water. *Argyræscin* and *aphrodæscin* are two amorphous acrid bodies, discovered by Rochleder (1862), which are insoluble in ether, soluble in alcohol, and yield with water solutions foaming like saponin; the latter is precipitated by baryta water, and boiled with alkalies yields butyric and amorphous *æscinic acids;* the former is a glucoside.

ÆSCULUS PAVIA, *Lin.* *Red buckeye.*—E. C. Batchelor (1873) obtained from the testa tannin, 3 per cent. of resin, a tasteless crystalline principle, and coloring matter. The cotyledons were found to contain 5 per cent. of greenish-brown fixed oil, 2½ per cent. cane-sugar and syrup, and a brownish, bitter, and acrid glucoside, different from argyræscin and apparently poisonous.

Medical Uses.—It is asserted that the bark of the branches, and also the æsculin obtained from it, have cured *periodical fevers* in which even quinia failed. The same statement is made respecting numberless bitter vegetable products. It is also stated that æsculin will cure *neuralgia*. These medicines are of little value. A decoction may be prepared with one or two ounces of the bark in a pint of water, boiled for ten minutes. *Dose*, a wineglassful. Æsculin may be given in doses of five or more grains.

HIRUDO, *Br.*—LEECH.

Hirudines, P. G.—*Sangsue*, Fr.; *Blutegel*, G.

Sanguisuga medicinalis, *Savigny*, and Sang. officinalis, *Sav.*
Class Vermes; *Ord.* Annulata; *Subord.* Apoda; *Family* Hirudinea.

Description.—Leeches are invertebrate animals with an elongated, roundish, or somewhat flattened body, which has numerous transverse wrinkles, and is generally attenuate towards both ends; the posterior one always terminates by a broad and muscular disk, by means of which the animal fastens itself upon objects. The blood-sucking leeches have their anterior end or head likewise terminated by a narrower disk, in the centre of which is placed the mouth containing three jaws, which are provided with two rows of numerous-pointed teeth, and are mutually inclined at an acute angle, so as to make a triangular incision through the skin. Respiration is carried on through small apertures or *stigmata*, arranged in two rows on the abdominal surface, and found at every fifth ring. Leeches are hermaphrodites, but mutually impregnate each other. Several pairs of testicles are located in the fore and middle part of the body; the filiform penis is projected from an abdominal orifice about one-third distant from the head, and the female organs with two ovaries have their aperture or vagina five rings below the penis. The ova are deposited near the edge of the water, invested with a kind of a jelly or mucus, which contracts into a capsular or cocoon-like body, having a spongy appearance, and containing about 10 or more eggs. Leeches are aquatic animals, and swim with a vertical undulating motion.

Sang. medicinalis, Sav. (*Hirudo medicinalis*, Lin.), has the back of an olive-green color and marked with six longitudinal pale rust-colored stripes, which are mostly spotted with black. The belly is greenish-yellow, more or less spotted with black, occasionally to such an extent that the prevailing color is black. The animal is indigenous to Central and Northern Europe, and is known in commerce as the *Swedish* or *German leech.*

Sang. officinalis, Sav. (*Hirudo provincialis*, Carena).—The back is green or blackish, marked with six longitudinal rusty-red stripes, dotted with black. The belly is olive-green, unspotted, but marked with a black stripe on each side. This leech is indigenous to the southern part of Europe, and is known in commerce as the *Hungarian leech.* There are several varieties of this species, differing from one another by modifications of the dorsal stripes.

Several other species of Sanguisuga are found in Southern Europe and occasionally employed, but are not an article of commerce. Leeches are generally kept in ponds by the wholesale dealer and even cultivated in this manner. They are usually transported imbedded in moist turf.

The *American leech*, Hirudo decora, *Say*, which draws less blood, is sometimes employed. Its back is of a dark green color, and marked with one row of orange-brown, and two lateral rows of black spots; the belly is of a light orange-brown color spotted with black.

Preservation.—Leeches require some attention to keep them healthy and in good condition. They are kept in clean river water, in a glass jar covered with a linen cloth, and put in a shady place which is free from ammoniacal and other noxious vapors. The temperature is best kept between about 10° and 20° C. (50° and 68° F.), sudden changes being carefully prevented. As soon as the water begins to get turbid or colored, the leeches should be placed in clean water of the same temperature, and the jar well cleaned from the slimy deposit, which is caused by the transparent epidermis being thrown off every four or five days. To facilitate its removal, some material is often put into the jar through which the leech may draw itself, and which, by retaining this slime, will tend to keep the water clean; charcoal, pebbles, clay free from lime, moss, and Irish moss have been recommended and found advantageous for the purpose, and apparatuses have been constructed in which leeches may be kept on a bed of material which permits of a frequent renewal of the water without handling the leeches. If they are kept in moist earth, turf, or clay, this should be examined from time to time and dead animals removed. The water should be changed at least once a week, and oftener in warm weather. It will be observed that the conditions for the preservation of leeches are pure air, pure water, and a pretty uniform temperature. Leeches are subject to several diseases which may become epidemic, and are recognized by an excessive separation of mucus, ulcerations, tumors, or a flaccid appearance of the body; when thus attacked, they should be at once removed from the healthy ones, and placed in a separate vessel in clean water upon a layer of charcoal.

Medical History.—Leeches have been used from time immemorial in Asia, but particularly in Bengal, where they are considered the best means of local depletion. They are especially preferred for Rayahs, for women and timid persons, and for the very young and very old (Wise). In Greek medicine, they were not apparently known until a late date; the first mention of them being made by Themison, who lived in the century preceding the Christian era. They are scarcely alluded to by Pliny, who flourished a century later in Rome; but subsequently their uses are described by all the Latin and Arabian medical writers, as well as the mode of applying and preserving them, and the accidents that may occur from their getting into the throat or stomach.

Medical Action and Uses.—Depletion by leeches is by no means identical with taking blood by venesection, even in its action upon the general system, for the rapidity of the loss in the one case, and its slowness in the other, render the effects quite different; in the former, the impression is direct and sudden, in the other, indirect and gradual. In their local actions, the difference is still more evident, for while in the one case the whole of the blood is despoiled to make a limited and local impression, in the other, the effect is produced by a very small loss of blood. It must be remembered that the circulatory apparatus is not a mere hydraulic machine, but that the bloodvessels, and especially the capillaries, are endowed with vital contractility which may be modified within a limited area and excited by a local irritation. All active congestions and inflammations are, in their origin, local diseases, and are therefore more or less amenable to local treatment, of which one of the most powerful forms is the abstraction of blood, the essential pabulum of all inflammatory processes. Hence the utility of leeches in inflammations in whose immediate neighborhood these animals can be applied; it is not so intelligible when they operate upon the surface of the body immediately over inflamed organs which have no direct communication with the skin, as in pneumonia, metritis, gastritis, enteritis, meningitis, etc. The mere loss of so small a quantity of blood as they abstract from the general circulation, does not appear to be a satisfactory explanation. The superiority of leeches over cups, as means of local depletion, consists not only in the advantages referred to above, but also in their being applicable to various parts to which cups could not be applied, as the eye, the mouth, the anus, vagina, etc.

Large leeches should be used only when blood is to be freely abstracted, and when the part is not very sensitive or exposed. The wounds they make are apt to be ecchymosed and to leave visible scars. Small leeches are always preferable for application to the face and neck, for the reasons just given, and also because the bleeding from their wounds is more easily controlled. The number to be used will depend upon the size of the leeches, the quantity of blood to be abstracted, and the vascularity of the part. The part to which the leeches are to be applied should be thoroughly washed with warm water, and even with hot water, if it is not sufficiently vascular. Sometimes a hot poultice is applied to stimulate the skin. In order to induce the animals to bite, it is customary to moisten the part with sugared water or milk, or to rub it with a piece of raw meat; or the leecher pricks the part with a fine needle and smears the blood over the skin; or he draws from his own finger a drop of blood for this purpose. A common method of applying leeches to a free surface is to put them in a small tumbler or wineglass, and invert it over the part. Others place the creatures in a cup, and direct them, as they crawl over its edge, to the part where they should bite. For application to the nostril, throat, or vagina, the leech may be inclosed in a tube open at either end.

A healthy leech of medium size will draw from one to two fluidrachms of blood, and as much more will usually flow after the leech has fallen. When a strong and rapid impression is to be made by leeches, the number applied at once should be considerable; but when a slow but continuous action is desired, a succession of them may be used. This is often desirable in cases of traumatic and other inflammations within the cranium. It is an ancient custom, instead of applying many leeches, to apply only one or two, or a comparatively small number, and when they are nearly gorged to puncture their bodies near the tail with a needle or fine lancet, when they will often continue to draw blood indefinitely. In any case, the punctures will continue to bleed if they are kept sponged with warm water. Sometimes there is a difficulty in stopping the flow of blood, particularly if the wound is in the epigastrium, the neck, or some other part where firm pressure cannot readily be made. The various hæmostatics may here be applied, several of them being of common use in domestic medicine, such as scraped lint, burned rag, agaric, cobweb, powdered rosin, India rubber softened by heat, vinegar and water, etc. If these fail, or, in their stead, a saturated solution of alum in hot water may be applied on lint, while the liquid is hot; or lint saturated with a solution of perchloride of iron, or of tannic acid; or the lunar-caustic pencil, reduced to a fine point, may be inserted in the wound; or, finally, the point of a red-hot knitting-needle may be used in the same way. In all these cases, the action of the hæmostatic should be aided by pressure with the hand, or with a small clamp or pincers made for the purpose, or by passing a needle through the skin, including the wound and surrounding it with a ligature in the form of a figure of eight.

Small leeches are sometimes taken in drinking water, and attach themselves to the fauces or pharynx, and have even penetrated into the larynx and fatally obstructed it. A strong gargle of salt and water usually suffices to make them quit their hold, and vinegar will have the same effect. These liquids have been used, as also has wine, when leeches have been swallowed; but the creatures would probably be unable to live under the action of the gastric juice. In some cases, and especially when the leech has entered the larynx, its presence has been discovered by the laryngeal mirror; and in one case, at least, laryngotomy had to be performed for its removal.

When leeches have been gorged with blood, they are not, if left to themselves, fit to be used again for several months. But by placing them in a weak solution of salt and water, or of vinegar and water, they may be made to disgorge the blood they have swallowed, and they soon regain their vigor if they are then placed in fresh water. They may also be emptied of their blood by stripping them. Such leeches are more subject to disease, and they should be kept separate from the others.

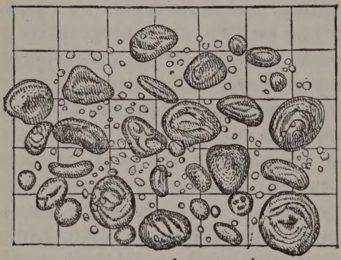
HORDEUM, *U. S.*—PEARL BARLEY.

Hordeum decorticatum, Br.; *Hordeum perlatum.—Orge perlé*, Fr.; *Perlgerste, Perlgraupen*, G.

The husked seeds of Hordeum distichon, *Lin.* *Nat. Ord.*—Graminaceæ.

Origin.—Barley is probably indigenous to Western Asia, and has been cultivated from a very early period. It is now raised in most parts of the temperate zones, and in Europe within the Arctic Circle. Besides the two-rowed or long-eared barley, *Hord. vulgare*, Lin., or spring barley, and *H. hexastichon*, Lin., or six-rowed barley, are the principal species cultivated. The fruit of these species is used indiscriminately in the preparation of malt, and, when in suitable mills deprived of the integuments and rounded at the ends, constitutes the officinal pearl barley.

Fig. 86.



BARLEY (HORDEUM)

Starch granules.

Description.—Pearl barley is nearly globular, of a white color and mealy appearance, with the exception of a groove in which fragments of the integuments are present. The larger pearls still contain externally a layer of gluten; the smaller ones consist altogether of the mealy albumen, and are formed of a cellular tissue filled with starch granules, which resemble wheat starch, and are made up of small and large grains with few intermediate ones. They are irregularly circular or elliptical in shape, with the nucleus or hilum rarely perceptible, and the layers indistinct. Pearl barley is inodorous, and has an insipid taste.

Constituents.—The average of the various analyses made by different chemists gives to barley 60 to 68 per cent. *starch*, 12 to 16 per cent. of *protein compounds*, consisting of gluten and albumen, 2 to 3 per cent. of *oil*, the same of *ash*, 10 to 14 per cent. of *moisture*, and 8 to 12 per cent. of *cellulose.* Lermer (1863) found in exsiccated barley also 6.6 per cent. of *dextrin*, and traces of tannin and bitter principle; and Lintner (1868) a little cholesterin. Proust's *hordein* was proven by Braconnot and Guibourt to be a mixture of cellular tissue, starch, and gluten. Beckmann's (1855) *hordeic acid* is evidently a fatty acid liberated by the oil of vitriol used in its preparation.

Off. Prep.—Decoctum hordei, *U. S.*, *Br.*

Medical Uses.—From the earliest times barley has been used not only as food, but to prepare drinks for the sick, especially in febrile diseases and in pulmonary and urinary disorders. It is now seldom employed externally, but continues to be given internally, and for the same purposes as of old. The addition of honey makes barley-water more efficient in *bronchial affections* and *sore throat;* forms of preparing it are given under Decoctum hordei.

HUMULUS, *U. S.*—HOPS.

Lupulus, Br.; *Strobili humuli s. lupuli.—Hop*, E.; *Houblon*, Fr.; *Hopfen*, G.

The strobiles of Humulus lupulus, *Lin.* Steph. and Church, Med. Bot., plate 41.

Nat. Ord.—Urticaceæ, Cannabineæ.

Origin.—The hop is distributed over a great portion of the northern temperate zone, and has been introduced into Brazil and Australia. It grows in hedges and thickets, and is indigenous to North America, where it is particularly common in the northern and western regions, and is found in the Sierra Madre range of Colorado at an altitude of 10,000 feet; it is met with also in Middle and Southern Siberia and throughout the greater portion of Europe. In many countries it is extensively cultivated. It is a perennial, producing rough, long, and twining stems, which have the leaves mostly opposite, heart-shaped, and 3 to 5 lobed. The staminate flowers are in short racemes, and the pistillate flowers in densely leafy cone-like spikes upon different plants; these spikes or strobiles are the parts used.

Description.—The strobiles are ovate in shape, 1 to 1½ inch long, and consist of a grayish, hairy, zigzag-shaped somewhat glandular axis, to the angles of which the enlarged leafy bracts and scales are attached; these are obliquely ovate, membranous, parallel-veined below, reticulately veined above, and at the base glandular and surrounding a subglobular akene, which is likewise covered with numerous yellow and shining glands (*lupulin*). Hops are of a yellowish-green color, of an agreeable aromatic odor, and of a bitter, aromatic, slightly astringent taste. When kept for some time, hops acquire a brownish color, and an unpleasant odor from the formation of some valerianic acid; these changes are prevented, or at least retarded, by exposure to sulphurous acid gas, and the color of brown hops is to some extent restored by the same means.

For an account of the culture of hops in the United States, consult papers by W. H. Ramsey in *Amer. Journ. Pharm.*, 1875, p. 241, and E. G. Bissel, 1877, p. 538. In the fiscal year 1875–1876, over 83,000 lbs. of hops were imported into the United States; in the following year only 20,177 lbs.

Constituents.—Besides the principles contained in the yellow glands (see Lupulina), hops contain about 4 per cent. of *tannin*, which, according to R. Wagner, resembles moritannic acid. Bissell (1877), however, found its behavior to mineral acids entirely distinct, and noticed that only a small portion of it is precipitated by gelatin. Bowman (1869) obtained by means of this reagent 3.67 per cent. of tannin. Hops, entirely freed from lupulin, gave to Bissell, with water, a neutral distillate, having an odor distinct from those of hops, and containing mere traces of organic matter; the extract was but slightly bitter. Hops contain 0.8 per cent. of volatile oil (R. Wagner, 1853), between 9 and 18 per cent. of resin (Siewert, 1870), some trimethylamin, and a volatile alkaloid, *lupulina*, having a conia-like odor (Griessmayer, 1874). Sacc (1876) asserted that hops contain a peculiar fermentative principle, which was disproven by Soxhlet and Pasteur (1876). C. G. Wheeler (1865) found hops to contain 1.7 per cent. of nitrogen, and to yield 7 to 10 per cent. of ash, in which potassa, lime, phosphoric acid, and silica predominate.

Off. Prep.—Extractum lupuli, *Br.;* Infusum humuli (lupuli), Tinctura humuli (lupuli), *U. S.*, *Br.*

Physiological Action.—Experiments on animals do not indicate the existence of a narcotic principle in hop, but clearly a sedative one, in that under the use of hop the pulse-rate is diminished. Like other bitters, hop tends to invigorate digestion. Lupulin in moderate doses has the same effect, and in large ones causes abdominal pain and constipation. It certainly calms disordered nervous action, and in this manner favors sleep; but there is no evidence to show that hop, when given to persons in health or free from pain, has distinctly shown narcotic properties. The apparently direct influence of the hop pillow in causing sleep is one which it shares with all odorous flowers, and is due to the essential oil which the strobiles contain.

Medical Uses.—The association in hop of a bitter tonic with a direct sedative of abnormal nervous action, renders it peculiarly fitted to relieve those numerous cases of *dyspepsia* which are due to abuse of the stomach, when it is both irritated and exhausted. Hence at one time it was celebrated in the treatment of atonic *gout*, a disease in which those conditions are prominent.

These qualities also explain its reputation in the treatment of the forms of constitutional derangement which exist in *scrofula* and *rickets*, when anæmia, glandular swellings, cutaneous eruptions, and dropsy, especially of the abdomen, are present. Hop tea is one of the best remedies for *delirium tremens;* it tends to restore its tone to the irritated and exhausted stomach, and directly to allay the characteristic nervous excitement of the attack. In various affections attended with genito-urinary irritation, as *priapism, seminal emissions, nocturnal incontinence of urine*, and *irritable bladder*, its influence is often most salutary. As an external application to relieve the pain of *abscesses, spasms, toothache, colic, bruises*, etc., hop is a most excellent application. It may be incorporated in a poultice, or the strobiles, inclosed in a bag, may be moistened with hot water, vinegar, or alcohol, and applied to the painful part. The infusion of hop is the best preparation for internal use, although so much more bulky than the tincture or the fluid extract of lupulin. A pure and strongly hopped beer contains all the virtues of this agent; but ordinary malt liquors are too often fraudulently adulterated to deserve this praise.

HURA.—SAND BOXTREE.

Sablier, Fr.; *Sandbüchsenbaum*, G.

Nat. Ord.—Euphorbiaceæ.

Description.—The following species have attracted some attention:—

HURA CREPITANS, *Lin.*, indigenous to the West Indies, Central and some portions of South America, and known there as *ajuapar.* It is a straight tree, about 70 feet high, with long petiolate, cordate-ovate and serrate smooth leaves; pendulous ovate staminate catkins, erect dark red or purple pistillate flowers, and depressed globular, twelve to eighteen-celled capsules, which, when ripe, break with some violence, scattering the roundish flattened seeds, which have an agreeable sweetish taste. The tree contains a very acrid milk juice. The leaves, steeped in oil, are used in rheumatic complaints.

HURA BRASILIENSIS, *Willd.*, known in Brazil as *assacou* or *ussacu*, resembles the preceding in appearance and properties, but has oblong catkins. The thick, hard, grayish, inodorous and slightly acrid bark, *casca de assacou*, is employed in South America.

Constituents.—Boussingault and Rivero (1825) ascertained that one of the acrid principles of the milk juice is oily and volatile, the other is crystallizable; the other constituents found were malates, nitrates, etc. Bonastre found in the integuments of the seeds much coloring matter, tannin, and gallic acid, and in the kernel fixed oil, soluble in alcohol, solid fat, albumen and salts.

Medical Action and Uses.—Like several other euphorbiaceæ it is a powerful irritant, and taken internally in large doses occasions violent vomiting and purging. For these reasons, probably, it is used as an anthelmintic. Applied to the skin in decoction it causes irritation and even vesication. In its native country, Brazil, it is much used in the treatment of leprosy, but there is no evidence of its having cured the disease. It is given in the form of a decoction, made by boiling half an ounce of the bark in a pint of water to half a pint. Baths made with a saturated infusion of the bark are also used. It is almost unnecessary to add that neither this medicine nor any other ever cured leprosy, and that the use of a drastic medicine like hura cannot fail to hasten the inevitable progress of the disease.

HYDRANGEA.—HYDRANGEA.

The root of Hydrangea arborescens, *Lin.*

Nat. Ord.—Saxifragaceæ, Hydrangeæ.

Origin and Description.—The wild hydrangea grows near the banks of rivers, preferring rocky places, from Pennsylvania westward to Illinois and southward. It has a pale brown, internally whitish, woody and much branching root, which is of a sweetish and pungent taste. The stem is about 6 feet high, and has a grayish, or on the branches a light reddish-brown bark, which is detached in thin concentric layers, from which circumstance the shrub is known as *seven-barks*. The leaves are opposite, nearly smooth, ovate, pointed, rounded or slightly heart-shaped at the base, and serrate on the margin. The flowers, which appear in July, are in flat cymes, whitish, the marginal ones often sterile and radiant, with 4 or 5 petals, and stamens twice that number. The fruit is a two-celled and two-beaked capsule, containing numerous seeds.

Constituents.—Nothing is known about the principles to which the medicinal properties of the root might be due. Laidley's analysis (1850) merely proved the presence of the common vegetable principles, gum, starch, resin, etc.

Medical Uses.—We are told that hydrangea root was employed by the Cherokee Indians for the relief of calculous complaints, and that when duly administered to persons suffering from urinary concretions in the kidneys and bladder, it provokes their discharge. We are also informed that in overdoses it occasions vertigo, oppression of the chest, etc. In regard to the first statement, it may be remarked that recent confirmation of it is wanting; and in regard to the second, that it would present the singular case of a medicine at once diuretic and narcotic. Further information upon the subject is desirable.

HYDRARGYRI CHLORIDUM CORROSIVUM, *U. S.*—CORROSIVE CHLORIDE OF MERCURY.

Hydrargyri perchloridum, Br.; *Hydrargyrum bichloratum corrosivum*, P. G.; *Hydrargyrum muriaticum corrosivum, Hydrargyrum corrosivum sublimatum, Hydrargyri bichloridum, Sublimatus corrosivus, Sublimatum corrosivum, Mercurius sublimatus corrosivus, Chloruretum (Chloretum) hydrargyricum.—Perchloride of mercury, Corrosive sublimate, Bichloride of mercury*, E.; *Deutochlorure de mercure, Sublimé corrosif, Chlorure mercurique*, Fr.; *Ætzendes Quecksilberchlorid, Ætzender Quecksilbersublimat*, G.

Formula $HgCl_2$. Molecular weight 271.

Preparation.—Take of Mercury twenty-four troyounces; Sulphuric Acid thirty-six troyounces; Chloride of Sodium eighteen troyounces. Boil the mercury with the sulphuric acid, by means of a sand-bath, until a dry white mass is left. Rub this, when cold, with the chloride of sodium in an earthenware mortar; then sublime with a gradually increasing heat. *U. S.*

Take of Sulphate of Mercury twenty ounces; Chloride of Sodium dried sixteen ounces; Black Oxide of Manganese in fine powder one ounce. Reduce the sulphate of mercury and the chloride of sodium each to fine powder, and having mixed them and the oxide of manganese thoroughly by trituration in a mortar, put the mixture into an apparatus adapted for sublimation, and apply sufficient heat to cause vapors of perchloride of mercury to rise into the less heated part of the apparatus which has been arranged for their condensation. *Br.*

Both processes are essentially alike, mercuric chloride being formed by the mutual decomposition of mercuric sulphate (freshly made by the first formula) and sodium chloride: $HgSO_4 + 2NaCl$ yields $HgCl_2 + Na_2SO_4$. By heat, mercuric sulphate is partly decomposed (see Hydrargyri sulphas), and the product of the above process is thereby apt to become contaminated with mercurous chloride or calomel; to prevent such a result, the British Pharmacopœia directs the addition of some binoxide of manganese, which, reacting with some of the sodium salt, generates chlorine sufficient to reconvert any mercurous into mercuric salt. On conducting the vapors into a large chamber, they are condensed in the form of a heavy white crystalline powder.

Properties.—Corrosive sublimate forms colorless prismatic crystals, or, more generally, heavy white crystalline masses. It has the density 5.4, and, when heated, fuses and sublimes without leaving any residue. It has a disagreeable metallic taste, and dissolves in about 2 parts of boiling water and 16 parts of water at the common temperature (Poggiale); also in 3 parts of alcohol and 4 parts of ether. When exposed to the light, its aqueous solution is decomposed with the precipitation of calomel and the liberation of hydrochloric acid; the decomposition is prevented by the presence of free hydrochloric acid or of ammonium chloride. The aqueous solution yields yellow precipitates of mercuric oxide with lime-water (see Lotio hydrargyri flava), or potassa solution, a white precipitate of ammoniated mercury with ammonia, and a white curdy one of silver chloride on the addition of nitrate of silver. Phosphorous and sulphurous acids separate calomel from the solutions; hypophosphorous acid and stannous chloride produce the same change, but when in excess and heated, liberate metallic mercury. The salt is soluble without decomposition in sulphuric, muriatic, or nitric acid, and cystallizes again on cooling.

Tests.—Corrosive sublimate should volatilize without leaving any residue (absence of fixed impurities), and be completely soluble in water or alcohol (absence of calomel). It often contains traces of arsenic, which are probably derived from the sulphuric acid with which the sulphate was prepared; this may be readily detected by mixing the solution with an excess of potassa solution, adding some zinc and heating, the test-tube being covered with filtering paper moistened with a drop of solution of silver nitrate; the appearance of a black spot indicates arsenic. J. G. Smith (1877) found in some samples $\frac{1}{10}$ per cent. of the impurity.

Pharmaceutical Uses.—Corrosive sublimate is employed in making Hydrarg. iodidum rubrum, Hydrarg. oxidum flavum, Hydrargyrum ammoniatum, *U. S.*, *Br.;* Liquor hydrarg. perchlor. and Lotio hydrarg. flava, *Br.*

Physiological Action. *On Animals.*—A solution of one part of this salt in a thousand of water destroys the life of plants, leeches, and fish immersed in it. Introduced into the connective tissue, it is absorbed and occasions the same symptoms and lesions of gastro-intestinal inflammation as if it had been given by the mouth. These symptoms include pain, thirst, vomiting of mucus and blood, and death by convulsion or exhaustion. The gastric lesions vary from slight redness to complete softening; similar ones may be found in the intestine, and especially in the rectum.

On Man.—Poisoning by corrosive sublimate may be produced by its external application as well as by its being taken internally. A solution of it applied to the unbroken skin has repeatedly caused symptoms of poisoning, such as an acrid taste in the mouth, irritation of the œsophagus, vomiting, epigastric pain, constriction of the chest, and a small and irregular pulse. When the skin is not whole, the same and more aggravated effects arise, including those of severe local irritation; and the absorption of mercury is proved by the salivation that ensues, and sometimes by the deposit of mercury upon articles of gold worn next the skin. Poisonous doses of this salt cause constriction and severe burning pain in the fauces, œsophagus, and stomach, with retching and the vomiting of mucus, bile, and blood; the abdomen grows painful under pressure, there is tenesmus, and sometimes bloody stools. There are also intense thirst, a quick, frequent, and small pulse, labored breathing, a cold and clammy skin, and scanty or suppressed urine. Death may occur within a few hours, or may be delayed for several weeks. If recovery takes place, the stomach and bowels remain irritable for a long time. After death from this poison, the stomach is contracted, and the mucous membrane of the œsophagus, stomach, and small intestine occasionally is injected, and sometimes ulcerated. Excessive doses convert the gastric mucous membrane into a soft pulp. Smaller, but not fatal doses present the above symptoms in a milder form and degree, and sometimes, although rarely, cause salivation. Indeed, of all mercurial compounds, this one is least apt to salivate, when taken by the stomach. The presence of a large proportion of table-salt in the food is said to prevent in a great degree the absorption of the bichloride, while a moderate proportion of salt promotes its absorption.

Medical Uses.—Corrosive sublimate has never lost the pre-eminence which it shared with calomel of being the best internal remedy for *syphilis.* In general, it is found not to salivate unless given in doses of at least half a grain twice a day, and even in smaller doses it should be guarded by association with some syrup, bitter extract, or opium, and taken directly after meals. To prevent its decomposition in solution it should be associated with muriate of ammonia, in the proportion of one grain of the bichloride to five grains of the latter salt. To this solution alcohol should be added in the proportion of one part to ten. It is preferable to prescribe as many daily doses of the medicine as the patient takes meals, in order to lessen the chances of gastro-intestinal irritation. In appropriate quantities this preparation is undoubtedly the best in infantile syphilis. About one-ninetieth of a grain should be given in solution three times a day, and generally prescribed in a syrup, or mixed with one when administered. If diarrhœa occurs it should be corrected by diminishing the frequency or the size of the dose, and by adding to it a minute proportion of laudanum. Baths of the bichloride have been used to cure syphilis, and with very great success; they are not apt to salivate, but the irritation of the skin they occasion renders them objectionable. The salt has also been employed hypodermically, but it is not more efficacious in this manner than when given internally, and the inconvenience of repeating the operation, and the severe local effects produced by it, have caused the method to be abandoned.

In various diseases of the *skin*, solutions of corrosive sublimate are useful topical applications; but the strength of the preparation should be carefully regulated, and none should be used if the skin is broken. A solution of fifteen grains of the salt in a pint of water, or, still better, in two fluidounces of dilute alcohol, and fourteen fluidounces of water, forms a very efficacious lotion in many cases of *acne*, especially in the form which affects the nose of certain women at their menstrual periods; in *chloasma;* in the discolorations of the skin which go under the general name of *freckles*; in *prurigo pudendi* as a palliative, and in *pityriasis* usually as a cure. *Malignant pustule* is said to be more efficiently than by any other method treated with corrosive sublimate applied to the raw surface of a crucial incision made through the hardened tissues. *Ozæna*, especially of syphilitic origin, is benefited by the injection into the nostrils of weak solutions of the bichloride, containing one or two grains to the ounce of water, or by a weaker solution applied with the nasal douche. In chronic vaginal *leucorrhœa* a similar application is sometimes useful.

In the subacute and chronic forms of muscular as well as articular *rheumatism*, a very gentle but sustained mercurial lotion will sometimes put an end to the lingering stiffness of the joints. For this purpose very minute doses of the bichloride, in compound syrup of sarsaparilla, will be found appropriate. In chronic rheumatic *arthritis* it is said that baths of the bichloride, and compresses wet with solutions of the salt, have sometimes produced cures of this intractable disease. It is recommended that a full bath should contain from three to eight drachms of the salt. The many possible dangers from the use of so large a quantity of a poisonous liquid should condemn its use, especially when its utility is so questionable.

HYDRARGYRI CHLORIDUM MITE, *U. S.*—MILD CHLORIDE OF MERCURY.

Hydrargyri subchloridum, Br.; *Hydrargyrum chloratum mite*, P. G.; *Hydrargyri chloridum, Hydrargyrum chloratum* (*muriaticum*) *dulce, Mercurius dulcis, Calomelas, Chloruretum* (*Chloretum*) *hydrargyrosum.—Subchloride* (*Protochloride*) *of mercury, Calomel*, E.; *Protochlorure* (*Sous-muriate*) *de mercure, Calomèle*, Fr.; *Quecksilberchlorür, Calomel*, G.

Formula Hg_2Cl_2 (or HgCl). Molecular weight 471 (or 235.5).

Preparation.—Take of Mercury forty-eight troyounces; Sulphuric Acid thirty-six troyounces; Chloride of Sodium eighteen troyounces; Distilled Water a sufficient quantity. Boil, by means of a sand-bath, twenty-four troyounces of the Mercury with the Sulphuric Acid until a dry white mass is left. Rub this, when cold, with the remainder of the mercury, in an earthenware mortar, until they are thoroughly mixed. Then add the chloride of sodium, and, having rubbed it with the other ingredients until globules of mercury cease to be visible, sublime the mixture into a large chamber so that the sublimate may fall in powder. Wash the sublimed matter with boiling distilled water until the washings afford no precipitate with water of ammonia, and dry it. *U. S.*

Take of Sulphate of Mercury ten ounces; Mercury seven ounces; Chloride of Sodium dried five ounces; Boiling Distilled Water a sufficiency. Moisten the sulphate of mercury with some of the water, and rub it and the mercury together until globules are no longer visible; add the chloride of sodium, and thoroughly mix the whole by continued trituration. Sublime by a suitable apparatus into a chamber of such size that the calomel, instead of adhering to its sides as a crystalline crust, shall fall as a fine powder on its floor. Wash this powder with boiling distilled water until the washings cease to be darkened by a drop of sulphide of ammonium. Finally, dry at a heat not exceeding 212° F., and preserve in a jar or bottle impervious to light. *Br.*

Both formulas direct mercuric sulphate, which is freshly prepared in the first part of the first process, to be mixed with the requisite quantity of mercury, to form mercurous sulphate, Hg_2SO_4, and afterwards with chloride of sodium. On heating the mixture reaction takes place between the two salts, resulting in the production of mercurous chloride which sublimes, and sodium sulphate which remains behind; $Hg_2SO_4+2NaCl$ yields $Hg_2Cl_2+Na_2SO_4$ If these vapors are cooled and condensed in a small space, white or yellowish-white crystalline masses would be obtained, which should be finely powdered. To avoid this operation, the Pharmacopœias direct the condensation to be effected in a large chamber, whereby a fine crystalline powder is obtained; it is condensed in a similar form, but still finer and as a still softer powder, by injecting steam into the condensing chamber while the sublimation is in progress. Calomel prepared in this way has been made officinal in the German Pharmacopœia, under the title of *Hydrargyrum chloratum mite vapore paratum*. Water being at the same time condensed, it will hold any corrosive sublimate in solution which may have sublimed with the vapors of calomel. It is for the purpose of removing the same impurity that the ordinarily condensed calomel requires to be washed with water as long as mercuric chloride is dissolved, which is indicated by the filtrate producing a white turbidity with ammonia, or a black one with sulphydrate of ammonium. A current of cold air injected into the condensing chamber will precipitate the calomel vapors as a soft powder in a manner similar to that produced by steam.

Very finely divided calomel is obtained by gradually adding a not too concentrated solution of mercurous nitrate to a solution containing an excess of sodium chloride, digesting the mixture for a short time, and washing the precipitate thoroughly with water. Wöhler (1854) proposed to reduce corrosive sublimate in solution by sulphurous acid, and by warming the mixture. Good results, and nearly the theoretical quantity of calomel, are obtained, according to Sartorius (1855), if the corrosive sublimate has been dissolved in 80 parts, or, according to Stein (1857), in 45 parts of water. Concentrated solutions yield only one-half the mercury as calomel.

Properties.—Calomel is a heavy, fine, and smooth white powder, which, under the microscope, is observed to consist of minute needle-shaped crystals; but when prepared by levigating the crystallized mass, it forms irregular fragments of crystals. Its density is about 7.0, but varies somewhat as prepared by different processes. When heated, it sublimes completely without previous fusion. It is insoluble in water and other simple solvents; but boiled with water it is slowly decomposed into metallic mercury and mercuric chloride. Solutions of the fixed alkalies and alkaline earths decompose it with the formation of soluble chlorides and black mercurous oxide Hg_2O (see Lotio hydrargyri nigra); ammonia water also colors it black, but the resulting compound has the composition NH_2Hg_2Cl. Moist calomel is reduced to the metallic state by many metals either in the cold or on being warmed, soluble chlorides and metallic mercury being formed. Boiling nitric or sulphuric acid dissolves calomel with disengagement of nitric oxide or sulphurous acid vapors and the production of mercuric chloride and nitrate or sulphate. Boiling concentrated hydrochloric acid dissolves mercuric chloride and leaves mercury; in the diluted state and heated in contact with the air, mercuric chloride is slowly dissolved without separation of mercury. Calomel left in contact with solution of ammonium chloride is gradually converted into mercuric chloride, which dissolves; the decomposition occurs more rapidly with a concentrated solution and at a somewhat elevated temperature. Potassium and sodium chlorides have a similar effect, but react more slowly. Chlorine water converts calomel into corrosive sublimate. With potassium iodide a green powder is produced containing mercurous iodide. When triturated with impure sugar, some corrosive sublimate is formed.

Tests.—Calomel should volatilize without leaving any residue (absence of fixed impurities). Heated with potassa solution it should turn black without evolving the odor of ammonia (absence of ammonium compounds). Agitated with warm water or alcohol, the filtrate should not be colored by sulphuretted hydrogen, nor yield a white precipitate with silver nitrate (absence of mercuric chloride). Agitated with diluted acetic acid, the filtrate should not be affected by sulphuretted hydrogen or silver nitrate (absence of ammoniated mercury).

Off. Prep.—Lotio hydrarg. nigra, *Br.;* Pilul. antimonii comp. (hydrarg. subchlor. comp.), *U. S.*, *Br.;* Pilul. catharticæ comp., *U. S.;* Unguent. hydrarg. subchlor., *Br.*

Physiological Action.—The action of calomel does not materially differ from that of uncombined mercury (see Hydrargyrum); it is, however, rather more irritating, and in excessive doses may cause active vomiting and purging. It is a remarkable fact that dogs cannot endure, without experiencing hypercatharsis, a third of the doses of calomel which are administered to the youngest children (Bretonneau). No mercurial is more apt to occasion salivation. This and other effects are by no means constantly proportioned to the dose of the medicine; and since it is certain that it must first undergo solution before it can either act locally or be absorbed, the mode in which these results are brought about has been variously stated and explained. The prevalent hypothesis regarding this point is that the alkaline chlorides convert the calomel into corrosive sublimate, rendering it soluble and absorbable, an opinion which, considering the poisonous properties of that compound, seems irrational.

The cholagogue action ascribed to mercury was an invention of the British physicians in India, who long accepted the doctrine that large doses of calomel diminish the vascularity of the gastro-duodenal mucous membrane, and dissolve the inspissated mucus investing it and obstructing the gall-ducts; and that small doses of the medicine are absorbed, and through the blood promote the secretion of bile. But a careful repetition of their experiments proved that large doses of calomel, as well as small doses, lessen the biliary secretion, and that among purgative medicines mercury in every form is the very one that tends least to augment the discharge of bile. It seems to be agreed that all purgatives, whether they increase the biliary secretion and excretion or not, tend to hurry forward the bile through the intestinal canal, and thereby prevent its reabsorption after combination with the results of gastric digestion. In this manner mercury becomes a cholagogue, not by stimulating the liver to increased secretion, but by carrying off the bile already secreted, preventing its reabsorption, and thereby diminishing whatever evils may arise from an excessive amount of bile in the liver and in the system generally. It has long been believed that a proof of the cholagogue action of calomel is to be found in the darker color of the stools during its administration, which have hence been called "calomel stools," and although one or two experimenters have recently reached the same conclusion, yet the more probable opinion is that the color in question is due to the presence of subsulphide of mercury in the dejections, and that even the natural brown color of the feces is produced, not by the bile, which is all reabsorbed in the small intestine, but by a special excretion of the colon. On the whole, the most probable conclusion upon this subject is expressed in these words: "Calomel is not a cholagogue, but diminishes the secretion of bile."

Medical Uses.—When the cure of *syphilis* was believed to depend upon the profuseness of the mercurial salivation established, calomel was generally employed to produce that effect. But at the present day this action of calomel, along with its tendency to purge, has caused it to be less frequently used than formerly. If prescribed at all, it should be in very small and repeated doses, and the frequency of its administration determined by its effects upon the mouth, the bowels, and the course of the disease. These remarks apply to indurated chancres as well as to secondary symptoms.

Much has been written both for and against the use of calomel in *typhoid fever*, but a careful study of its history seems to show, 1, that it is most useful when given in the forming stage of the disease and in purgative doses; and, 2, that it is peculiarly mischievous in all cases which tend to assume an ataxic or an adynamic type. In other words, it is to be placed, in relation to typhoid fever, in the same category as other purgatives, among which the salines have been proved to be eminently useful in the first period of the disease. It is very probable that calomel, acting as a purgative, assists in removing the poisonous material from the bowel, and possibly tends to neutralize it if it be a ferment; while, owing to its imperfect solubility, the medicine may serve as a protective to the mucous glands of the small intestine. It has been recommended to administer calomel in small and repeated doses, and so as slightly to affect the gums, about the height of the disease, when the tongue grows dry, the abdomen tympanitic, and the mind dull; but if we know anything about the nature of these symptoms, it is that they are signs of increased exhaustion of the nervous system and poisoning of the blood, and, therefore, the very last to be treated by a medicine which tends directly to aggravate those conditions. The period at which these phenomena appear, only to subside again in three or four days, in the natural course of the disease, is the one in which the medicine is supposed to be indicated, and the reason assigned for its use probably results, therefore, from an error of observation.

At one time calomel was held to be a specific in *yellow fever;* according to some if given in large doses, according to others if given in small doses intended to produce its constitutional effects. Experience has condemned both methods as not only useless, but injurious. The same may be said, but not so absolutely, in regard to *remittent fever;* the necessity of "unloading the portal circulation," which purgative doses of calomel were supposed to effect, does not now appear so imperative as it did to the theorists of thirty or forty years ago; but the gastro-duodenal inflammation with the engorged state of the liver are undoubtedly allayed by alvine evacuants, among which calomel is one of the best because it is one of the least irritating, particularly if followed by copious saline draughts in divided portions. The constitutional action of calomel in this disease is no longer sought by judicious physicians.

During the last century, and, indeed, until within a few years, calomel has been used by English and American physicians in all *inflammatory* diseases, with complete faith in its efficacy. Borrowed originally from the treatment of acute hepatitis in hot climates, it was applied in England to a totally different order of diseases, plastic inflammations, and gradually came to be regarded as a specific in most of them. Subsequently this empirical practice was supposed to find a rational justification, when it appeared that mercury diminished the coagulability of the blood by lessening the proportion of its fibrin, and, still later, when it appeared that the medicine directly diminished the proportion of red globules in the blood. The former effect was probably, indeed, only a consequence of the latter. But, although it seemed to be proved that mercury thus restricted inflammatory action and its consequences, it was not proved that their restriction by this means was necessary to cure the disease, and it was even rendered probable that the antiphlogistic use of calomel involved more danger than advantages. Extensive observation has now demonstrated that, with one or two possible exceptions, inflammatory affections may be cured quite as rapidly, and much more safely and agreeably, without mercury than with it, while the dangers involved in the antiphlogistic use of the medicine are so serious as to condemn it whenever a safer remedy can be substituted for it.

Of acute inflammations, for whose treatment calomel has been long supposed essential, may be mentioned *pericarditis*, *endocarditis*, *pleurisy*, *pneumonia*, *peritonitis*, *meningitis*, and *hepatitis*. It is now apparently determined that none of these diseases require calomel for their cure, and that most of them are aggravated by it. In regard to peritonitis, it may be added that as the disease is never idiopathic, at least in adults, and never primary unless traumatic, pathology confirms what clinical observation demonstrates, that mercury is unsuited to its cure. Acute hepatitis is not now, as formerly, indiscriminately treated by calomel in tropical climates, where alone it is frequently observed. The use of mercurial, as of other purgatives, appears to be beneficial in the early stage of the disease, but not through its specific operation. There are good grounds for suspecting that in hot climates its repeated administration in divided doses leads to the formation of abscess of the liver. Meningitis, like peritonitis, is always a secondary disease when not traumatic; depending upon a specific poison in epidemic cerebro-spinal meningitis, upon the rheumatic poison in another class of cases, upon tubercle in a third, etc. In no form of meningitis is calomel of any avail unless it may be in certain exceptional cases of the tubercular variety; although it must be confessed that diagnostic difficulties obscure the subject, still, in the present state of our knowledge, mercury stands next to iodine in the promise of doing good. Calomel is worse than useless in acute articular *rheumatism;* it neither mitigates the disease nor prevents its complications. In certain cases of subacute and chronic rheumatism involving the ligaments of the joints, rendering the latter stiff and painful on motion, a course of very small doses of calomel will sometimes act beneficially. But more advantage may be derived from iodide of potassium. In *metritis*, both acute and chronic, calomel and opium are generally administered with supposed advantage. In diseases of the *kidney*, whether acute or chronic, mercury is a mischievous medicine. *Iritis*, although it may, in its simple form, recover without mercury, is more readily cured by calomel and opium internally, and mercurial ointment with extract of belladonna or instillation of atropia, topically. Syphilitic iritis should always be treated by the internal use of calomel, if not by mercurial inunctions.

In *jaundice* depending upon engorgement of the liver or upon obstruction of its ducts with thick bile, saline purgatives are the appropriate remedies, but the English custom of first administering calomel or blue pill prevails in this country. It is very doubtful whether the mercurial renders the purgative treatment more efficient. It can do no harm as an occasional remedy, but is very mischievous if habitually taken.

Among mucous inflammations, *pseudomembranous laryngitis*, or true croup (and not diphtheria, which is a totally different affection), is treated by calomel internally, and by mercurial inunctions, in the belief that, under its operation, exudation-matter will form less densely and adhere less tenaciously, and hence be rejected by coughing or by vomiting more readily. The question of their efficacy is difficult to solve, for the cases of the disease differ widely among themselves in the thickness and tenaciousness of the membrane, and in the extent of its deposit. But in a disease with such fatal tendencies even a doubtful remedy should not be rejected. In *syphilitic laryngitis*, which is generally ulcerative, calomel, or mercury in some form, is indispensable. In acute *dysentery* calomel has been used as a purgative, and in small or so-called alterative doses. There appears to be no doubt that in the sthenic form of the disease purgative doses of calomel, if given in the forming stage, will modify the course of the disease just as salines, rhubarb, and ipecacuanha will. There is no reason to attach any special importance to calomel as such. Its virtue resides chiefly in its mild evacuant and substitutive action. In this disease calomel, in small or fractional doses, is most useful when associated with ipecacuanha, and least so when combined with opium. The advantage of the latter treatment consists mainly in its negative virtue of protecting the patient from perturbative measures. It is most suitable when the acute stage has begun to decline, and after a judicious evacuant treatment has mitigated the severity of the attack. A similar remark is, perhaps, justifiable in regard to the calomel treatment of epidemic *cholera*. The huge doses of the drug which were originally used by the British East India surgeons have long ago been condemned, as well as the other elements of their crude therapeutics. If calomel has shown any special virtues in epidemic cholera it has only been when it was administered in doses of one or two grains every five or ten minutes, with one or two drops of laudanum in each of the first few doses. Knowing, as we do, the utter loss by the stomach of its absorbing function in this disease, the method in question really amounts to a negative treatment, and this, it is pretty well settled, is more efficient than any of the active methods which have prevailed. The hostile influence of mercury upon the lower forms of animal life explains the propriety of using calomel purges in some cases of *lumbricoid worms*. But the possibility of its poisonous action on the system renders it less eligible for this purpose than other direct vermicides.

In an ointment (calomel ʒj, lard ℥j) calomel is sometimes used locally in the treatment of limited *scaly eruptions;* and in powder it has been used to destroy *maggots* infesting wounds in hot weather. In the latter form, also, it has been applied to *ulcers of the cornea*, but is not strongly to be recommended for this purpose.

Administration.—Calomel is most conveniently given mixed with a little syrup, or inclosed in wafers. As a purgative *dose* from five to twenty grains may be administered. Children require larger doses, in proportion to their age, than adults. To produce the constitutional action, of which the first sign is usually a metallic taste in the mouth or soreness of the gums, one or two grain may be given three times a day, with an eighth of a grain of opium; but still smaller doses, more frequently repeated, as a tenth or the twelfth of a grain every hour, will affect the system more promptly.

HYDRARGYRI CYANIDUM, *U. S.*—CYANIDE OF MERCURY.

Hydrargyrum cyanatum (borussicum), Mercurius cyanatus s. borussicus, Cyanuretum hydrargyricum.—Cyanuret of mercury, E.; *Cyanure (Bicyanure, Prussiate) de mercure*, Fr.; *Cyanquecksilber, Quecksilber-Cyanid*, G.

Formula $HgCy_2$ or $Hg(CN)_2$. Molecular weight 252.

Preparation.—Take of Ferrocyanide of Potassium five troyounces; Sulphuric Acid four troyounces and one hundred and twenty grains; Red Oxide of Mercury in fine powder, Water, each a sufficient quantity. Dissolve the ferrocyanide of potassium in twenty fluidounces of water, and add the solution to the sulphuric acid, previously diluted with ten fluidounces of water, and contained in a glass retort. Distil the mixture nearly to dryness into a receiver, containing ten fluidounces of water and three troyounces of red oxide of mercury. Set aside two fluidounces of the distilled liquid, and to the remainder add, with agitation, sufficient red oxide to destroy the odor of hydrocyanic acid. Then filter the solution, and, having added the reserved liquid, evaporate the whole in a dark place, in order that crystals may form. Lastly, dry the crystals, and keep them in a well-stopped bottle, protected from the light. *U. S.*

Hydrocyanic acid is prepared as the first step by acting upon potassium ferrocyanide with sulphuric acid. (See Acid. hydrocyanicum, page 49.) On agitating it with mercuric oxide, a combination is effected resulting in the production of mercuric cyanide and water; $2HCy+HgO$ yields $HgCy_2+H_2O$. Should an excess of mercuric oxide be present, it will combine with the cyanide to mercuric oxycyanide, $HgO.HgCy_2$, which is converted into cyanide by the addition of the reserved portion of hydrocyanic acid; an excess of the latter does not change the nature of the product.

This is not the only process, but the most convenient one, by which mercuric cyanide may be obtained. On boiling pure ferrocyanide of iron with mercuric oxide, mercuric cyanide enters into solution; and on boiling potassium ferrocyanide with a proper quantity of mercuric sulphate, a complex reaction will take place, resulting finally in the production of metallic mercury and of a solution containing mercuric cyanide, potassium sulphate, and ferric sulphate, to be separated by crystallization; $7HgSO_4+2K_4FeCy_6=Hg+6HgCy_2+4K_2SO_4+Fe_23SO_4$.

Properties.—Mercuric cyanide is in colorless or white quadrangular prisms, which are soluble in eight parts of water and about twenty parts of alcohol, but quite sparingly soluble in absolute alcohol. The aqueous solution is not decomposed by nitric or dilute sulphuric acid, but hydrochloric acid liberates hydrocyanic acid, recognizable by its odor, and mercuric chloride remains in solution. The aqueous solution is not precipitated by alkalies or nitrate of silver; but yields a black precipitate with sulphuretted hydrogen. The salt has a bitter metallic taste, is blackened by exposure to the light, and when carefully heated is decomposed into mercury and cyanogen, which is inflammable, burning with a purplish flame. When rapidly heated, black paracyanogen remains behind, and in the presence of moisture carbonic acid and ammonia are evolved besides hydrocyanic acid.

Tests.—Mercuric oxycyanide, if present, is sparingly soluble in cold water, and the solution imparts a brown color to turmeric paper.

Medical Action and Uses.—Cyanide of mercury is a violent irritant poison, producing also extreme prostration and local cyanosis, and death by exhaustion. It has been used in the treatment of syphilis, but no sufficient reason appears for retaining so dangerous a preparation among officinal medicines. Twenty grains of it caused death in ten days, and two grains a severe illness which lasted for three weeks.

HYDRARGYRI IODIDUM RUBRUM, *U. S.*, *Br.*—RED IODIDE OF MERCURY.

Hydrargyrum biiodatum rubrum, P. G.; *Deutoioduretum* (*Biniodidum*) *hydrargyri*, *Mercurius iodatus ruber*, *Ioduretum hydrargyricum.*—*Biniodide of mercury*, E.; *Deuto-iodure* (*Bi-iodure*) *de mercure*, *Iodure mercurique*, Fr.; *Rothes Jodquecksilber*, *Quecksilberjodid*, G.

Formula HgI_2. Molecular weight 454.

Preparation.—Take of Corrosive Chloride of Mercury a troyounce; Iodide of Potassium a troyounce and one hundred and twenty grains; Distilled Water a sufficient quantity. Dissolve the corrosive chloride of mercury in a pint and a half, and the iodide of potassium in half a pint of distilled water, and mix the solutions. Collect the precipitate upon a filter, and, having washed it with distilled water, dry it with a gentle heat, and keep it in a well-stopped bottle. *U. S.*

Take of Perchloride of Mercury four ounces; Iodide of Potassium five ounces; Boiling Distilled Water four pints. Dissolve the perchloride of mercury in three pints, and the iodide of potassium in the remainder of the water, and mix the two solutions. When the temperature of the mixture has fallen to that of the atmosphere, decant the supernatant liquor from the precipitate, and, having collected the latter on a filter, wash it twice with cold distilled water, and dry it at a temperature not exceeding 212° F. *Br.*

Mercuric chloride and potassium iodide, when mixed in the proportion of the weights of one molecule of the former to two of the latter salt, decompose each other into mercuric iodide, which precipitates, and potassium chloride, which remains in solution; $HgCl_2 + 2KI$ yields $HgI_2 + 2KCl$. Both Pharmacopœias use the two salts in the proportion of 4 to 5, which is a slight excess of the potassium salt over the theoretical quantity, but is generally necessary in practice, owing to the small percentage of impurities always present in commercial iodide of potassium. By mixing the two solutions cold, the new compound is separated in the form of powder, but when the hot solutions are mixed and slowly cooled, beautiful crystals are obtained. In either case the yield should not be less than 50 per cent. over the weight of the corrosive sublimate used.

Properties.—Mercuric iodide is a scarlet-red powder or is in brilliant crystals; on being heated it turns yellow, fuses near 240° C. (464° F.) to an amber-colored liquid, and sublimes to bright yellow tabular crystals, which, after cooling, are again converted into the prismatic or octahedral red crystals. The salt is very sparingly soluble in cold or hot water, little so in ether, and freely in hot alcohol, from which it crystallizes on cooling. The solutions are colorless, and are partly decomposed by potassa solution, a portion of the mercury being deposited as mercuric oxide; the remainder forming a soluble iodide of potassium and mercury. When a hot solution of potassium iodide is saturated with mercuric iodide, and then allowed to cool, one-third of the latter salt crystallizes on cooling; the remainder is obtained, on further concentration, as yellow prisms, which are soluble in alcohol and ether, but are partly decomposed by water. The crystals are *mercuric potassium iodide*, $2(KI.HgI_2)3H_2O$, more generally known as *iodohydrargyrate of potassium*, and are likewise formed on adding mercuric chloride to an excess of potassium iodide.

Impurities, if present, are readily detected by the residue left on subliming the salt (red oxide of lead and other non-volatile compounds), and on dissolving it in hot alcohol (vermilion, etc.).

Pharmaceutical Uses.—The observation of Nessler (1856) of the effect of ammonia upon such solutions, has resulted in the discovery of a very delicate reagent for minute quantities of ammonia or ammonia salts, known as the

NESSLER REAGENT.—It is made by dissolving 50 grams of potassium iodide in a little boiling distilled water, and adding to it, carefully, sufficient boiling hot concentrated solution of mercuric chloride until the red precipitate formed is no longer redissolved on agitation; the liquid is decanted and filtered, and the filtrate mixed with 200 grams of potassa dissolved in a small quantity of water; when cold the mixture is diluted to the measure of one liter by the addition of distilled water. It will be observed that this is a solution of mercuric-potassium iodide in caustic potassa. On the addition of ammonium salt this is decomposed by the potassa, ammonia is liberated and reacts now with the double iodide and another portion of the potassa, resulting in the formation of brown insoluble dimercur-ammonium (NHg_2) iodide, potassium iodide, and water, as will be seen from the equation $NH_3 + 2(KI.HgI_2) + 3KHO = NHg_2I + 5KI + 3H_2O$. If the ammonia is present in minute quantity, the color is best observed by looking through the column of the liquid contained in a tall test-tube and placed on white paper.

Winckler (1830), Von Planta (1846), and Groves (1858), observed the behavior of solutions of the double iodide upon solutions of vegetable alkaloids, which led F. F. Mayer (1862) to the adoption of a tenth normal solution, now known as

MAYER'S SOLUTION.—It is prepared by dissolving 13.546 grams of mercuric chloride and 49.8 potassium iodide in sufficient distilled water to obtain one liter of liquid. The test is applied in acidulated aqueous solutions, since ammonia would also be precipitated if an alkaline liquid was used. One cubic centimeter of this test liquid precipitates of

Aconitia	0.0267 grams.	Conia	0.00416 grams.	Quinia	0.0108 grams.
Atropia	0.0145 “	Morphia	0.020 “	Quinidia	0.0120 “
Brucia	0.0233 “	Narcotina	0.0213 “	Strychnia	0.0167 “
Cinchonia	0.0102 “	Nicotina	0.00405 “	Veratria	0.0269 “

The end of the precipitation is determined by filtering a few drops of the liquid tested upon a watch-crystal, and by placing a small drop of the test solution alongside, allowing the two to run together. For colorless solutions, which are free from chlorides, etc., an excess of the test liquid may be used, and the excess determined in the filtrate by a standard solution of silver nitrate.

Off. Prep.—Liq. arsen. et hydrarg. iodidi, *U. S.;* Unguent. hydrarg. iodidi rubri, *Br.*

Medical Action and Uses.—Biniodide of mercury is a powerful irritant poison. Two grains of it taken with a drachm of iodide of potassium caused violent gastric pain, coma, stertor, opisthotonos, and convulsion. As an internal remedy it is superfluous, and dangerous unless very cautiously used. It may, however, be given in constitutional *syphilis* in a solution of iodide of potassium, and in the dose of one-sixteenth of a grain, cautiously increased. As a caustic, it has been applied to the treatment of *lupus*, but is inferior to other substances used for this purpose.

HYDRARGYRI IODIDUM VIRIDE, *U. S.*, *Br.*—GREEN IODIDE OF MERCURY.

Hydrargyrum iodatum flavum, P. G.; *Hydrargyrum iodatum, Hydrargyri iodidum (vel proto-ioduretum), Ioduretum hydrargyrosum.—Yellow iodide of mercury, Mercurous iodide*, E.; *Proto-iodure de mercure, Iodure mercureux*, Fr.; *Quecksilberjodür, Gelbes Jodquecksilber*, G.

Formula Hg_2I_2 (or HgI). Molecular weight 654 (or 327).

Preparation.—Take of Mercury a troyounce; Iodine three hundred grains; Stronger Alcohol a sufficient quantity. Mix the mercury and iodine in a mortar, and, having added half a fluidounce of Stronger Alcohol, triturate the mixture until the ingredients are thoroughly incorporated. Stir the mixture occasionally, and, at the end of two hours, triturate again, with considerable pressure, until it is nearly dry. Then rub it up with stronger alcohol, gradually added, until it is reduced to a uniform, thin paste; and, having transferred this to a filter, wash it with stronger alcohol until the washings cease to produce a permanent cloudiness when dropped into a large quantity of water. Lastly, dry the iodide in the dark with a gentle heat, and keep it in a well-stopped bottle, protected from the light. *U. S.*

Take of Mercury one ounce; Iodine two hundred and seventy-eight grains; Rectified Spirit a sufficiency. Rub the iodine and mercury in a porcelain mortar, occasionally moistening the mixture with a few drops of the spirit, and continuing the trituration until metallic globules are no longer visible, and the whole assumes a green color. The product thus obtained should be dried in a dark room on filtering paper, by simple exposure to the air, and preserved in an opaque bottle. *Br.*

Mercury and iodine are contained in mercurous iodide very nearly in the proportion 8 : 5, as directed by the United States and German Pharmacopœias; this gives a slight excess of mercury, amounting to less than 2.5 per cent. of the weight of the iodide. The French Codex directs the proportion 5 : 3, insuring a still greater excess of mercury. The proportion used by the British Pharmacopœia is that of the atomic weights of the two elements. On bringing iodine and mercury together, they unite, forming mercurous or mercuric iodide, according to the proportions employed. It appears, however, that a portion of mercuric iodide is always formed, and being poisonous, requires to be removed or reduced to mercurous iodide by long trituration. The former is the course adopted by the Pharmacopœias, the British excepted, the removal being accomplished by washing the product with alcohol. Le Canu (1877) states the washing to be unnecessary if the mercury is first finely divided by trituration with a little alcohol before the iodine is added in small portions. But even in this case we would prefer the subsequent employment of alcohol to insure the absence of the red iodide.

It has been repeatedly proposed to prepare mercurous iodide by double decomposition of calomel or other mercurous salt with iodide of potassium; the results, however, are never satisfactory, since, by the action of the potassium salt, some red iodide is formed and metallic mercury liberated. (See a paper in *Amer. Journ. Pharm.*, 1857, p. 11.)

Properties and Tests.—Mercurous iodide which has not been washed with alcohol is dark green; but having been freed from the red iodide by either hot or cold alcohol it is greenish-yellow. On exposure to the light red iodide is formed, it turns dark green and finally black, the decomposition being accelerated by moisture. When heated it turns red-brown, and finally sublimes, yielding mercury and red crystals of mercuroso-mercuric iodide $Hg_2I_2.2HgI_2$, which become yellow on cooling. Mercurous iodide is almost insoluble in water and entirely insoluble in alcohol and ether; when treated with alcohol, the filtrate on being dropped into water should produce only a very faint cloudiness, and on evaporation should leave only a minute trace of red iodide. Fixed impurities, if present, remain behind if a portion is heated to redness in a porcelain crucible.

Medical Action and Uses.—Green iodide or protiodide of mercury is chiefly used in the treatment of constitutional *syphilis*, and is preferred above other preparations by several eminent syphilographers. It should be given in doses of from three-quarters of a grain to one grain three times a day, and gradually increased until these doses are trebled, or more, provided that neither salivation nor diarrhœa occurs. It is less apt than calomel to produce these effects. The following formula is much employed: ℞. Protiodide of mercury, Extract of lettuce, each 45 grains; Extract of opium, 15 grains; Confection of roses, 90 grains. Mix, and divide into sixty pills. One, two, or three to be taken daily.

HYDRARGYRI OXIDUM FLAVUM, *U. S.*, *Br. Add.*—YELLOW OXIDE OF MERCURY.

Hydrargyrum oxydatum via humida paratum, P. G.; *Hydrargyrum oxydatum præcipitatum (vel flavum).—Precipitated oxide of mercury*, E.; *Oxyde de mercure jaune (précipité)*, Fr.; *Präcipitirtes (Gelbes) Quecksilber-Oxyd*, G.

Formula HgO. Molecular weight 216.

Preparation.—Take of Corrosive Chloride of Mercury four troyounces; Solution of Potassa seventeen troyounces; Distilled Water a sufficient quantity. Dissolve the corrosive chloride of mercury in five pints of distilled water, and mix with the solution of potassa; after the precipitate has subsided, pour off the supernatant liquid, and wash with distilled water until the washings cease to be affected by a solution of nitrate of silver. Then dry the precipitate on bibulous paper, in a dark place, and preserve it in bottles, protected from the light. *U. S.*

Take of Perchloride of Mercury four ounces; Solution of Soda two pints; Distilled Water a sufficiency. Dissolve the perchloride of mercury in four pints of distilled water, aiding the solution by the application of heat, and add this to the solution of soda. Stir them together; allow the yellow precipitate to subside; remove the supernatant liquor by decantation; thoroughly wash the precipitated oxide on a calico filter with distilled water, and finally dry it by the heat of a water-bath. *Br.*

On mixing solutions of mercuric chloride and potassa or soda, an alkaline chloride, water, and mercuric oxide are formed, the latter being precipitated; $HgCl_2 + 2HKO$ yields $2KCl + H_2O + HgO$. The alkali must be in excess, lest some mercuric oxychloride would be precipitated with the oxide, and it is advisable to pour the mercuric solution into the alkali. The German Pharmacopœia directs boiling solution of soda.

Properties and Tests.—It is a heavy, smooth, yellow or reddish-yellow powder, which on exposure to light becomes dark in consequence of partial reduction to mercurous oxide, and when heated assumes a red color. When mixed with a solution of oxalic acid, it forms white mercuric oxalate (difference from red oxide). Heated with an alcoholic solution of mercuric chloride it speedily turns black from the formation of an oxychloride; red mercuric oxide slowly undergoes a similar change (Roucher). It should be completely volatilized by heat, or leave only a very minute residue.

Off. Prep.—Unguent. hydrarg. oxidi flavi, *U. S.*

Medical Uses.—This preparation is only used as an external remedy to stimulate indolent *ulcers*, especially of venereal origin, and as an application to granular and ulcerated conditions of the *eyes*. It is applied, chiefly, in an ointment, which is officinal.

HYDRARGYRI OXIDUM RUBRUM, *U. S.*, *Br.*—RED OXIDE OF MERCURY.

Hydrargyrum oxydatum rubrum, P. G.; *Hydrargyri nitrico-oxidum*, *Mercurius corrosivus* (*præcipitatus*) *ruber*, *Oxydum hydrargyricum.*—*Peroxide of mercury*, *Red precipitate*, *Mercuric oxide*, E.; *Deuto-oxyde* (*Peroxyde*) *de mercure*, *Oxyde mercurique*, *Précipité rouge*, *Poudre de Jean de Vigo*, Fr.; *Rothes Quecksilberoxyd*, *Rother Präcipitat* (*Quecksilber-Präcipitat*), G.

Formula HgO. Molecular weight 216.

Preparation.—Take of Mercury thirty-six troyounces; Nitric Acid twenty-four troyounces; Water two pints. Dissolve the mercury, with the aid of a gentle heat, in the acid and water previously mixed, and evaporate to dryness. Rub the dry mass into powder, and heat it in a very shallow vessel until red vapors cease to arise. *U. S.*

Take of Mercury by weight eight ounces; Nitric Acid four and a half fluidounces; Water two fluidounces. Dissolve half the mercury in the nitric acid diluted with the water, evaporate the solution to dryness, and with the dry salt thus obtained, triturate the remainder of the mercury until the two are uniformly blended together. Heat the mixture in a porcelain dish, with repeated stirring, until acid vapors cease to be evolved, and, when cold, inclose the product in a bottle. *Br.*

In both processes nitrate of mercury is formed as the first step; this is directly decomposed by heat, or, as directed by the second formula, previously mixed with an additional quantity of mercury, which during the subsequent heating is oxidized at the expense of the nitrate. In both cases the color changes to yellow and then to red, red fumes of nitric peroxide being given off. Occasionally a minute quantity of nitrate remains undecomposed. The decomposition by the second formula is as follows: $2(Hg2NO_3) + Hg_2 = 4HgO + 2N_2O_4$.

Properties and Tests.—When made on a small scale it is a finely granular powder of a yellowish-red color, without lustre; but made in larger quantities it is obtained in the form of bright brownish-red shining crystalline scales, which on trituration yield a fine orange-red powder. By exposure to light it becomes superficially black, but much more slowly than the yellow oxide. When heated, its color is changed to dark-red, brown, and black, the original color reappearing on cooling; but when heated to a little beyond the boiling point of mercury, it is decomposed into metal and oxygen. When thus treated red nitrous vapors should not be given off (absence of nitrate), and no residue should be left (absence of non-volatile impurities). It dissolves completely in nitric acid; a red-colored residue would indicate the presence of brick-dust or of vermilion, the latter being volatilizable by heat; a brown residue (of puce-colored oxide of lead) would prove an adulteration with red lead, and the nitric acid solution would contain lead recognizable by the white precipitate appearing on the addition of a little sulphuric acid.

The preparation formerly officinal in various Pharmacopœias as *Mercurius præcipitatus per se* or *Mercurius calcinatus* was red oxide of mercury in the form of crystalline scales, which were obtained by keeping metallic mercury in a loosely-covered flask at a temperature near its boiling point. The process required several weeks for its completion.

Pharmaceutical Uses.—Red oxide of mercury is used in preparing Hydrarg. cyanidum and Liq. hydrarg. nitratis, *U. S.* It is a constituent of Unguent. hydrarg. oxidi rubri, *U. S.*, *Br.*

Medical Action and Uses.—Red precipitate is a powerful irritant, and taken internally may act as a corrosive poison. Its application to ulcers, wounds, etc., has been frequently followed by its constitutional operation, including salivation. The last-named effect is said to be unusual when the medicine is administered internally, as it sometimes has been in the treatment of *syphilis*, in the *dose* of one-tenth of a grain twice a day and gradually increased. Externally it is generally used in the form of an ointment; but sometimes it is also applied as a fine powder mixed with sugar to indolent syphilitic ulcers, condylomata, etc., and even to granular eyelids and opacities of the cornea.

HYDRARGYRI PERCHLORIDUM, *Br.* See HYDRARGYRI CHLORIDUM CORROSIVUM.

HYDRARGYRI SUBCHLORIDUM, *Br.* See HYDRARGYRI CHLORIDUM MITE.

HYDRARGYRI SULPHAS, *Br.*—SULPHATE OF MERCURY.

Hydrargyrum sulphuricum, Mercurius vitriolatus, Sulfas mercuricus.—Persulphate of mercury, Mercuric sulphate, E.; *Deuto-sulfate (Persulfate) de mercure, Sulfate mercurique,* Fr.; *Schwefelsaures Quecksilberoxyd,* G.

Formula $HgSO_4$. Molecular weight 296.

Preparation.—Take of Mercury by weight twenty ounces; Sulphuric Acid twelve fluidounces. Heat the mercury with the sulphuric acid in a porcelain vessel, stirring constantly until the metal disappears, then continue the heat until a dry white salt remains. *Br.*

Mercury does not dissolve in cold sulphuric acid; but on heating the mixture sulphurous acid and watery vapors are disengaged, any excess of sulphuric acid is driven off, and the residue consists of mercuric sulphate: $Hg_2 + 4H_2SO_4$ yields $2SO_2 + 4H_2O + 2HgSO_4$.

Properties and Tests.—Mercuric sulphate is a heavy white crystalline powder which, on being mixed with a small quantity of water, is at first colored yellow, but after some time is converted into colorless shining prisms of the hydrated salt. A larger quantity of water decomposes it permanently into yellow basic sulphate. When heated to redness, it is decomposed and entirely volatilized; any non-volatile residue left would indicate impurities. The salt is partly decomposed by heat, mercurous sulphate and mercury being sublimed, besides undecomposed mercuric sulphate.

Pharmaceutical Uses.—It is employed for the preparation of turpeth mineral, corrosive sublimate, and calomel.

It is not used in medicine.

HYDRARGYRI SULPHAS FLAVA, *U. S.*—YELLOW SULPHATE OF MERCURY.

Hydrargyri subsulphas, Hydrargyrum sulphuricum flavum, Mercurius emeticus flavus, Sulphas hydrargyricus flavus, Turpethum minerale.—Subsulphate of mercury, Turpeth mineral, E.; *Sulfate trimercurique, Sulfate jaune de mercure, Turbith minéral,* Fr.; *Basisch swefelsaures Quecksilberoxyd, Mineralischer Turpeth,* G.

Formula $2HgO.HgSO_4$. Molecular weight 728.

Preparation.—Take of Mercury four troyounces; Sulphuric Acid six troyounces. Mix them in a glass vessel, and boil, by means of a sand-bath, until a dry white mass remains. Rub this into powder, and throw it into boiling water. Pour off the supernatant liquid, wash the yellow precipitate repeatedly with hot water and dry it. *U. S.*

In the first part of the process mercuric sulphate is formed, which, by the subsequent addition of water, is converted into basic or *oxy-mercuric sulphate*, while an acid sulphate remains in solution. The result varies somewhat, depending upon the amount and the temperature of the water. Using three times a pint of boiling water for the above quantities, the yield will be about 75 per cent. of the weight of the dry mercuric sulphate used.

Properties and Tests.—Yellow sulphate (or oxysulphate) of mercury is a heavy bright lemon-yellow powder which, on heating, becomes red, and yellow again on cooling; by a higher heat, it is completely volatilized. It requires 2000 parts of cold and 600 parts of boiling water for solution (Fourcroy). It is decomposed by potassa solution, yellow mercuric oxide being formed, and dissolves completely in hydrochloric acid, the solution, according to Mohr, containing corrosive sublimate and free sulphuric acid; it should answer to all the tests for mercuric oxide and sulphate.

Medical Action and Uses.—Turpeth mineral is a powerful irritant, and in sufficient doses may act as a corrosive poison, causing active corrosion of the fauces, œsophagus, and stomach, and even sloughing of the first-named parts, as well as salivation. Several fatal cases of its use are recorded. In spite of these grave effects, turpeth mineral has been used as an emetic in "croup," by which was probably meant spasmodic laryngitis. The employment of so dangerous a remedy in a disease which involves no danger to life is inexcusable. The emetic action of this preparation is the first stage of its poisonous operation. The *dose* fitted to produce that effect is from two to three grains for a child. Owing to its tendency to salivate, it should not be employed as an errhine.

HYDRARGYRI SULPHURETUM RUBRUM, *U. S.*—RED SULPHURET OF MERCURY.

Hydrargyrum sulfuratum rubrum, P. G.; *Cinnabaris, Sulfuretum hydrargyricum.—Red sulphide of mercury, Cinnabar, Vermilion*, E.; *Sulfure rouge de mercure, Cinnabre*, Fr.; *Rothes Schefelquecksilber, Zinnober*, G.

Formula HgS. Molecular weight 232.

Preparation.—Take of Mercury forty troyounces; Sublimed Sulphur eight troyounces. To the sulphur, previously melted, gradually add the mercury, with constant stirring, and continue the heat until the mass begins to swell. Then remove the vessel from the fire and cover it closely to prevent the contents from inflaming. When the mass is cold, rub it into powder and sublime. *U. S.*

The preparation of vermilion is carried on in large establishments, and will hardly ever be attempted by the pharmacist, except as an experiment. It may be obtained in the dry or humid way. The officinal process belongs to the former class, but a large excess of sulphur is directed, 6½ troyounces being sufficient for the quantity of mercury; the excess is volatilized before the cinnabar is condensed. If the black mass obtained in the first part of the above process is digested with solution of potassa and some potassium sulphuret, at a temperature of about 45° C. (113° F.), it will be gradually converted into vermilion.

Properties and Tests.—Vermilion is seen in commerce in the form of a bright scarlet-red powder which, on being heated, becomes brown, then black, and finally volatilizes, and assumes its red color again on cooling. Heated in contact with the air, it burns with a blue flame, emitting the odor of sulphurous acid. Nitro-muriatic acid dissolves it with the separation of sulphur and the production of sulphuric acid and mercuric chloride. Its complete volatility by heat insures the absence of red lead and basic lead chromate (American vermilion); and when it is treated with warm solution of potassa, the colorless solution, on being acidulated, would yield a yellow or orange precipitate if sulphides of arsenic or antimony were present.

HYDRARGYRI SULPHURETUM NIGRUM, s. *Æthiops mineralis.*—This preparation has been very properly discarded by the United States and British Pharmacopœias, but is still employed on the continent of Europe. It is made by triturating equal weights of mercury and sulphur, until all metallic globules have disappeared. It forms a fine black and heavy powder which, when viewed with a lens, does not show any globules of uncombined mercury. When heated upon a plate, it takes fire and burns with a blue flame, without leaving any residue; heated in a test-tube, it yields a red sublimate of vermilion. When digested with hydrochloric acid, the acid liquid does not yield a white precipitate on being diluted with water (absence of antimony). Ethiops mineral is a mixture of black amorphous sulphide of mercury, HgS, with a large excess of sulphur.

Medical Action and Uses.—This, like other metallic sulphurets, is less irritating than the sulphates of the same metal. Indeed, there is much reason for believing that in its natural state it has no action at all. It is seldom used, and then only by fumigation, the powdered cinnabar being strewn upon hot coals; the sulphuret is decomposed, and the fumes contain metallic mercury and sulphurous acid. The irritating action of the latter renders the method objectionable. As occasionally used, the patient is inclosed in a wooden box with an aperture through which his head passes, so that he is not obliged to inhale the irritating fumes. This method is said to be a very efficient one, although not without the risk of salivating, causing congestion of the brain, etc.

HYDRARGYRUM, *U. S.*, *Br.*—MERCURY.

Hydrargyrum, Mercurius vivus, Argentum vivum.—*Quicksilver*, E.; *Mercure, Vif-argent*, Fr.; *Quecksilber*, G.

Symbol Hg. Atomicity bivalent. Atomic weight 200.

Origin.—Mercury is principally obtained from New Almaden in California, from Peru, China, Idria in Austria, and Almaden in Spain. It is found to some extent in the metallic state in the form of minute or large globules; but the principal ore for extracting it is *cinnabar.*

Preparation.—Most of the mercury is obtained by roasting the ore in a kiln. It is placed upon an arch of brick-work containing several openings, through which the flames pass, whereby the sulphur of the ore is ignited and burns, air being admitted at the same time; the heat thus produced volatilizes the mercury, the vapors of which, mingled with the smoke and sulphurous acid gas, are passed through a series of condensing chambers, where the metal is condensed, the incondensible gases finally escaping through the flue. This is essentially the process as carried on at Idria and New Almaden; likewise at Almaden, except that the vapors are passed through the so-called *aludels*, consisting of cylinders adapted to each other, first in a descending and then in an ascending direction, where most of the mercury is condensed and collects in a gutter placed under the angle, the remainder being condensed in a large terminal chamber, from which the gases pass into the flue. In the Palatinate the cinnabar is mixed with lime, and in Bohemia with hammerslag and then distilled, sulphide of calcium remaining behind in the former, and sulphide of iron in the latter case.

Mercury appears in commerce in cylindrical iron flasks containing 75 pounds each. In this condition it still contains small quantities of other metals, principally lead, which, however, do not interfere with its uses in the silvering of looking-glasses, in the amalgamation process for the extraction of gold and silver, nor in the preparation of some chemicals. For barometers and thermometers, as well as for some pharmaceutical preparations, a purification of the metal is required or advisable, and may be effected by distillation or by the following process directed in the German Pharmacopœia:—

HYDRARGYRUM DEPURATUM.—Take of Mercury one hundred parts; Nitric Acid, Distilled Water, each five parts. Introduce them into a suitable vessel, and digest for three days, shaking frequently. Having poured off the acid liquid, wash well the mercury with distilled water, and dry it completely.

The operation is best conducted in a broad glass or porcelain vessel, so as to expose a very large surface of the metal to the action of the dilute acid. The lead, being far more easily oxidized and dissolved than the mercury, is thereby removed, though a little of the latter likewise passes into solution. After washing, most of the water may be removed by bibulous paper.

Properties.—Mercury is solid at a temperature of —39.44° C. (—39° F.), and crystallizes in octohedrons and needles, which are ductile and may be cut with a knife. At the ordinary temperature it forms a bright silvery liquid, which is very cohering, and not adhering to glass, unless it be impure, when small globules will *tail* or leave a streak upon it. When triturated with sugar, fat, various salts, oil of turpentine, etc., it is converted into a gray powder consisting of minute globules separated by the foreign substances, and running together again on their removal; this finely divided state is called the *extinction* or *killing* of mercury, and is accomplished in making mercurial ointment and several other officinal preparations. Mercury has at 4° C. (39.2° F.) the specific gravity 13.59, and at 15° C. (59° F.) 13.57. It boils at about 350° C. (662° F.), but volatilizes very slowly even at the ordinary temperature. It is permanent at the ordinary temperature, the whitish pellicle which forms upon the surface of commercial mercury being due to the presence of foreign metals (lead, zinc, etc.). It unites directly with chlorine, bromine, and iodine, and dissolves even in dilute nitric acid with the evolution of nitric oxide. Boiling hydrochloric and dilute sulphuric acids are without action upon it; but hot concentrated sulphuric acid dissolves the metal, sulphurous acid being given off. When heated to near its boiling point in contact with the atmosphere, it combines with oxygen, forming scales of red oxide.

Tests.—The purity of mercury is ascertained from its behavior and properties as described above. When some mercury is agitated for a while with the officinal solution of ferric chloride, which is free from ferrous chloride, the liquid should afterwards not yield a blue precipitate on the addition of potassium ferridcyanide, which would result through the solution of a foreign metal and the reduction of some ferric to ferrous chloride; nor should the liquid, if necessary after being acidulated with muriatic acid, yield more than a mere trace of a colored precipitate on the addition of hydrogen sulphide.

OXIDES AND SALTS.—Mercury unites with oxygen in two proportions and forms two series of salts, the *mercurous* and *mercuric*. All soluble salts of mercury are poisonous, have an acid reaction upon test-paper and a strongly metallic taste. The normal salts are usually white, and the basic salts yellow; treated with stannous chloride, phosphorous or sulphurous acid, or other deoxidizing agents, they are blackened and finally reduced to metal. Their solutions deposit a silvery coating of metallic mercury upon a bright piece of metallic copper, and yield black precipitates with sulphuretted hydrogen and white ones with sodium phosphate. *Mercurous* salts yield black precipitates with potassa, ammonia, and, on boiling, also with alkaline carbonates. Muriatic acid causes a white precipitate of calomel, and potassium iodide separates a greenish-yellow deposit. *Mercuric* salts yield with potassa or soda yellow, with ammonia and ammonium carbonate white, and with potassium or sodium carbonate red-brown precipitates. Muriatic acid does not disturb the solutions; potassium iodide causes a scarlet-red precipitate, which is soluble in an excess of either solution. All compounds of mercury are either volatilized or decomposed by heat.

Pharmaceutical Uses.—The following chemical compounds of mercury are officinal: Hydrarg. chlorid. corros. (perchloridum), Hydrarg. chlorid. mite (subchloridum), *U. S.*, *Br.;* Hydrarg. cyanidum, *U. S.;* Hydrarg. iodidum rubrum, Hydrarg. iodidum viride, Hydrarg. oxidum flavum, Hydrarg. oxid. rubrum, *U. S.*, *Br.;* Hydrarg. sulphas, *Br.;* Hydrarg. sulphas flava, Hydrarg. sulphuretum rubrum, *U. S.;* Hydrargyrum ammoniatum, *U. S.*, *Br.;* also the solutions: Liquor arsenici et hydrarg. iodidi, *U. S.;* Liquor hydrarg. nitratis (nitrat. acidus), *U. S.*, *Br.;* Liquor hydrarg. perchloridi, *Br.*

The following pharmaceutical preparations contain mercury chiefly uncombined: Emplast. ammoniaci cum hydrargyro, Empl. hydrargyri, Hydrargyrum cum creta, *U. S.*, *Br.;* Linim. hydrargyri, *Br.;* Pilul. hydrargyri, *U. S.*, *Br.;* Suppositoria hydrargyri, *Br.;* Unguent. hydrargyri, *U. S.*, *Br.;* Unguent. hydrarg. comp., *Br.*

The following pharmaceutical preparations contain combined mercury: Lotio hydrarg. flava, Lotio hydrarg. nigra, *Br.;* Pilul. antimonii comp. (hydrarg. subchloridi comp.), *U. S.*, *Br.;* Pilul. catharticæ comp., *U. S.;* Unguent. hydrarg. ammoniati, *U. S.*, *Br.;* Unguent. hydrarg. iodidi rubri, *Br.;* Unguent. hydrarg. nitrat., *U. S.*, *Br.;* Unguent. hydrarg. oxidi flavi, *U. S.;* Unguent. hydrarg. oxidi rubri, *U. S.*, *Br.;* Unguent. hydrarg. subchloridi, *Br.*

Physiological Action.—In the following account we shall consider the action and uses of metallic mercury, and the effects which are common to it and a certain number of the compounds of the metal, referring the reader to those compounds for a description of their special operations.

On Animals.—It has always been well known that mercury in every form is destructive of life in plants, insects, and small animals, and that its vapors prevent the development of the embryo in seeds and eggs. In the neighborhood of furnaces for smelting mercurial ores, animals become cachectic; cows abort, and fish in contaminated streams lose their natural color. It has also long been known that mercury rubbed into the skin of an animal may destroy its life after having deranged all the functions, and may be extracted from the blood and tissues after its death, and from its secretions during life. Injected into the veins, it accumulates in the lungs on the venous side of the pulmonary circulation, and occasions there the formation of small abscesses; a similar effect in remote portions of the body is produced by the injection of metallic mercury into the arteries.

On Man.—Metallic mercury has frequently been swallowed in quantities varying from several ounces to two pounds, generally for the purpose of overcoming an intestinal obstruction. Occasionally, but very rarely, it has salivated, and sometimes, also, by its bulk and weight, it has ruptured a diseased bowel. It has been found repeatedly in the metallic form in the tissues of persons who had taken mercury, or breathed an atmosphere impregnated with its fumes; and it has also been demonstrated in the secretions of the skin, the kidneys, and the mucous membranes, in the blood, milk, saliva, bile, and pus. The permanence of mercury in the system of those who have used the metal, is shown by its having frequently been revived on the administration of iodide of potassium. Its absorption is illustrated on a large scale by the cachexia of the miners of, and workers in, mercury, and of the salivation and other specific effects produced on numbers of persons in an atmosphere accidentally contaminated by the emanations even of metallic mercury, and especially upon the inhabitants of districts near smelting furnaces, among whom the proportion of abortions, stillbirths, and cachectic children, is vastly in excess of that existing under other circumstances. All persons employed in trades which expose them to mercurial emanations, such as miners of mercury, gilders, mirror-makers, etc., are apt to be affected with a trembling palsy, and other and fatal disorders of the nervous system.

The action of medicinal doses of the milder preparations of mercury (as blue-mass and calomel) is first seen in an increase of the secretions, especially of the intestinal canal; but if the action be maintained, nutrition becomes impaired, as is shown by the tendency of newly formed callus and cicatricial matter to be absorbed, while the muscles waste, the skin grows pale, and œdema readily forms where the venous circulation is interrupted. These symptoms appear to denote an impaired crasis of the blood, which, indeed, is further exhibited by a tendency to ecchymoses and to hemorrhage. It would seem, that, provided the dose of mercury be small, although large enough to cure syphilitic disease, its primary effect is not to diminish, but actually to increase the proportion of the red corpuscles of the blood, no doubt by counteracting the morbid poison in that liquid. The power of mercury to lessen the coagulability of the blood makes its use injudicious when there is already a hemorrhagic tendency, and especially in females who suffer from repeated and profuse menorrhagia.

Along with the evidences of impaired nutrition just pointed out, another occurs which is peculiarly characteristic of the action of mercury. This is salivation. It is apt to be preceded and accompanied by feverishness and nervous susceptibility. The first local evidence of its occurrence is usually a metallic taste in the mouth, with soreness of the teeth when the jaws are struck together. The breath has a characteristic fetor. A red line may be observed along the gingival attachments of the lower incisors, and then of the remaining teeth. The gums, lips, cheeks, tongue, and fauces are more or less tumefied, and the tongue has a sodden look, with an impress of the teeth upon its edges. The salivary glands are swollen and tender, and there flows from the mouth a transparent, viscid liquid, of alkaline reaction, and a penetrating smell. When salivation is excessive and prolonged, ulcers are apt to attack the gums, cheeks, and fauces, and in healing may cause the adhesion of contiguous parts; the breath becomes insufferably fetid, the teeth loosen, and may fall out, and caries may attack the remaining teeth, and even the maxillary bones. Children and infants are seldom salivated, but when they are so the effects are apt to be very severe. Salivation is partly a reflex effect of the ulcerative processes in the mouth, and partly the sign of a direct action upon the salivary glands which they share with all the glands of the body.

Under the constitutional operation of mercury the appetite fails, and the bowels readily grow loose; it is probable that the pancreatic secretion is augmented, and very improbable that the secretion of bile is increased. The belief which was general and implicit that mercury had some mysterious control over the liver, through which it increased or diminished the secretion of that organ at the physician's will, has given place to a very general scepticism in regard to the matter; and, indeed, it is asserted that, compared with croton oil, podophyllin, rhubarb, senna, colchicum, scammony, and taraxacum, mercury manifests the least degree of cholagogue operation. Upon the nervous system the action of mercury is depressing, occasioning a morbid susceptibility to cold, and a state of mental uncertainty and restlessness, with feebleness of the intellectual powers. It also appears to be injurious to the fœtus in utero, and to favor miscarriage. Among its constitutional effects are cutaneous eruptions, generally in the form of eczema, sometimes in that of a febrile rubeoloid eruption, and more rarely as an eruption of bloody bullæ. Deep, foul, and intractable ulcers sometimes occur; they are most common within the cavity of the mouth and throat, and may prove fatal by hemorrhage or by exhaustion, the ulcerative process sometimes destroying the cheeks and the soft parts of the throat. It appears probable that mercury may give rise to periosteal nodes which sometimes advance to the destruction of the bones. Finally, when administered too freely, and for too long a period, mercury may produce a general cachexia, of which the chief phenomena are these: the muscles lose their firmness, and waste; the complexion grows pallid and earthy, the breath fetid, and the urine readily becomes so, and usually there is diarrhœa. The gums grow spongy, the hair falls out, the bones and joints suffer dull pains, œdema of the ankles or general dropsy may supervene; hemorrhage from the nose, bowels, kidneys, or reopened wounds takes place, and hectic fever, with tubercular consumption, may terminate life.

To remedy, as far as possible, these mischiefs, during a treatment by mercurials, their use should be suspended in season, and attempts made by means of iodide of potassium, purgative mineral waters, and diaphoretics, to hasten the elimination of the poison. The regimen should consist of nutritious food, protection from cold and dampness, and the cautious administration of iron. The local ulcerative lesions should be treated with washes of muriatic acid, chlorate of potassium, and nitrate of silver.

The mode of action of mercury which may be inferred from the preceding summary of its effects is the following: Being essentially non-nutritive, yet penetrating every tissue, it probably acts in small and transient doses as a stimulant of all organic processes; but in a little greater proportion and by continued use it impairs nutrition, hindering the formation of tissue on the one hand, and, on the other, hastening its destruction and elimination. At the same time it augments more or less the glandular secretions. It diminishes the proportion of fibrin and of the red corpuscles in the blood. Thus, hindering nutrition in all its steps, mercury causes the waste of all the tissues, and especially of those least organized, as cicatrices and callus, and favors the removal of all plastic exudations. These effects are essentially morbid and destructive, and are only incidentally, and within varying limits, salutary.

Medical Uses.—It is probable that as much injury has been inflicted by the use of mercury in primary *syphilis* as good has been accomplished by its administration in the constitutional forms of the disease. And when it is considered that every simple sore following a suspected coition was apt to be treated as syphilitic, by mercurialization of the system, it may be a question whether, on the whole, the medicine has not been more mischievous than useful. In regard, even, to true chancres, although mercurials will sometimes hasten their cure by lessening their induration, and may thereby postpone constitutional infection, it does not in any case prevent that result, nor even the enlargement of the inguinal glands. Moreover, in certain states of the primary sore, and of the patient's system, mercury aggravates the disease. Such is the case when the skin around the sore is very red, swollen, tense, and painful, or shows a tendency to gangrene; when the patient is anæmic, scrofulous, tuberculous, or scorbutic, or has been an habitual drunkard. Opinions differ in regard to treating pregnant syphilitic women with mercury; the better opinion is in favor of this measure for the sake of the child as well as the mother. But this judgment refers to secondary, not to primary syphilis.

Until comparatively recent times the treatment of constitutional syphilis consisted in the administration of mercury for the purpose of exciting profuse salivation, which was maintained for four or five weeks at a time. The disastrous consequences of this method, which had no other reason for its use than the hypothesis that the syphilitic poison was to be eliminated with the saliva, and which thus illustrated the folly and dangers of *a priori* therapeutics, caused it at last to be abandoned, and it is now certain that mercury cures syphilis without salivation better than by means of it. The commencing dose of mercury should always be small, and gradually increased until its effects on the disease begin to appear or some soreness of the gums occurs; it should then be continued, or slightly diminished, or even temporarily suspended if the symptoms begin to decline; but it should never be abandoned as long as any trace of the disease remains. This often involves a course of six months' duration, and sometimes a much longer one; but it is safe, while the method of treatment with large doses of mercury is always hazardous.

The treatment by inunction with mercurial ointment may be referred to here. It is one of the oldest modes of employing mercury in this disease, and is still a favorite hospital method; but it is too filthy for private practice, and it necessarily betrays the nature of the patient's disease. It, moreover, ruins all the body and bed clothing which is used. The advantages attributed to it are that it is much less likely to disorder the bowels than mercury taken by the mouth; it cures, also, more quickly and with less risk of injuring the constitution. It is chiefly appropriate to the treatment of syphilitic affections of the skin; and next to these, but far less efficiently, to ulcerated states of the mouth and throat, and still less to syphilitic disorders of the nervous system. Syphilis of the bones and their annexes is more successfully treated with iodide of potassium. Before commencing mercurial inunction, the patient should live for some days on simple food, use laxative medicine, and cleanse the skin thoroughly by warm bathing. Immediately afterwards, in bed, or near a warm fire in winter, the ointment should be methodically rubbed into the skin with the hand covered with a caoutchouc glove or a piece of softened pig's bladder. The places selected for friction should be used alternately or in succession, as the thighs, the armpits, the legs, the arms, etc., and if the part is hairy, it should be shaven, and the frictions made in the direction of the hairs. About two drachms should be rubbed in daily for five or six days, at the end of which time the patient should have a warm bath with soap, and be allowed to quit his bed, but warmly clothed. After an interval of a week the same discipline should be renewed, and this generally suffices for the cure. The result is supposed to be quickened by the use of sudorific diet-drinks, such as the compound decoction of sarsaparilla. Mercurial inunction of syphilitic infants is conveniently performed by enveloping the trunk of the patient with a flannel band that has been smeared with mercurial ointment. The use of other mercurial preparations in syphilis is treated of in connection with those preparations.

In the greater number of *febrile* and *inflammatory* affections calomel is the form of mercury usually selected by those who believe mercurials appropriate to these diseases, but sometimes its action is supplemented by the use of mercurial ointment, as in acute *meningitis*, *pericarditis*, *hepatitis*, etc. In these cases it is generally applied upon a blistered surface. In *acute dyspepsia*, often accompanied with jaundice, and produced by excesses in eating and drinking and a constipated habit, a superstitious belief prevails among English physicians and their American copyists, that the sovereign and specific remedy is blue pill followed by a saline cathartic. Other nations, it is true, relieve such symptoms by the saline alone, or by rhubarb and aloes along with it. Whenever congestion of the liver is associated with enlargement of the spleen, the administration of blue pill or other mercurial is extremely apt to be followed by profuse salivation, and even gangrene of the mouth. An apparent exception to this rule is the cure of malarial enlargement of the *spleen* by the external use of biniodide of mercury. Metallic mercury has been used to overcome *intestinal obstructions* supposed to be formed by invagination; and also to expel intestinal worms. In neither case is its utility proven. Mercurial ointment is probably the best remedy for *ascarides of the rectum.* It is generally used as an application around the eye in the treatment of acute *iritis*, along with the internal use of calomel. It is a valuable auxiliary also in the treatment of true *croup* (pseudomembranous laryngitis), when it should, from the commencement of the attack, but only in primary and sthenic cases, be rubbed into the axillæ and the groins. It relieves the pain and is said to subdue the inflammation in *paronychia;* it has an analogous effect in *erysipelas;* and there is reason to believe that it checks the development of *smallpox* pustules, and thereby tends to prevent their pitting. Metallic mercury has been successfully used to amalgamate with a *gold ring* which had become too tight for the finger, and to render it so brittle that it readily broke under pressure. The ring in such cases should first be cleansed with alcohol or ether.

Metallic mercury is seldom given internally, except in the modified form of blue pill (see Pil. hydrargyri).

HYDRARGYRUM AMMONIATUM, *U. S.*, *Br.*—AMMONIATED MERCURY.

Hydrargyrum præcipitatum album, P. G.; *Hydrargyrum amidato-bichloratum (ammoniato-muriaticum)*, *Hydrargyri ammonio-chloridum*, *Mercurius præcipitatus albus.*—*White precipitate*, E.; *Oxychlorure ammoniacal de mercure*, *Mercure précipité blanc*, Fr.; *Weisser Quecksilberpräcipat*, *Quecksilber-Chloridamidid*, G.

Formula NH_2HgCl. Molecular weight 251.5.

Preparation.—Take of Corrosive Chloride of Mercury six troyounces; Water of Ammonia eight fluidounces; Distilled Water eight pints. Dissolve the corrosive chloride of mercury in the distilled water, with the aid of heat, and to the solution, when cold, add the water of ammonia, frequently stirring. Wash the precipitate with water until the washings become nearly tasteless, and dry it. *U. S.*

Take of Perchloride of Mercury three ounces; Solution of Ammonia four fluidounces; Distilled Water three pints. Dissolve the perchloride of mercury in the water with the aid of a moderate heat; mix the solution with the ammonia, constantly stirring; collect the precipitate on a filter, and wash it well with cold distilled water until the liquid which passes through ceases to give a precipitate when dropped into a solution of nitrate of silver acidulated by nitric acid. Lastly, dry the product at a temperature not exceeding 212° F. *Br.*

In following the above processes, one-half of the ammonium has two atoms of the univalent hydrogen replaced by one atom of the bivalent mercury, producing the radical mercur-ammonium (NH_2Hg), which is a monad like ammonium, and combines with one atom of chlorine to form the white precipitate; the other half of the ammonium unites with the other atom of chlorine contained in the mercuric chloride to ammonium chloride which remains dissolved; water is likewise produced, by the reaction, which is explained by the equation, $HgCl_2 + 2NH_4HO = NH_2HgCl + NH_4Cl + 2H_2O$. The ammonium chloride requires to be washed out, as long as the washings have a saline taste or cause a white precipitate with acidulated solution of silver nitrate. Cold water must be used for the purpose, and the washing not be continued too long, to prevent the precipitate from acquiring a yellowish tint.

Properties and Tests.—Ammoniated mercury is a white powder or is often in friable masses, having an earthy afterwards metallic taste. It is insoluble in ether, alcohol, and water, but yields with boiling water a lemon-yellow basic compound, ammonium chloride being dissolved. When heated, it volatilizes without fusion and without leaving any residue (absence of non-volatile compounds). Potassa solution or lime-water evolves ammonia and colors the powder yellow; it is soluble in hot solutions of ammonium salts and in hydrochloric, as well as in nitric and acetic acids, without effervescence (absence of carbonates). The solutions yield white precipitates with potassa (ammoniated mercury) and silver nitrate (silver chloride). The solution in acetic acid yields no precipitate with sulphuric acid (absence of lead), and when treated with an excess of hydrogen sulphide, a black precipitate is obtained, and a colorless filtrate, which on being acidulated with muriatic acid, evaporated to dryness, and ignited, is not charred (absence of starch), and leaves no fixed residue (absence of zinc, calcium, etc., salts).

Fusible white precipitate, which was formerly considered to be identical with the preceding, until Wöhler and Kane proved its difference, was prepared by dissolving ammonium and mercuric chlorides in water and precipitating with sodium carbonate. Thus obtained it has the composition $(NH_3)_2HgCl_2$ or perhaps $NH_4Cl.NH_2HgCl$, and differs from the officinal ammoniated mercury in fusing, when heated, to a yellowish liquid, evolving nitrogen and ammonia, and yielding a transparent and an opaque white sublimate.

Off. Prep.—Unguentum hydrargyri ammoniati, *U. S.*, *Br.*

Medical Action and Uses.—The insolubility of ammoniated mercury in water and even in the normal acid contents of the stomach renders it a less active irritant than some other mercurial salts. Sometimes its irritant operation seems to be attributable to defects in its manufacture, or to its exposure to light, whereby a portion of it is converted into corrosive sublimate. Certainly in several cases it has occasioned all the symptoms of an irritant poison, with the specific effects of mercury, and a fatal result at last. It is not used internally as a medicine, but its ointment, which is officinal, is employed in *ophthalmia* and *skin diseases*.

HYDRARGYRUM CUM CRETA, *U. S.*, *Br.*—MERCURY WITH CHALK.

Mercure avec la craie, *Poudre de mercure crayeux*, Fr.; *Quecksilber mit Kreide*, G.

Preparation.—Take of Mercury three troyounces; Prepared Chalk five troyounces. Rub them together until the globules cease to be visible, and the mixture acquires a uniform gray color. *U. S.*

Take of Mercury by weight one ounce; Prepared Chalk two ounces. Rub the mercury and chalk in a porcelain mortar until metallic globules cease to be visible to the naked eye, and the mixture acquires a uniform gray color. *Br.*

When certain substances are triturated with metallic mercury, they acquire a gray tint, and the metallic lustre of the mercury gradually disappears in consequence of its fine division (see page 722). To effect this with chalk alone is a tedious operation, to shorten which Dr. Stewart (1843) proposed to triturate, first with resin, then with chalk, and finally to remove the resin by alcohol; Dr. Mettauer suggested the use of a mixture of starch and chalk, kept damp by a little water during the trituration; and W. Hewson (1850) proposed to shake the metal with a portion of the chalk in a bottle until extinguished, and then to add the remaining powder. This process is followed on a large scale, a barrel or other suitable vessel containing the mixture being turned on its axis; or it is combined with trituration, a ball being also introduced into a vessel having a somewhat eccentric motion. Dr. Squibb (1857) constructed an apparatus in which the mercury is shaken with honey or syrup, and, when completely extinguished, mixed with the chalk, most of the sugar being afterwards washed out with cold water; this process yields a very pure product, but the globules are larger than in the products of the other processes, and the powder cannot be triturated with pressure without separating some metallic globules. W. E. Bibby (1876) has suggested a method which enables the pharmacist to prepare this medicament without the expenditure of much time by substituting sugar of milk for about one-fifth of the chalk, which greatly facilitates the fine division of the metal.

Properties and Tests.—Mercury with chalk is a gray powder free from grittiness, from which the mercury is volatilized by heat. When treated with an excess of diluted acetic acid, the chalk dissolves with effervescence, metallic mercury being left behind; the solution thus obtained usually yields a faint turbidity on the addition of hydrochloric acid, calomel being formed with the *mercurous oxide* dissolved by the acid. The presence of this oxide is disregarded by the British Pharmacopœia, which requires the preparation to be partly dissolved by dilute hydrochloric acid; any mercurous oxide present would be converted into calomel, and remain with the finely divided undissolved mercury. Both Pharmacopœias require the preparation to be free from *mercuric oxide*, which would be detected in the clear solution containing hydrochloric acid by a white or gray precipitate with stannous chloride, or by a black one with hydrogen sulphide. Dr. Squibb (1857) determined in a sample the presence of 1.2 per cent. of mercurous and 1.44 per cent. of mercuric oxide; Jos. P. Remington (1869) found even 14.3 and 25.7 per cent. of the latter in two samples taken from dispensing bottles. These results fully explain the violent action which has been occasionally observed. The preparation should be examined from time to time to insure its good qualities.

Medical Action and Uses.—This preparation seems to be only metallic mercury maintained in a state of minute subdivision by chalk. The proportion of the latter ingredient is too small to be regarded as of any direct therapeutic value, for in eight grains of the compound there are three of mercury and five of chalk; and in the dose of two or three grains, in which it is generally administered, any immediate action, except that which belongs to an unirritating insoluble powder, can scarcely be admitted. Mercury with chalk is chiefly used in the *bowel complaints* of children, especially when the discharges are colorless and sour, and is very generally believed to cause a secretion of bile, and thus restore the normal action of the alimentary canal. Of this action, as elsewhere stated (Hydrargyrum), no proof exists. The chief good it does is very probably to take the place of larger doses of more perturbative medicines. *Dose*, from three to ten grains.

HYDRASTIS, *U. S.*—HYDRASTIS.

Rhizoma hydrastis.—Golden seal, Yellow root, Yellow puccoon, Orange root, Indian dye, Indian turmeric, E.; *Racine d'hydrastis de Canada*, Fr.; *Canadische Gilbwurzel*, G.

The rhizome with the rootlets of Hydrastis Canadensis, *Lin.*, s. Warnera Canadensis, *Miller*. Bentley and Trimen, Med. Plants, 1.

Nat. Ord.—Ranunculaceæ, Helleboreæ.

Origin.—This perennial is indigenous to Canada and the United States east of the Mississippi; it grows in rich woodlands, and in the Southern States is confined to the mountainous districts. It has a low stem, and at the summit two round heart-shaped leaves and a single greenish-white flower, and produces a crimson fruit composed of 12 or more one- or two-seeded berries.

Description.—The rhizome is 1 to 2 inches long, about $\frac{1}{4}$ inch thick, oblique, with several short branches, terminated by a broad concave scar, somewhat flattened, annulate from the leaf-scars, longitudinally wrinkled, and below beset with many thin fragile rootlets 3 to 5 inches long, containing a thin triangular or quadrangular ligneous cord and a thick bright yellow bark. The rhizome is externally brownish-gray with a yellow hue, hard, and breaks with a short waxy fracture of a bright reddish- or brownish-yellow color; the bark is about $\frac{1}{8}$ the thickness of the rhizome; the central pith and medullary rays are broad, and the yellowish wood consists of 8 to 12 narrow wedges, or, near the base of the branches, of a few linear and several larger irregular bundles. Golden seal has a slight odor, and a bitter taste free from any marked astringency.

Constituents.—Besides the common constituents, like starch, sugar, etc., A. B. Durand (1851) found in it a yellow coloring matter and a white alkaloid *hydrastia.* The former was recognized by Mahla (1862) as *berberina*, the hydrochlorate of which has been used by eclectic practitioners under the incorrect name of *hydrastin.* Perrins (1862) obtained 4 per cent. of the crude hydrochlorate (see Berberis, p. 282) and 1.5 per cent. of hydrastia, which was analyzed by Mahla (1863). *Hydrastia*, $C_{22}NH_{23}O_6$, is contained in the mother liquor from the preparation of berberina, and obtained by diluting the liquid with water, evaporating the alcohol, neutralizing carefully with ammonia, filtering from the precipitated resin, etc., and precipitating with ammonia; the fawn-colored deposit is purified by animal charcoal and recrystallization from hot alcohol. It is in white shining quadrangular prisms, which fuse at 135° C. (275° F.), are readily soluble in alcohol, ether, chloroform, and benzol, insoluble in water, colored red by nitric acid, brown-red by sulphuric acid and potassium chromate, and yield with acids soluble and very bitter salts. From the investigations of A. K. Hale (1873) and J. C. Burt (1875) it appears that the hydrastia of former investigators was not quite pure, but probably mixed with a *third alkaloid*, which Hale obtained of a dark yellow color, and Burt crystallized as sulphate in colorless needles; warmed with nitric acid it turns red, with sulphuric acid reddish-brown, and the solution of its hydrochlorate is colored dark brown to black by ferric chloride; it is present in smaller quantity than hydrastia.

Off. Prep.—Extractum hydrastis fluidum, *U. S.*

Medical Action and Uses.—The bitter taste of this root probably led to its employment as a stomachic tonic, and in mild cases of intermittent fever. A variety of incongruous virtues have been attributed to it by the ignorant. It does not deserve to rank among officinal medicines. A decoction is made by boiling an ounce of the bruised rhizome in a pint of water for fifteen minutes. Of this one or two fluidounces may be taken several times a day.

HYDROCOTYLE.—WATER PENNYWORT.

Indian pennywort, E.; *Bevilacqua*, Fr.; *Wassernabel*, G.

Hydrocotyle asiatica, *Lin.* Bentley and Trimen, Med. Plants, 117.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Description.—A low, creeping perennial, which is indigenous to the tropical and subtropical regions of Asia, Africa, and America. The leaves are smooth, situated in tufts on the nodes of the stem, have petioles with a sheathing base, are roundish-reniform in outline, with a somewhat crenate margin, about an inch broad, rather thick, radiately veined, and dark green. The pink-colored flowers are in small umbellate clusters of about three, and produce small, laterally flattened, suborbicular fruits without oil tubes. The plant is inodorous, but on bruising the fresh leaves a peculiar odor is developed; the taste is bitterish and pungent.

Constituents.—Lépine (1855) isolated *vellarin*, which he regarded as the active principle. It is an oily liquid, having a bitter taste, a strong, peculiar odor, becoming viscous on exposure, insoluble in potassa solution, and soluble in ammonia, diluted alcohol, and ether. He obtained from the dried leaves 13 per cent. of ash.

Allied Plants.—Most other species of this genus appear to possess somewhat similar sensible properties. The North American species H. ranunculoides, *Lin.*, and H. americana, *Lin.*, have likewise reniform leaves, those of the former being 3- to 7-cleft; those of the latter, thin, crenate-lobed, the lobes of both being crenate.

Peltate leaves, with doubly crenate margins, are met with in the European H. vulgaris, *Lin.*, which has 5-flowered umbellate clusters, and in the American H. umbellata, *Lin.*, which has the umbellate clusters about 20-flowered.

Medical Uses.—About 1852 this medicine, which had long been employed in India in the treatment of febrile diseases and as a diuretic, was announced by a French physician in the Mauritius to have cured a case of *leprosy*. Other reports of a favorable character proceeded from different quarters, some of them containing specific details of the cure of this fatal affection in numerous instances; and then it fell into complete disfavor, as other medicines of like pretensions had done. Meanwhile it was found an efficient remedy in *scaly diseases* of the skin, including those of syphilitic origin, in chronic *eczema*, in scrofulous and other *ulcers*, and chronic *rheumatism*. The powdered root has been prescribed in doses of three grains several times a day; and an alcoholic extract in doses of half a grain.

HYDROGENII PEROXIDUM.—PEROXIDE OF HYDROGEN.

Peroxyde d'hydrogène, Fr.; *Wasserstoffhyperoxyd*, G.
Formula H_2O_2. Molecular weight 34.

Origin.—Thénard (1818) discovered this compound, which has also been called *oxygenated water* and *oxygen hydrate*, by acting with dilute acids upon peroxide of barium. Meissner (1863) proved its presence in the rain-water collected during thunder storms, and this observation has since been corroborated by Schönbein (1869), Struve, and others. Houzeau (1868) did not succeed in finding it.

Preparation.—The preparation of peroxide of hydrogen in the pure state is a difficult process, and depends upon the decomposition of barium peroxide by hydrochloric acid in the presence of ice-cold water, and the precipitation of the newly-formed barium chloride by means of sulphate of silver. Instead of hydrochloric, carbonic or hydrofluoric acid may be employed; or peroxide of potassium may be acted upon by hydrofluosilicic acid. The *barium peroxide* is obtained by conducting oxygen gas over pure baryta heated to redness.

Properties.—The aqueous solution of peroxide of hydrogen may be concentrated by the aid of the air-pump, until its spec. grav. is 1.452. It then forms a colorless, transparent liquid, which does not congeal at —30° C. (—22° F.), and volatilizes in vacuo, slowly and without decomposition, at the ordinary temperature. But when heated or brought into contact with charcoal, silver, gold, the platinum metals, the oxides of manganese, or various other compounds, the peroxide is decomposed with explosive violence, and in the presence of the oxides of the metals mentioned these are reduced to the metallic state. Some other bodies act less energetically, or are oxidized. Litmus and turmeric paper are gradually bleached. Peroxide of hydrogen is without odor, and has a harsh and bitter taste; applied to the skin, it colors it white, and produces violent itching.

Composition.—Peroxide of hydrogen is the *binoxide* or *dioxide of hydrogen* H_2O_2, and has also been viewed as a hydrate of oxygen, $O.H_2O$. The oxygen, which is given off under the conditions mentioned above, has been regarded by Schönbein and others as a peculiar modification, which has been called *positive oxygen* or *antozone*, to distinguish it from *ozone*, or oxygen in the negative condition. The correctness of these distinctions, however, is denied by many investigators.

Ethereal solution of hydrogen peroxide has been prepared by Böttger, by adding impure sodium peroxide (obtained by the burning of sodium) to a cold mixture of 1 part of sulphuric acid and 24 parts of water, with the precaution of avoiding an elevation of temperature; the mixture is then repeatedly agitated with ether. Such a solution was used by Dr. Richardson (1869) under the name of *ozonized ether*. He found that the addition of a little alcohol to the ether facilitates the absorption of the peroxide, and that the combination of the latter with the ether and some water, although very slight, is persistent, for the mixture was sent to Australia without deterioration.

Medical Action and Uses.—Upon theoretical grounds this compound was introduced as a cure for *diabetes*, but it signally failed after a sufficient trial by competent judges. It is unnecessary to enumerate the other diseases in which it proved to be equally valueless as an internal remedy. Externally it has been applied to *ulcers* of various kinds. It seems to promote their healing both by stimulating them and coagulating their secretions; and in the case of syphilitic sores it is thought to disinfect their virus. It has been used in an ointment (one part to seven of lard) to anoint the skin of *scarlet fever* patients, with the alleged result of diminishing the mortality, and preventing the spread of the disease. There is no sufficient ground for this opinion.

HYOSCYAMI FOLIA, *U. S.*, *Br.*—HYOSCYAMUS LEAVES.

Herba hyoscyami.—*Henbane leaves*, E.; *Feuilles de jusquiame noir*, Fr.; *Bilsenkraut*, G.

The leaves of Hyoscyamus niger, *Lin.* Steph. and Church, Med. Bot., plate 9.

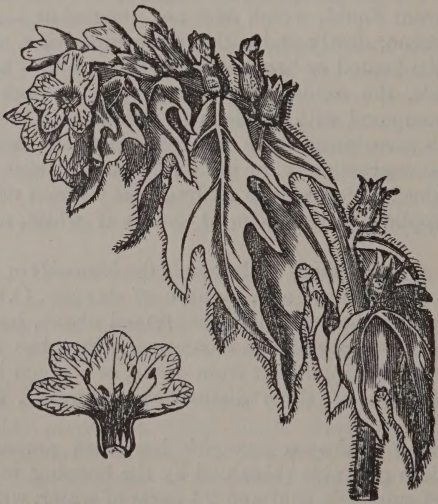
HYOSCYAMI SEMEN, *U. S.*—HYOSCYAMUS SEED.

Semen hyoscyami, P. G.—*Henbane seed*, E.; *Semences de jusquiame noir*, Fr.; *Bilsensamen*, G.

The seeds of Hyoscyamus niger, *Lin.* *Nat. Ord.*—Solanaceæ.

Origin.—The typical form of henbane is biennial, grows in sandy soil and waste places throughout the greater portion of Europe, and eastward and southward to Siberia, Northern India, and Egypt, and has been naturalized in North America from the New England States to Michigan. It is 2 to 3 feet high, covered

Fig. 87.



Hyoscyamus niger, *Lin.*

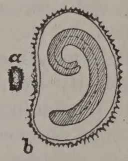
with long, jointed, glandular hairs, and has the numerous nearly sessile flowers in a long, leafy, one-sided spike-like raceme. The funnel-shaped five-lobed corolla is about 1¼ inch long and wide, pale yellow, with purple veins, and a similar colored base. The capsule (pyxis) is inclosed in the bell-shaped calyx, about ½ inch long, dehiscent near the top by a cap, two-celled, and contains numerous seeds. An annual variety, H. agrestis, *Kitaibel*, is not over a foot high, less villous, and has smaller leaves and fewer flowers; if the latter are veinless, the plant is H. pallidus, *Willd.*

H. albus, *Lin.*, and H. aureus, *Lin.*, of Southern Europe, are occasionally employed there, but are less active. H. physaloides, *Lin.*, is used in Siberia.

Description. 1. THE LEAVES.—Taken from different parts of the stem, they vary from 2 to 10 inches in length, and 1 to 4 inches in width, the lower leaves being stalked, the upper sessile and amplexicaul. They are ovate to ovate-oblong in shape, on each side with one (upper leaves) to five coarse sinuate teeth or lobes, which are rather acute and oblong or triangular. In the dry state they are of a grayish-green color, hairy above, more densely so on the lower surface and upon the prominent broad midrib. Some of the characteristic flowers or capsules or both may usually be found with the drug, the heavy narcotic odor of which is diminished by drying, but becomes more prominent again when the leaves are moist. The taste is bitter and somewhat acrid. Being very hygroscopic, the leaves should be kept in a dry place.

2. THE SEEDS.—They are about ½ line long, roundish reniform, flattened, with a gray-brown, finely and densely rough-pitted testa, containing a whitish oily albumen, which incloses a curved embryo of the shape of the figure 9. The hilum is in the curved side of the seed. The seeds are without odor, and have an oily, bitter, and acrid taste.

Fig. 88.



Hyoscyamus Seed.—*a*, slightly magnified; *b*, longitudinal section.

Belladonna seeds are of about the same size and shape, but are of a red-brown color.

Constituents.—Brandes (1820) obtained from the seeds 25 per cent. of a bland, limpid, and colorless oil, of which about 20 parts were readily soluble in absolute alcohol. Their most important constituent, however, like that of the leaves, is the alkaloid *hyoscyamia*, which was observed by Brandes, and again obtained by Geiger and Hesse (1833), and by Kemper (1866), in a purer condition from both the leaves and seeds. More complete investigations were made by Höhn (1870 and 1871), who deprived the seeds of the oil by ether, and then exhausted them by alcohol slightly acidulated with sulphuric acid. The tincture was distilled and evaporated, filtered, almost neutralized with soda, and precipitated by tannin; the precipitate, still moist, was mixed with lime, exhausted with alcohol, the solution again acidulated, concentrated, shaken with ether, to remove oil and color, decomposed by soda, and the alkaloid exhausted by ether. The filtrate from the tannin precipitate and the fixed oil retained some of the alkaloid, of which altogether 0.0453 per cent. was obtained. Thibault (1875) received it in silky crystals on the spontaneous evaporation of the chloroformic solution.

Hyoscyamia, $C_{15}H_{23}NO_3$, is soft like wax, containing wart-like crystals, fusible at 90° C. (194° F.), and then emitting a peculiar odor, suggesting that of salicyl compounds, readily soluble in the ordinary solvents, of a strongly alkaline reaction, and yielding with acids crystallizable salts. Boiled with baryta solution it is decomposed into *hyoscinic acid*, $C_9H_{10}O_3$, which crystallizes in needles, and has an odor somewhat like that of benzoic acid, and into *hyoscina*, $C_6H_{13}N$, which is a volatile alkaloid of a slight narcotic odor.

Höhn (1870) obtained also a bitter glucoside, *hyoscypicrin*, $C_{27}H_{52}O_{14}$, which has a bitter taste, is neutral, soluble in alcohol and water, and precipitated by tannin; on distilling the mother liquors with soda, some volatile bases were obtained, among them, probably, methylammonia.

Thorey (1869) states that the leaves contain the largest proportion of hyoscyamia and of potassium nitrate before flowering.

Off. Prep.—1. Of the leaves. Extract. hyoscyami, *U. S.*, *Br.*; Extract. hyoscyami alcoholicum, Extr. hyoscyami fluid., *U. S.*; Tinctura hyoscyami, *U. S.*, *Br.*

2. Of the seeds. Emulsio amygdal. comp., *P. G.* (See Mistura amygdalæ.)

Physiological Action. *On Animals.*—It is implied in the etymology of hyoscyamus that the plant may be eaten without harm by hogs; it is also said not to injure sheep or cows, nor to have much effect upon rabbits, while barnyard fowls and fish are poisoned by it. Upon dogs, hyoscyamus and its alkaloid act as they do upon man. In these animals, in cats, and various others, they produce dilatation of the pupil, and, in full doses, dryness of the mouth, and a dull or lethargic condition, with loss of power in the hinder legs. In moderate doses, they slow both respiration and circulation, rendering the pulse fuller and stronger; in full doses, they have the opposite effect. They increase the discharge of urine, from which the alkaloid can be recovered. These effects are so nearly like those occasioned by belladonna and atropia, that some pharmacologists regard the latter alkaloid and hyoscyamia as identical.

On Man.—The following effects are produced by henbane and by hyoscyamia: In full medicinal dose, the former occasions headache, pasty mouth, hoarse voice, dry throat, a warm skin, and a slower and then an accelerated pulse, while the pupil becomes dilated and the limbs give way under the body. The sense of touch is blunted, and the voluntary muscles are apt to be cramped or to be affected alternately with spasm and paralysis. No direct narcotic effect is produced in the greater number of cases, but rather a loquacious sub-delirium, which may merge into a restless and dreamy sleep. Only in large doses is it decidedly hypnotic. The power of henbane to produce a peculiar talkative and pugnacious delirium was fully described by ancient writers, and some modern observers have witnessed similar effects. It is curious that, in certain cases, although the general sensibility is impaired, severe neuralgic pains may be felt in the limbs. Continued medicinal doses tend to produce a reddish efflorescence upon the skin, which is dry and itching. When poisonous doses, on the other hand, have been taken, the skin is sometimes cool and clammy, the face pale, and the lips bluish. Notwithstanding the threatening character of the symptoms, death from this substance is extremely rare. In proportion to the dose they are less alarming in children than in adults, and especially in old persons. This peculiarity is doubtless due to the rapid elimination of the poison in the young. From an experimental point of view, it must be concluded that hyoscyamus is not a narcotic soporific, that it is anodyne or anæsthetic, that it excites the cerebral and depresses the spinal functions, and that it is a mydriatic.

Medical Uses.—At one time, hyoscyamus was believed to be a valuable remedy for *epilepsy*, but experience has shown that in the doses formerly given it is quite inert, and that even in really operative doses, its utility is limited to cases of emotional origin. Dr. Lawson, in England, has found hyoscyamia very useful in controlling violent outbreaks of *mania*, especially of the recurrent acute and subacute forms, the monomania of suspicion, and the excitement of senile dementia. It appears to be essential to the success of this treatment that the medicine should be given in a dose of not less than one grain, as in the following draught: ℞. Hyoscyamiæ, gr. j; Spt. ætheris (Br. Ph.) ♏viij; Alcoholis, ♏xxiv; Aq. fontis, ad f℥j.—M. If a smaller dose is given, it is said, cerebral excitement, without complete motor paralysis, is produced, and remains through the whole period of the operation of the medicine. In some forms of *hypochondriasis*, it seems to have been useful as a means of calming agitation. In functional *palpitation* of the heart of a purely nervous nature, it has been found beneficial, when used hypodermically, in the dose of about one-fiftieth of a grain. The same means relieve cardiac and pulmonary *asthma*. Hyoscyamia has been used in trembling *palsy* and mercurial *trembling chorea*, *locomotor ataxia*, and *tetanus*. In the first, it exerts a marked power in moderating the tremulousness, and in the second, it is alleged to have effected cures; it seems, indeed, to have cured a number of cases of chorea, of which several occurred in adults; in locomotor ataxia it palliates the spasms and the neuralgic pains, and in tetanus moderates the severity of the paroxysms. In these affections, and notably in chorea, its therapeutical action appears to be explained by its paralyzing influence upon the spinal cord, which seems to be of the same nature as that produced by conium. The *vomiting* of pregnancy, a symptom of reflex origin, has been controlled by it. It was prescribed in a solution containing five milligrammes of the alkaloid in 125 grammes of liquid, of which a teaspoonful was given every hour.

There is no doubt that hyoscyamus is anodyne, and apparently by its operation upon the sensitive nerves and ganglia, and not upon the cerebral organs of perception. The crushed leaves of fresh henbane are popularly applied, where the plant abounds, for the relief of local pains, and internally its preparations are of common use to allay *neuralgic* and other pains that hinder sleep. It is also used to lessen the tendency to gripe of certain cathartics given in a pilular form, for it has the advantage of tending to relax rather than confine the bowels. Like the other mydriatics, henbane is used to dilate the *pupils*. Poisoning by henbane should be treated by evacuating the stomach, applying warmth to the extremities and cold to the head, and administering stimulants, particularly coffee, and morphia hypodermically in small and repeated doses.

The *dose* of powdered henbane is stated at from five to ten grains; but this form of the medicine is rarely used. Hyoscyamia may be given in the dose of one milligramme, or $\frac{1}{65}$ gr., repeated at intervals of several hours; or, if not for a temporary purpose, this dose should be prescribed twice a day, and gradually increased until its characteristic effects are observed in the pupils and the throat. But, in cases of great functional excitement or disorder, a full grain may be given by the mouth.

HYPERICUM.—St. John's Wort.

Millepertuis, *Casse-diable*, Fr.: *Johanniskraut*, *Hartheu*, G.

Hypericum perforatum, *Lin.* *Nat. Ord.*—Hypericaceæ.

Description.—This plant grows in fields and on roadsides, throughout Europe, Northern Africa, and a considerable portion of Asia, and has been extensively naturalized in North America and in other countries. It has a perennial woody and branching dark-brown root, and a somewhat two-edged stem about 2 feet high. The leaves are opposite, sessile, oblong or linear-oblong, nearly an inch long, obtuse, entire on the margin, and pellucid-punctate. The flowers are in open terminal cymes, deep yellow, nearly an inch broad, and are furnished with numerous stamens clustered in three groups, and with a three-celled ovary. The petals, anthers, leaves, and stem are more or less marked with black dots. When bruised, the herb has a slight balsamic odor; its taste is somewhat resinous, bitter, and slightly astringent.

Constituents.—Buchner (1830) found in the flowers a little tannin, producing a dark-green color with ferric salts, some pectin, and 8 per cent. of a red coloring principle, *hypericum red*, which is soluble in alcohol, ether, volatile oils, and warm olive oil, and dissolves with a green color in ammonia and other alkalies; calcium and lead salts produce yellow precipitates, ferric chloride a yellowish-green one. According to Clamor-Marquart, this coloring matter is a mixture of a red and a yellow principle.

Pharmaceutical Uses.—The fresh flowering tops, digested with olive oil sufficient to cover them, yield a yellowish-red liquid, *oleum hyperici*, which is popularly knows as *red oil*. Linseed oil is sometimes used in place of olive oil.

Allied Plants.—Several other European species of hypericum possess similar properties, and some of our North American species may be equally effective.

HYPERICUM SAROTHRA, *Mich.* (Sarothra gentianoides, *Lin.*, s. Sar. hypericoides, *Nutt.*) has thin, almost thread-like branches, opposite awl-shaped scaly leaves, and minute sessile yellow flowers. It is common in sandy fields in the United States, where it is known as *orange-grass* or *pine-weed*, and is sometimes used like the preceding.

ASCYRUM CRUX-ANDREÆ, *Lin.*, *St. Andrew's cross*, is a decumbent North American herb, with narrow oblong-obovate leaves and solitary flowers, having the four linear-oblong yellow petals arranged in the form of a cross.

Medical Action and Uses.—The aromatic and terebinthinate odor of this plant when it is crushed in the hand, and its resinous and bitter taste, sufficiently account for the vogue which it enjoyed in certain diseases, even from ancient times. It was celebrated by Celsus, Paulus Ægineta, Galen, and Dioscorides, and its vogue only declined when modern science substituted for it medicines whose remedial effects were conceived to be more intelligible. The titles it bore indicate its popular estimation; they were such as these: "St. John's Wort," "The Lord God's Wonder Plant," "The Devil's Scourge," "The Witches' Herb," and many similar. The ancients attributed to it stimulating, drying, cleansing, and cicatrizing virtues, held it to be diuretic and emmenagogue, and a specific remedy for wounds, ulcers, and burns. In the middle ages analogous virtues were ascribed to it as well as curative powers in calculous affections, intestinal worms, and mental disorders. In more recent times it was given for the relief of chronic catarrhs of the lungs, bowels, and urinary passages, and was especially esteemed in the last. It was also used in hot infusion to bring on retarded *menses*. Externally it was applied in the fresh state, bruised, as a discutient for recent *contusions*, and for the relief of local *pains*. Its flowers, immersed in oil in a bottle and hung in the sun for a month or two, give to the oil a dark-red color (red oil), forming one of the most popular applications made to *excoriations*, *wounds*, and *bruises*, both in Europe and in this country. An infusion may be prepared with an ounce of the plant in a pint of hot water.

HYSSOPUS.—HYSSOP.

Hysope, Fr.; *Ysop*, G.

Hyssopus officinalis, *Lin.* *Nat. Ord.*—Labiatæ, Satureieæ.

Description.—Hyssop is an herbaceous perennial, indigenous to Southern Europe, frequently cultivated and sparingly naturalized in the United States. It is about a foot high, with wand-like simple quadrangular branches, and opposite, sessile, linear-lanceolate, entire, and nearly obtuse leaves, which are about an inch long, nearly smooth, and finely punctate on both sides. The purplish-blue flowers are in small clusters, have a 15-ribbed calyx, a two-lipped corolla with a rather short and notched upper lip, and four exserted and divergent stamens. Hyssop has an aromatic, somewhat camphoraceous odor, and a pungent, aromatic, and bitterish taste.

Constituents.—The principal constituent is *oil of hyssop*, of which the fresh herb yields $\frac{1}{4}$ to $\frac{1}{2}$ per cent. It is pale yellow or greenish, limpid, of about the specific gravity 0.94, and freely soluble in alcohol; it contains oxygen, and commences to boil at 142° C. (287.6° F.), the boiling point rising to 180° C.

(356° F.). It has the odor and taste of the herb. The *hyssopin* of Herberger (1829) was found by Trommsdorff to be impure sulphate of calcium.

Allied Plants.—CUNILA MARIANA, *Lin.*, *Dittany*, a North American plant, grows in dry soil, has a thin, purplish, much-branched stem, about 12 inches high, and nearly sessile, ovate, serrate, smooth leaves, which are rounded or subcordate at the base. The pale-purple flowers are in small pedunculate clusters, and have two exserted stamens.

SATUREJA HORTENSIS, *Lin.;* Summer savory, *E.;* Sarriette, *Fr.;* Saturei, Bohnenkraut, *G.*—This South European annual is cultivated as a culinary herb. The stem is about 10 inches high, much branched, roughish pubescent; the leaves are linear-lanceolate or oblong-linear, entire, acute, and tapering into a very short petiole; the cymules are about 3-flowered, with the corolla pale-purplish, and 4 diverging, rather included stamens.

PYCNANTHEMUM LINIFOLIUM, *Pursh*, *Virginia thyme*, has rigid, narrowly linear sessile crowded leaves, which are entire and three-nerved; the flowers are in terminal hemispherical clusters, supported by imbricate rigidly pointed bracts. It has been popularly regarded as useful in hydrophobia, and has been employed in atonic dyspepsia.

PYCN. LANCEOLATUM, *Pursh*, resembles the preceding, but has lanceolate or lance-linear leaves; both have a resinous and bitter taste.

PYCN. INCANUM, *Mich.*, has broader ovate-oblong, hoary, pubescent leaves, and an aromatic mint-like taste. It is known as *mountain mint*, *wild basil*, and in some places as *horse-mint*, and is used like monarda.

Ch. Mohr. (1876) isolated from Pyc. linifolium a tannin which is very similar if not identical with caffeo-tannic acid; volatile oil, resin, bitter principle, etc., were likewise obtained.

Medical Action and Uses.—Anciently hyssop seems to have been used as a cathartic, for we read in Scripture, "I will purge thee with hyssop and thou shalt be clean;" and, if this passage be thought to apply to external cleansing, Pliny says expressly that "mixed with figs it purges, and with honey vomits." He also refers to its external use in phthiriasis. Down to quite a recent period it has been used to improve digestion, particularly in atonic and flatulent *dyspepsia;* and, like other plants which are so employed, and contain an essential oil associated with a bitter and astringent principle, it is found useful in subacute and chronic *bronchitis*, especially in old persons, also in *amenorrhœa*, and externally as a stimulant application to *bruises*, and in muscular *rheumatism.* Its infusion was also used as a gargle in *sore throat* of the diphtheritic form. Hyssop may be given in an infusion made with a drachm of the herb to a pint of water. The essential oil was formerly given in doses of one or two drops.

IBERIS.—IBERIS.

Herbe d'iberis, Fr.; *Iberiskresse*, G.

Lepidium iberis, *Lin.* *Nat. Ord.*—Cruciferæ, Siliculosæ.

Description.—This plant is found from Southern Europe to Siberia; has a branching stem about two feet high; petiolate, pinnatifid or incisely serrate radical leaves about two inches long; smaller linear-lanceolate or linear entire stem-leaves, and minute white flowers in racemose cymes; the fruit is small, ovate, and acute. The plant is smooth and rather glaucous, and has a pungent taste resembling that of allied plants. (See p. 304.)

Constituents.—This plant yields a sulphuretted volatile oil. Leroux (1837) obtained from the flowering tops and seeds an amorphous, bitter principle which he named *lepidin.*

Medical Action and Uses.—This plant was known to the ancients, who employed it as a rubefacient in rheumatic and other local affections. Pliny ascribes the discovery of its virtues to a certain physician named Damocrates. Even in recent times its powdered seeds were incorporated in an ointment for purposes like those above mentioned. Internally it is said to have acted as an irritant, producing nausea and diarrhœa; and to have been useful in bronchitis and dropsy. Its value, if any, is not determined.

ICHTHYOCOLLA, *U. S.*—ISINGLASS.

Colla piscium, P. G.—*Fishglue*, E.; *Colle de poisson*, *Ichthyocolle*, Fr.; *Hausenblase*, *Fischleim*, G.

The swimming bladder of Acipenser huso, *Lin.*, and of other fishes.

Class Pisces. *Ord.* Sturiones.

Origin.—Isinglass is mentioned by the British Pharmacopœia among the articles employed in chemical testing. The kind preferred is that known in commerce as *Russian isinglass*, which is obtained from several sturgeons, species of Acipenser, which inhabit the Caspian and Black Seas and their tributary rivers, and the most important of which are *Ac. huso*, Lin., or *belugo; Ac. Güldenstädtii*, Br. and Ratz., or *osseter; Ac. ruthenus*, Lin., or *sterlet*, and *Ac. stellatus*, Pall., or *sewruga.* It is prepared by cutting the air-bag or swimming-bladder open, washing and soaking it in water, and spreading it upon boards, the outer silvery membrane being turned upward and removed by rubbing. The bladder is then merely dried in sheets, and constitutes *leaf isinglass;* or several are put together and folded before they are completely dry, forming *book isinglass:* or each bladder is rolled up and folded around a few pegs into the form of a horseshoe, heart, or lyre, in which shape it is dried. The latter is the *staple isinglass*, which, according to its dimensions, is again divided into *long* and *short staple.* The kind now most commonly met with in our commerce is the leaf isinglass.

Description.—Russian isinglass is a somewhat horny and tough membranous tissue, which is semi-transparent, of a whitish or pale-yellowish color, pearly appearance, and iridescent; it is best torn in the direction of its fibres, is inodorous, and quite insipid in taste. Immersed in water or diluted alcohol it swells, and dissolves at a somewhat elevated temperature, leaving a flocculent residue not exceeding 2 per cent.; on cooling, its solution with 24 parts of water congeals to a transparent jelly. Isinglass which is discolored or less soluble in water is not adapted for medicinal purposes.

Other Varieties of Isinglass.—The air-bags of most large fishes appear to be adapted for some of the purposes for which isinglass is used in the arts; when they are dried without being split open, they are known as *purse* or *pipe isinglass.*

American isinglass, according to C. T. Carney (1857), is prepared from the sounds of *Gadus merluccius*, Lin., or hake; they are cleansed, soaked in water, passed through rollers, and dried in the form of ribbons or thin and transparent sheets. C. C. Meyer (1873) found the former to leave 30 per cent. and the latter only 18 per cent. of matter insoluble in water; the fresh bladder of a hake weighing 15 ounces left 1 ounce undissolved. Storer states that the swimming bladder of *Otolithus regalis*, Cuv., the weak fish, likewise furnishes some isinglass.

Brazilian isinglass comes from species of the genera Pimelodus and Silurus, the entire sounds being often dried, so as to adhere together (*lump isinglass*), and the lumps are sometimes split open (*honeycomb isinglass*). A false isinglass from Para consisted, according to Pereira (1853), of the ovaries of a fish, probably *Sudas gigas.*

East Indian isinglass is produced from several large fishes, and is met with in the form of purses and of leaves.

Constituents.—Besides membranous matter and some salts, isinglass consists of that variety of gelatin known to chemists as *glutin.* (See Gelatina, page 661.)

Pharmaceutical Uses.—Isinglass forms the basis of *isinglass plaster* and of *court-plaster* (see page 516), and may be employed for similar purposes as gelatin (see page 661). The German Pharmacopœia gives the following process for

EMPLASTRUM ADHÆSIVUM ANGLICUM.—30 grams of isinglass are dissolved in sufficient hot water to obtain a solution weighing 360 grams, one-half of which is spread upon taffeta 104 centimeters long and 42 centimeters wide, each coating being permitted to dry before applying the next. The remaining solution is, meanwhile, mixed with 120 grams of alcohol and 3 grams of glycerin, and this mixture applied in the same manner. The reverse side is then coated with tincture of benzoin, and the plaster finally dried. According to these directions 1 gram of isinglass is made to cover 21 square inches.

Medical Action and Uses.—Isinglass was anciently applied as a protective to the skin when it was abraded or affected with eruptions. It is emollient and nutritive, and forms a valuable addition to boiled milk, or to farinacea prepared with milk, in treating the chronic bowel complaints of children. In court-plaster it is used for its adhesive qualities.

IGNATIA, *U. S.*

Semen Ignatiæ, Faba Ignatii.—Ignatia, Bean of St. Ignatius, E.; *Fève de Saint-Ignace, Fève igasurique,* Fr.; *Ignazbohnen,* G.

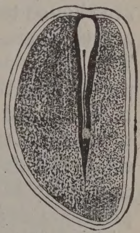
The seed of Strychnos Ignatia, *Lindley* (Str. Ignatii, *Bergius*, s. Str. philippensis, *Blanco*, s. Ignatiana philippinica, *Lour.*, s. Ignatia amara, *Lin. f.*).

Nat. Ord.—Loganiaceæ.

Origin.—This is a large climbing shrub, indigenous to the Philippine Islands and naturalized in Cochin China, with opposite ovate leaves, and an oblong or subglobular berry-like fruit, having a brittle pericarp, and containing about 24 seeds imbedded in a bitter pulp.

Description.—The seeds are from 1 to 1¼ inch long, oblong, ovate or roundish ovate in shape, by mutual pressure irregularly angular; the hilum is on one of the edges in a small depression, and the surface of the seeds is of a dull reddish-gray, or brownish, when old even blackish color, and granular, or partly covered by gray or light brown silky hairs. Ignatia consists of a very hard horny albumen, which is of the shape of the seeds, and translucent at the edges, and surrounds an irregular cavity. The embryo projects into this cavity and consists of a rather long radicle and oblong ovate, acute cotyledons. The seeds break under the hammer with a granular and irregular fracture, and soften after prolonged digestion. They are inodorous, and have a very persistent bitter taste.

Fig. 89.



Ignatia.—Vertical section of seed.

Constituents.—Pelletier and Caventou (1819), found the seeds to contain the same constituents, though in different proportions, as nux vomica; they stated the yield of strychnia (still containing brucia) to be 1.4 per cent. Geiseler (1837) likewise found 1.5 per cent. of this alkaloid. F. F. Mayer (1863), on assaying ignatia with his solution, obtained from two troyounces of the seeds 4.5 grains of strychnia and 13.73 grains of brucia, which correspond to 0.52 per cent. of the former, and 1.43 per cent. of the latter.

Off. Prep.—Extractum ignatiæ, *U. S.*

Medical Action and Uses.—The action and uses of ignatia are identical with those of nux vomica.

ILEX.—HOLLY.

Houx, Fr.; *Stechpalme*, *Christdorn*, G.

The leaves of different species of Ilex. *Nat. Ord.*—Aquifoliaceæ.

Origin and Description. ILEX OPACA, *Ait.*, *American holly.*—It is indigenous to the United States, and is either shrubby, or a tree 30 or 40 feet high. The leaves are petiolate, coriaceous and evergreen, about two inches long, oval in shape, and with a wavy-toothed margin, the teeth being furnished with rigid and sharp spines. They are without odor, and have a mucilaginous, bitterish and astringent taste.

ILEX AQUIFOLIUM, *Lin.*—The *European holly* is very nearly related to the preceding. The leaves differ in being rather ovate, dark green and glossy on the upper surface.

ILEX CASSINE, *Lin.*, known as *yaupon*, *youpon* or *cassena.*—It grows in the United States from Virginia southward. The leaves are shortly petiolate, about 1 inch long, coriaceous, varying in shape between lance-ovate, ovate and oblong, crenate on the margin, smooth, dark green and glossy above, and paler beneath. They are inodorous, and have an astringent and bitterish taste.

The following two species are likewise known as *cassena* in the Southern States:—

ILEX DAHOON, *Walt.*, has leaves about 2 inches long, which are oblong or oblanceolate, with the margin revolute or entire, or sharply serrate towards the apex.

ILEX MYRTIFOLIA, *Walt.*—The leaves are linear-lanceolate or linear-oblong, 1 inch long, entire on the margin, or furnished with a few sharp teeth.

The fruit of these species is a red drupe, usually containing four one-seeded ribbed or grooved nutlets.

ILEX PARAGUAYENSIS, *St. Hil.*, is a small tree indigenous to Brazil and the Argentine Republic. The leaves are oblong or lanceolate, wedge-shaped at the base, rather obtuse at the apex, and with distant teeth on the margin. They furnish the *yerba maté* or *Paraguay tea*, which is prepared as follows: The small branches with the leaves are placed in the *tatacúa*, a plot of earth about 6 feet square, surrounded by fire, where they undergo their first roasting. They are thence taken to the *barbacúa*, which is a grating underneath which burns a fire, where they are somewhat torrefied, to develop the aromatic principle. The leaves are subsequently reduced to powder in a sort of mortar, formed of pits dug in the earth, and well rammed. More recently suitable furnaces have been erected for drying and torrefaction, and mills are used for powdering.

Constituents.—The leaves of the European holly were examined by Lassaigne (1822), Déleschamps (1832), Lebourdais (1841), Moldenhauer (1857), and Bennemann (1858). The four first-named investigators obtained the bitter principle as a more or less colored amorphous mass; Bennemann in the form of feathery crystals, too small in quantity for further investigation. Déleschamp's *ilicin* was *not*, but Moldenhauer's and Bennemann's *was* precipitated by subacetate of lead; Lebourdais' ilicin was absorbed from the decoction by animal charcoal, and extracted from it by boiling alcohol. D. P. Pancoast's (1856) ilicin was obtained by Lebourdais' process from the fruit of the American holly, and is described as being in minute needles; the same process applied to the leaves yielded an amorphous green mass.

Moldenhauer isolated *ilixanthin*, $C_{17}H_{22}O_{11}$, the yellow coloring matter of the leaves, in the form of straw-yellow needles, which are soluble in alcohol and boiling water, but insoluble in ether. *Ilicic acid* is syrupy; its barium salt is amorphous, the calcium salt crystallizes in scales.

The yaupon contains 0.122 per cent. of *caffeina*, 2.409 per cent. of tannin, 4 per cent. of ash, besides wax, resin, etc., according to the analysis of H. M. Smith (1872). Caffeina was also found in maté by Stenhouse (1843), who regards the tannin as differing somewhat from caffeo-tannic acid. Rochleder, on the contrary, considers the tannin from the two sources as identical. Alonzo Robbins (1878) examined seven samples of maté, and found the caffeina to vary between 0.2 and 1.6 per cent., and the tannin between 10 and 16 per cent.; the samples containing the largest amount of caffeina yielded the least tannin, and *vice versa*.

Medical Action and Uses.—According to Barbier, holly leaves and their preparations produce a sense of heat and oppression in the stomach, with some nausea, followed by colic without diarrhœa. The berries vomit and purge, and at least one case is recorded of their proving fatal to a child. The leaves, being bitter, were naturally employed for the cure of *intermittent fever*, and a formal inquest upon their virtues having been held upon them by the Institute of France, its chairman reported that their efficiency was real, although it was very slow in exhibiting itself. He was probably unacquainted with the fact that intermittent fever patients removed to a hospital generally recover without medicinal treatment. Moreover, subsequent clinical observations by competent physicians proved that the curative power of the medicine in this disease is absolutely null. The leaves have been used in *rheumatism*, internally and topically, and the berries as cathartics in *dropsy*. An American species, *I. opaca*, is demulcent, and is used in decoction to palliate cough and promote expectoration.

ILLICIUM.—STAR ANISE.

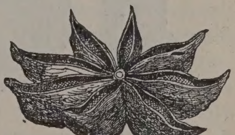
Fructus (Semen) anisi stellati, Semen badiani.—*Badiane, Anise étoilé*, Fr.; *Sternanis*, G.

The fruit of Illicium anisatum, *Lour.*, s. Ill. religiosum, *Siebold.* Bentley and Trimen, Med. Plants, 10.

Origin.—This is a small tree with evergreen lanceolate entire pellucid punctate leaves and greenish-yellow polypetalous flowers. It is indigenous to and cultivated in Eastern Asia, and planted near the temples in Japan. During the year 1866–1867, there were imported into the United States 17,307 pounds of star anise.

Description.—Star anise consists of about 8 boat-shaped follicles which are horizontally arranged in one circle around a short axis. The follicles are somewhat beaked, wrinkled, of a brown color externally, internally smooth, red-brown and glossy, and on the upper margin usually split open. Each carpel has a single seed, which is oval, flattened, oblique at the base, smooth and of a polished brown color, and contains a large oily albumen inclosing the small embryo. Star anise yields about 78 per cent. of capsular integuments, which have a very agreeable anise-like odor and a sweetish aromatic taste. The seeds weigh about 22 per cent., are but slightly aromatic, and have an oily taste.

Fig. 90.



Star Anise.

Constituents.—The fruit and seeds were separately examined by Meissner (1818), who obtained from the former 5.3 per cent. of volatile oil, 2.8 of fat, 10.7 of resin, etc.; the fruit seems also to contain a little tannin, mucilage, and pectin. The seeds were found by Meissner to yield only 1.8 per cent. of volatile oil and 2.6 per cent. of resin, but about 20 per cent. of fixed oil. The volatile oil is chemically identical with that of Pimpinella anisum (see Oleum anisi).

Allied Plants.—Illicium floridanum, *Ellis*, and Ill. parviflorum, *Mich.*, two shrubs, indigenous to Florida and adjacent States, are strongly aromatic and anise-like. The fruit of I. floridanum and of I. parviflorum resembles the preceding, but the carpels are 12 or 15 in number.

Medical Action and Uses.—Star aniseed has the same qualities as the officinal anise, and in the East its seeds and oil are used for the same purposes, viz., as carminative, anodyne, stimulant, and diuretic, and as a condiment for vegetable food. Externally, they are there applied to allay local pains, such as *colic*, *rheumatism*, *earache*, etc. In Germany, they are employed in a similar manner, and also for the relief of *bronchitis*. The native species, I. floridanum, is aromatic in its leaves, bark, and seeds; the bark has been suggested as a substitute for cascarilla, and the seeds for those of anise. The root of I. parviflorum is said to resemble that of sassafras in its properties.

IMPERATORIA.—MASTERWORT.

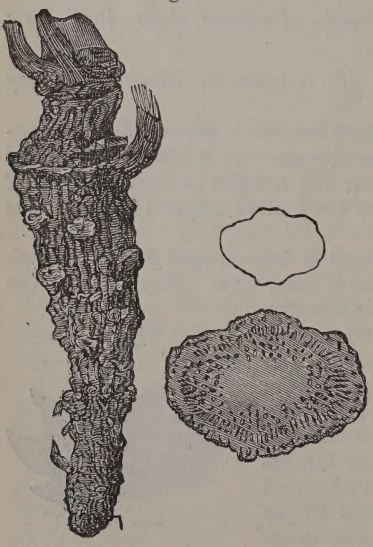
Impératoire, Fr.; *Meisterwurz*, *Kaiserwurz*, G.

The root-stock of Imperatoria ostruthium, *Lin.* *Nat. Ord.*—Umbelliferæ, Orthospermæ.

Origin.—Masterwort is indigenous to the mountainous regions of Southern and Central Europe, grows 2 or 3 feet high, and has large umbels of many white or reddish flowers. The root-stocks are produced at the termination of thin rhizomes, which are about 6 inches long.

Description.—The root-stock is 2 or 3 inches long, of the thickness of a finger, somewhat conical, and slightly flattened. Externally, it is dark brownish-gray, wrinkled, with warty protuberances or scars, and finely annulate. Internally, it is brownish-white, and exhibits upon the transverse section a thin bark and a large central pith, both containing many brown-yellow resin-cells; the wood bundles are small, forming a loose circle. Masterwort has a strong balsamic odor and an aromatic pungent and bitter taste. It has been noticed by Holmes (1877) as an adulteration of aconite root.

Fig. 91.



Imperatoria ostruthium, *Lin.*—Root-stock, natural size; and transverse section, natural size, and magnified.

Constituents.—Masterwort contains about $\frac{3}{4}$ per cent. of volatile oil, which, according to Hirzel (1849), is a mixture of several hydrates of a hydrocarbon, $C_{10}H_{16}$. Wackenroder (1831) obtained colorless shining crystals of *imperatorin*, $C_{12}H_{12}O_3$, which, in alcoholic solution only, have a pungent taste. Schlatter (1833) obtained *peucedanin* from the root of Peucedanum officinale, *Lin.*, which was afterwards proved by R. Wagner to be identical with imperatorin. Both principles, when boiled with an alcoholic solution of potassa, are resolved into *angelic acid* and *oreoselin*, $C_{14}H_{12}O_4$. The latter body may also be obtained from *athamantin*, $C_{24}H_{30}O_7$, which was discovered by Winckler (1842) in the root of Athamanta (Peucedanum, *Mœnch*) oreoselinum, *Lin.* Athamantin resembles imperatorin, unites with dry hydrochloric acid, and, on boiling this compound with alcohol, is split into *valerianic acid* and *oreoselon*, $C_{14}H_{10}O_3$, which crystallizes in needles, and, on being boiled with water and an acid, yields the crystalline oreoselin.

Medical Action and Uses.—The acrid and aromatic taste of this plant, and its odor resembling that of angelica, depend upon its essential oil; and to the stimulating operation of this oil nearly all the remedial virtues of the medicine are due. It is but little used at the present day, but it was formerly employed in various conditions of local or general debility. Among these were the *typhoid state* of fevers and inflammations, *intermittent fever*, *delirium tremens*, and some forms of dropsy; atonic *dyspepsia*, *flatulent colic*, *hysteria*, and *asthma;* and locally it was used as a masticatory to relieve *toothache* and *paralysis* of the tongue or palate, and as a stimulant of unhealthy *ulcers.*

INDIGO.—Indigo.

Indicum, Pigmentum indicum.—Indigo, Fr., G.

A blue dye-stuff extracted from different species of Indigofera. Bentley and Trimen, Med. Plants, 72.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The genus consists of herbaceous or suffruticose plants, which are indigenous to and cultivated in tropical and subtropical countries. The most important species are Indigofera tinctoria, *Lin.* (s. I. indica, *Lam.*), I. anil, *Lin.*, and I. argentea, *Lin.* (s. I. glauca, *Lam.*, I. cœrulea, *Roxb.*). The genus *Baptisia* appears to yield a similar coloring matter. Indigo is also obtained from Isatis tinctoria, *Lin.*, *Nat. Ord.* Cruciferæ, the *woad* indigenous to Europe, and from Polygonum tinctorium, *Lin.*, *Nat. Ord.* Polygonaceæ, a native of China.

Preparation.—The plants are immersed in water until fermentation has set in, whereby the chromogene is dissolved. When the liquid has assumed a sherry color, it is drawn off and briskly stirred so as to bring it freely into contact with air. As the chromogene becomes oxidized, the newly-formed coloring matter, which is insoluble in water, subsides. The supernatant liquid is then decanted and the precipitate collected, pressed, and dried. Between 1 and 1½ million pounds of indigo are annually imported into the United States.

Properties.—Indigo is met with in hard but brittle lumps or cubical cakes, which are inodorous, tasteless, and of a deep blue color, assuming a coppery hue when scratched or rubbed with a hard body. It is insoluble in the ordinary solvents, dissolves freely in concentrated sulphuric acid, and, when rapidly heated, sublimes partly in purple-colored vapors, which condense into copper-colored needles. The color of indigo is altered by oxidizing and deoxidizing agents.

Constituents.—Indigo contains variable quantities of inorganic substances; when of good quality it yields about 7 per cent. of ash. It contains the proteid *indigo-gluten*, which is soluble in warm diluted acids, and the coloring principles *indigo-brown*, soluble in caustic alkalies, and *indigo-red* or *indigo-resin*, which is taken up by boiling alcohol after the indigo has been previously exhausted with dilute acids and alkalies. But the most important principle is *indigo-blue* or *indigotin*, of which good indigo contains between 50 and 60 per cent., and which is not contained in the plants, but is formed from a colorless syrupy bitterish compound called *indican*, $C_{26}H_{33}NO_{18}$. During the treatment described above, indican is split into a saccharine body, *indiglucin*, and indigotin,

C_8H_5NO. On mixing 2 or 3 parts of finely powdered indigo, 6 parts of slaked lime, 4 parts of ferrous sulphate, and 450 parts of boiling water, the blue color disappears, and the yellow solution contains *indigo-white*, C_8H_6NO, which may be obtained as a white crystalline powder on adding the clear solution to an excess of boiled dilute hydrochloric acid, with the precaution to avoid all contact with the air; if access of air be permitted during the latter part of this process, indigotin is regenerated and deposited in the form of a deep blue powder. By oxidation of indigotin with nitric acid, *isatin*, $C_8H_5NO_2$, is obtained, forming yellowish-red shining prisms, which are soluble in alcohol, hot water, and alkalies, and, on distillation with potassa, yield *anilina*.

Soluble indigo, or *sulphate of indigo*, is prepared by gradually adding 1 part of powdered indigo to 5 parts of Nordhausen sulphuric acid, or 8 parts of oil of vitriol, and preventing a rise of temperature by immersing the vessel in cold water. In the course of 2 or 3 days it becomes a dark blue pasty mass, the solution of which in about two parts of water is *liquid blue*. This compound contains *sulphindigotic*, or *sulphocœrulic acid*, $HC_8H_4NO.SO_3$, which is obtained pure by transferring it from its dilute solution to wool, and dissolving it from the latter by means of a weak alkali. Its salts are amorphous; those with potassium and sodium are sold in commerce as *indigo-carmine*, and are usually obtained by adding a potassium or sodium salt to a solution of sulphate of indigo, washing the precipitate with a solution of the same salt, and expressing; the product is soluble in pure water.

The *valuation of indigo* is based upon determining approximately the amount of indigotin contained in it, by the process given above, or by adding chlorine ($KClO_3$ and HCl) to finely powdered indigo until the blue color has been destroyed. The richer it is in indigotin, the larger will be the amount of chlorine necessary to effect decolorization.

Pharmaceutical Uses.—Besides its uses in the arts for dyeing, a solution of indigo is employed as a test for determining the presence of nitric acid, chlorine, etc.

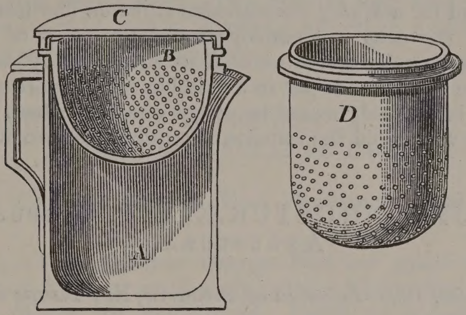
Medical Action and Uses.—During the experiments made many years ago with indigo in the treatment of *epilepsy*, it was given in very large doses, and, as a consequence, deranged the digestive organs, causing vomiting and purging, with debility, and in some instances the urine and sweat acquired a bluish color. There is not the slightest ground for believing that it exhibits curative virtues in epilepsy or in any other disease.

INFUSA, *U. S.*, *Br.*

Infusions, E., Fr.; *Tisanes*, Fr.; *Infusionen*, *Aufgüsse*, G.

Infusions are aqueous solutions of the soluble principles of vegetable or animal drugs obtained by maceration or digestion in hot or cold water, and differ from decoctions only in the lower degree of heat employed in their preparation. Substances containing volatile or other principles which would be dissipated or injured by boiling, are particularly adapted for this purpose, and it will be observed that the majority of the officinal infusions are made with drugs, the activity of which depends wholly or in part upon a volatile constituent. Except in a few cases in which percolation is directed, infusions are prepared by pouring boiling or cold water upon the material, and allowing them to remain in contact for the proper length of time, at the expiration of which the solution is poured upon a strainer, and the solid material expressed, to recover the liquid absorbed by it. A convenient apparatus well adapted for making these preparations is Squire's infusion pot; this consists of a jar A, with a projecting ledge near the top, which supports a strainer, B or D, containing the material to be exhausted; the jar is closed by a well-fitting cover, C. The advantages of this contrivance are, that the material is exhausted by circulatory displacement, the liquid as it becomes charged with the soluble ingredients descending to the bottom, giving place to fresh portions of less saturated menstruum; and that no further straining is required, should care have been taken not to use too fine a powder.

Fig. 92.



Squire's Infusion Pot.

The drugs are best adapted for exhaustion with water if cut into thin slices by a suitable knife, so that they may be easily permeated by the liquid; when cutting is inadmissible, they should be bruised to a coarse powder. Ligneous drugs, however, should be in a fine or moderately fine powder, which is also best adapted for most of those which may be made by percolation.

The time directed for the maceration with boiling water is, in the U. S. Pharmacopœia, usually two hours, and in the British Pharmacopœia a quarter or half hour, which is in most cases sufficient.

The strength of the infusions of the British Pharmacopœia is usually such that the virtues of one part of the drug are represented by 20 or 40 parts of the infusion; the majority of the infusions of the U. S. Pharmacopœia are made approximately in the proportion of 1 to 15 or 30 by weight. The *tisanes* of the French Codex are weaker than either of the preceding, and generally in the proportion of 1 to 100, or occasionally 200.

Infusions are not intended to be kept except for a very limited period. Exposed to air, as they necessarily must be in the sick chamber, through the vial containing them being opened from time to time, decomposition must ensue after a day or two, and may be retarded somewhat only by keeping the vessel in a cool place, or, better still, on ice. When desirable to have a larger quantity prepared, the liquid may be preserved by *Appert's method;* it is put into convenient sized vials, which are heated in a water-bath gradually to the boiling point, and stopped well at that temperature. However, considering that infusions are rarely made by the pharmacist, but are usually prepared by the attendants of the patient, and may be frequently made as required, there is little necessity for such a course, or for any of the various contrivances that have been proposed for obviating fermentation and other changes in infusions. But for the physician it may be useful to know that most of the infusions may be prepared in a more concentrated form, or reduced in volume by evaporation at a moderate heat, and then be kept unaltered for a considerable time by the addition of one-third their volume of alcohol. Dissolving half a grain of salicylic acid in each fluidounce of the infusion will have a similar preservative effect.

Nearly all the infusions will yield precipitates or become discolored with the salts of iron, lead, mercury, silver, and other heavy metals, and are therefore incompatible with them.

The Pharmacopœia would, perhaps, not be less useful to the physician and the pharmacist if all infusions were omitted except those which require some special manipulation, or which, from their containing a sufficient amount of alcohol, are permanent for a reasonable length of time. The German Pharmacopœia recognizes by formula only one infusion (Inf. sennæ comp.), but gives the following general directions: "When infusions are ordered without giving the quantity of the drug to be used, they are made so that from one part of the drug ten parts of liquid are obtained. For a *concentrated infusion* (infusum concentratum), one and a half parts, and for a *highly concentrated infusion* (infusum concentratissimum) two parts of the drug are employed, and ten parts of liquid obtained. The quantity of medicinally active substances should always be determined by the physician. The substance is put in a suitable vessel, boiling water is poured upon it, the vessel is covered, heated by means of a steam-bath for five minutes, then set aside, and when cold the infusion is strained with expression."

INFUSUM ANGUSTURÆ, *U. S.*—INFUSION OF ANGUSTURA.

Infusum cuspariæ, Br.—*Infusion of cusparia*, E.; *Tisane d'angusture*, Fr.; *Angustura-Infusion*, G.

Preparation.—Take of Angustura in moderately coarse powder half a troyounce; Water a sufficient quantity. Moisten the powder with two fluidrachms of water, pack it firmly in a conical percolator, and gradually pour water upon it until the filtered liquid measures a pint. Or, macerate the angustura in a pint of boiling water for two hours, in a covered vessel, and strain. *U. S.*

Take of Cusparia Bark in coarse powder one-half ounce; Distilled Water, at 120° F., ten fluidounces. Infuse in a covered vessel for two hours, and strain. *Br.*

Medical Uses.—Besides being used in cases of digestive debility, it is also employed, like the infusions of cinchona, as an adjuvant to quinia, or as a substitute for it in cases of mild intermittent fever. Its use is limited by the liability of the bark to be mixed with that of false angustura bark. The *dose* is from one to two fluidounces.

INFUSUM ANTHEMIDIS, *U. S.*, *Br.*—INFUSION OF CHAMOMILE.

Infusum chamomillæ romanæ.—*Tisane de chamomille romaine*, Fr.; *Römisch-Kamillenthee*, G.

Preparation.—Take of Chamomile half a troyounce; Boiling Water a pint. Macerate for ten minutes, in a covered vessel, and strain. *U. S.*

Take of Chamomile Flowers one-half ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for fifteen minutes, and strain. *Br.*

Medical Uses.—The *dose* of this infusion is about a wineglassful before meals; it is more apt to agree with the stomach when made with cold water. The infusion, when warm, is an efficient and gentle emetic.

INFUSUM AURANTII, *Br.*—INFUSION OF ORANGE PEEL.

Tisane d'écorce d'orange, Fr.; *Pomeranzenschalen-Aufguss*, G.

Preparation.—Take of Bitter Orange Peel cut small one-half ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for fifteen minutes, and strain. *Br.*

Medical Action and Uses.—This infusion may be prescribed to allay pain and flatulence in *colic*, and as a vehicle for other medicines, particularly magnesia. *Dose*, one or two fluidounces.

INFUSUM AURANTII COMPOSITUM, *Br.*—COMPOUND INFUSION OF ORANGE PEEL.

Tisane d'écorce d'orange composée, Fr.; *Pomeranzen- und Citronenschalen-Aufguss*, G.

Preparation.—Take of Bitter Orange Peel cut small one-quarter of an ounce; Fresh Lemon Peel cut small sixty grains; Cloves bruised thirty grains; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for a quarter of an hour, and strain. *Br.*

Medical Action and Uses.—The compound infusion of orange peel is a grateful carminative, appropriate in *flatulence*, and also in slight *diarrhœa* caused by indigestion. *Dose*, one or two fluidounces.

INFUSUM BUCHU, *U. S.*, *Br.*—INFUSION OF BUCHU.

Infusum diosmæ s. barosmæ.—*Tisane de bucco*, Fr.; *Buchuaufguss*, G.

Preparation.—Take of Buchu a troyounce; Boiling Water a pint. Macerate for two hours, in a covered vessel, and strain. *U. S.*

Take of Buchu Leaves bruised one-half ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for an hour, and strain. *Br.*

Medical Uses.—This preparation contains all the virtues of buchu, and is preferable to more concentrated forms of the medicine. *Dose*, one or two fluidounces. It is usual to make an infusion with equal proportions of buchu and uva ursi.

INFUSUM CALUMBÆ, *U. S.*, *Br.*—INFUSION OF COLUMBO.

Infusion of calumba, E.; *Tisane de colombo*, Fr.; *Kolombo-Infusion*, G.

Preparation.—Take of Columbo in moderately coarse powder half a troyounce; Water a sufficient quantity. Moisten the powder with two fluidrachms of water, pack it firmly in a conical percolator, and gradually pour water upon it until the filtered liquid measures a pint. Heat the filtrate to the boiling point, and strain when cold. Or, macerate the Columbo in a pint of Boiling Water for two hours, in a covered vessel, and strain. *U. S.*

Take of Calumba Root cut small half an ounce; Cold Distilled Water ten fluidounces. Macerate in a covered vessel for one hour, and strain. *Br.*

The infusion made by the second process of the United States Pharmacopœia is much more mucilaginous and unsightly than those made with cold water either by maceration or percolation, as directed by the other formulas.

Medical Uses.—This is probably the most useful preparation of columbo, if made with due precautions. *Dose*, a wineglassful before meals.

INFUSUM CAPSICI, *U. S.*—INFUSION OF CAPSICUM.

Tisane de capsique, Fr.; *Spanischpfeffer-Infusion*, G.

Preparation.—Take of Capiscum in coarse powder half a troyounce; Boiling Water a pint. Macerate for two hours in a covered vessel, and strain. *U. S.*

Medical Uses.—Infusion of capsicum is used almost exclusively as a gargle in the treatment of pseudo-membranous and gangrenous affections of the *throat*, including these conditions in *scarlet fever*, and of the forming stage of simple inflammation of the same part. No other local treatment is more efficient, and none, perhaps, as much so. When patients are unable to use the infusion as a gargle, it may be applied with a mop. The following preparation has had a great reputation in malignant sorethroat: Take two tablespoonfuls of capsicum and the same quantity of fine salt, beat them into a paste with a little water, and add half a pint of boiling water. Strain off the liquor, when cold, and add to it half a pint of very sharp vinegar. Of this the dose for an adult is a tablespoonful every half hour. Except when the throat is covered with false membrane and with sloughs, the acrimony of this preparation is not easily borne.

INFUSUM CARYOPHYLLI, *U. S.*, *Br.*—INFUSION OF CLOVES.

Tisane de girofle, Fr.; *Gewürznelken-Infusion*, G.

Preparation.—Take of Cloves bruised one hundred and twenty grains; Boiling Water a pint. Macerate for two hours in a covered vessel, and strain. *U. S.*

Take of Cloves bruised a quarter of an ounce; Boiling Distilled Water ten fluidounces. Macerate in a covered vessel for one hour, and strain. *Br.*

Medical Uses.—Infusion of cloves is used to allay flatulent colic, and nausea from exhaustion. *Dose*, a tablespoonful.

INFUSUM CASCARILLÆ, *U. S.*, *Br.*—INFUSION OF CASCARILLA.

Tisane de cascarille, Fr.; *Kaskarilla-Aufguss*, G.

Preparation.—Take of Cascarilla in moderately coarse powder a troyounce; Water a sufficient quantity. Moisten the powder with half a fluidounce of water, pack it firmly in a conical percolator, and gradually pour water upon it until the filtered liquid measures a pint. Or, macerate the Cascarilla in a pint of Boiling Water for two hours in a covered vessel, and strain. *U. S.*

Take of Cascarilla Bark in coarse powder one ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for one hour, and strain. *Br.*

Medical Uses.—Cascarilla is best administered in this form. It may be given in doses of two fluidounces two or three times a day.

INFUSUM CATECHU COMPOSITUM, *U. S.*—COMPOUND INFUSION OF CATECHU.

Infusum catechu, Br.—*Infusion of catechu*, E.; *Tisane de cachou composée*, Fr.; *Catechuaufguss mit Zimmt*, G.

Preparation.—Take of Catechu in fine powder half a troyounce; Cinnamon in moderately fine powder sixty grains; Boiling Water a pint. Macerate for an hour, in a covered vessel, and strain. *U. S.*

Take of Pale Catechu in coarse powder one hundred and sixty grains; Cinnamon Bark bruised thirty grains; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for half an hour, and strain. *Br.*

Medical Uses.—The addition of cinnamon to catechu in this preparation increases its astringency, and renders it stimulant and anodyne at the same time. It is a convenient remedy for diarrhœa with flatulent colic, provided that the bowels are free from irritating ingesta. *Dose*, from one to three fluidounces.

INFUSUM CHIRATÆ, *Br.*—INFUSION OF CHIRETTA.

Tisane de chirette, Fr.; *Chiretta-Thee*, G.

Preparation.—Take of Chiretta cut small a quarter of an ounce; Distilled Water at 120° F. ten ounces. Infuse in a covered vessel for half an hour, and strain. *Br.*

Medical Uses.—This infusion resembles that of quassia in its qualities, and may be used where simple bitters are needed, in the *dose* of two or three fluidounces.

INFUSUM CINCHONÆ FLAVÆ, *U. S.*, *Br.*—INFUSION OF YELLOW CINCHONA.

Infusion of calisaya bark, E.; *Tisane de quinquina jaune*, Fr.; *Kalisayarindenaufguss*, G.

Preparation.—Take of Yellow Cinchona in moderately fine powder a troyounce; Aromatic Sulphuric Acid a fluidrachm; Water a sufficient quantity. Mix the acid with a pint of water. Then moisten the powder with half a fluidounce of the mixture, and, having packed it firmly in a conical glass percolator, gradually pour upon it the remainder of the mixture, and afterwards water, until the filtered liquid measures a pint. *U. S.*

Take of Yellow Cinchona Bark in coarse powder half an ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for two hours, and strain. *Br.*

The first process, if well conducted, obtains all the alkaloids of the bark in a soluble condition, and is, in point of fact, simply a solution of the sulphates of these alkaloids. The second process will yield preparations very different in appearance and strength if the infusion is strained at a higher or lower temperature; in the former case it will be similar to a decoction of the bark, and become turbid on cooling, while in the latter case it will be clear, but contain only that portion of the cinchona alkaloids which in the natural combination are soluble in cold water. But to extract the bark with cold water alone, would require a longer maceration or slow percolation of it in moderately fine powder.

Medical Uses.—The infusions of cinchona are used only as tonics and not as antiperiodics, and may be prescribed in the *dose* of two fluidounces three times a day.

INFUSUM CINCHONÆ RUBRÆ, *U.S.*—INFUSION OF RED CINCHONA.

Tisane de quinquina rouge, Fr.; *Rothe China-Infusion*, G.

Preparation.—Take of Red Cinchona in moderately fine powder a troyounce; Aromatic Sulphuric Acid a fluidrachm; Water a sufficient quantity. Mix the acid with a pint of water. Then moisten the powder with half a fluidounce of the mixture, and, having packed it firmly in a conical glass percolator, gradually pour upon it the remainder of the mixture, and afterwards water, until the filtered liquid measures a pint. *U. S.*

It contains the alkaloids of the red cinchona bark dissolved in the form of sulphates.

Medical Uses.—Its uses are the same as those of the infusion of yellow cinchona.

INFUSUM CUSPARIÆ, *Br.* See INFUSUM ANGUSTURÆ.

INFUSUM CUSSO, *Br.*—INFUSION OF KOUSSO.

Tisane de cousso, Fr.; *Kossotrank*, G.

Preparation.—Take of Kousso in coarse powder half an ounce; Boiling Distilled Water eight fluidounces. Infuse in a covered vessel, for fifteen minutes, without straining. *Br.*

Medical Uses.—Following the Abyssinian mode of administering this vermifuge, the coarsely powdered flowers are taken along with the water in which they are infused. The eight fluidounces should be divided into two portions, and taken at intervals of an hour in the morning, fasting.

INFUSUM DIGITALIS, *U. S.*, *Br.*—INFUSION OF DIGITALIS.

Tisane de digitale, Fr.; *Fingerhutaufguss*, G.

Preparation.—Take of Digitalis in coarse powder sixty grains; Tincture of Cinnamon a fluidounce; Boiling Water half a pint. Macerate the digitalis in the water for two hours, in a covered vessel, and strain; then add the tincture of cinnamon and mix. *U. S.*

Take of Digitalis Leaves dried thirty grains; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for one hour, and strain. *Br.*

The bitter taste of digitalis is masked in the first preparation by the cinnamon, and the small quantity of alcohol and oil of cinnamon will preserve the infusion for several days, before a precipitate makes its appearance, which probably contains a portion of the digitalin in combination with the tannin of the cinnamon. D. E. Prall (1878), however, did not succeed in isolating digitalin from the precipitate.

Medical Uses.—The infusion is probably the most certain diuretic preparation of digitalis. In the treatment of *dropsy*, it should be steadily continued until it begins to act either upon the kidneys, the stomach, the pulse, or the bowels. Then, however, it should be at once discontinued, or its dose greatly lessened. Its physiological effects, it should be remembered, continue for several days after the medicine is suspended, and its diuretic action occurs most readily during a state of rest. *Dose*, from half an ounce to an ounce two or three times a day. A compound vinous infusion is a more efficient diuretic than the simpler officinal preparation, thus: White wine seven hundred and fifty parts; Juniper berries bruised fifty parts; Digitalis ten parts; Squill five parts. Macerate for four days, and add acetate of potassa fifteen parts. *Dose*, a tablespoonful three times a day.

INFUSUM DULCAMARÆ, *Br.*—INFUSION OF DULCAMARA.

Tisane de douce-amère, Fr.; *Bittersüssaufguss*, G.

Preparation.—Take of Dulcamara bruised one ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for one hour, and strain. *Br.*

Medical Uses.—The infusion is probably the most efficient preparation of dulcamara. Its very dilution renders it more operative. *Dose*, from one to two fluidounces.

INFUSUM ERGOTÆ, *Br.*—INFUSION OF ERGOT.

Tisane de seigle ergoté, Fr.; *Mutterkornaufguss*, G.

Preparation.—Take of Ergot in coarse powder one-quarter ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for half a hour, and strain. *Br.*

Medical Uses.—The *dose* of this preparation for a woman in *labor* is one to two fluidounces. Each fluidounce contains about ten grains of ergot.

INFUSUM EUPATORII, *U. S.*—INFUSION OF THOROUGHWORT.

Tisane d'herbe à fièvre, Fr.; *Eupatorium-Aufguss*, G.

Preparation.—Take of Thoroughwort a troyounce; Boiling Water a pint. Macerate for two hours in a covered vessel, and strain. *U. S.*

Medical Uses.—This infusion is used cold as a tonic and antiperiodic, in the *dose* of one or two fluidounces two or three times a day. As a diaphoretic, it is administered hot in doses of a fluidounce or two every half hour until nausea occurs, or the proposed effect is induced. As an emetic, it is given warm in the dose of half a pint, repeated if necessary.

INFUSUM GENTIANÆ COMPOSITUM, *U. S.*—COMPOUND INFUSION OF GENTIAN.

Mistura gentianæ, Br.; *Gentian mixture*, E.; *Tisane de gentiane composée*, Fr.; *Enzianaufguss*, G.

Preparation.—Take of Gentian in moderately coarse powder half a troyounce; Bitter Orange Peel in moderately coarse powder, Coriander in moderately coarse powder, each sixty grains; Alcohol two fluidounces; Water a sufficient quantity. Mix the alcohol with fourteen fluidounces of water, and, having moistened the mixed powders with three fluidrachms of the menstruum, pack them firmly in a conical percolator, and gradually pour upon them first the remainder of the menstruum, and then water, until the filtered liquid measures a pint. *U. S.*

Take of Gentian Root sliced one-quarter ounce; Bitter Orange Peel cut small, Coriander Fruit bruised, each thirty grains; Proof Spirit two fluidounces; Distilled Water eight fluidounces. Macerate the gentian, orange peel, and coriander in the proof spirit for two hours, then add the water, macerate again for two hours, and strain through calico. *Br.*

The alcohol is present in sufficient quantity to preserve the infusion unaltered for some days. As it is an elegant preparation, frequently prescribed in small quantities, J. T. Shinn (1862) proposed to exhaust four times the weight of material directed, by percolation with diluted alcohol sufficient for obtaining one pint of tincture, four fluidounces of which, diluted with twelve fluidounces of water, will exactly represent one pint of the officinal infusion of the United States Pharmacopœia.

Infusum gentianæ compositum, of the British Pharmacopœia, is made as follows:—

Take of Gentian Root sliced, Bitter Orange Peel cut small, each sixty grains; Fresh Lemon Peel cut small one-quarter ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for one hour, and strain. *Br.*

Medical Uses.—This is an agreeable and efficient stimulant stomachic tonic, and may be used in *doses* of a fluidounce two or three times a day.

INFUSUM HUMULI, *U. S.*—INFUSION OF HOPS.

Infusum lupuli, Br.—*Tisane de houblon*, Fr.; *Hopfenaufguss*, G.

Preparation.—Take of Hops half a troyounce; Boiling Water a pint. Macerate for two hours in a covered vessel, and strain. *U. S.*

Take of Hop one-half ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for two hours, and strain. *Br.*

Medical Uses.—It is the most eligible form for the administration of hop when alcohol is contraindicated. *Dose*, from two to four fluidounces every two or three hours.

INFUSUM JUNIPERI, *U. S.*—INFUSION OF JUNIPER.

Tisane de genièvre, Fr.; *Wachholderbeeren-Aufguss*, G.

Preparation.—Take of Juniper bruised a troyounce; Boiling Water a pint. Macerate for an hour in a covered vessel, and strain. *U. S.*

Medical Uses.—This preparation has the stimulant and diuretic virtues of juniper in a high degree, and is much used in *dropsies* and in chronic affections of the urinary passages. Most frequently its operation as a diuretic is increased by the addition of acetate of potassium, or the association with it of parsley, horseradish, etc. *Dose*, a wineglassful or two every three or four hours.

INFUSUM KRAMERIÆ, *U. S.*, *Br.*—INFUSION OF RHATANY.

Tisane de ratanhia, Fr.; *Ratanha-Aufguss*, G.

Preparation.—Take of Rhatany in moderately coarse powder a troyounce; Water a sufficient quantity. Moisten the powder with half a fluidounce of water, and, having packed it firmly in a conical glass percolator, gradually pour water upon it until the filtered liquid measures a pint. *U. S.*

Take of Rhatany Root bruised one-half ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for one hour, and strain. *Br.*

Medical Uses.—In all cases of internal *hemorrhage* to which astringents are applicable, this infusion may be advantageously used, the more so the more passive the bleeding. It is also useful in *mucous profluvia* of the bronchia and the gastro-intestinal tube. A watery solution of the extract of rhatany is, however, generally preferable. *Dose*, two fluidounces.

INFUSUM LINI COMPOSITUM, *U. S.*—COMPOUND INFUSION OF FLAXSEED.

Infusum lini, Br.—*Infusion of linseed*, E.; *Tisane de lin*, Fr.; *Leinsamenaufguss*, G.

Preparation.—Take of Flaxseed half a troyounce; Liquorice Root bruised one hundred and twenty grains; Boiling Water a pint. Macerate for two hours, in a covered vessel, and strain. *U. S.*

Take of Linseed one hundred and sixty grains; Fresh Liquorice Root sliced sixty grains; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel, for four hours, and strain. *Br.*

Liquorice root is added in this infusion with the view of improving its flavor. As the mucilage is contained in the covering of the seed, it should not be bruised, otherwise the oil will be emulsionized, and the swelling of the entire tissue will prevent the straining of the liquid.

Medical Uses.—The apparent intention of this preparation is to provide an appropriate remedy for acute mucous inflammations of the respiratory tract, an object which scarcely required a special formula, since in domestic practice it is customary to add liquorice, or sugar, or lemon juice to flaxseed tea, for these affections. The liquorice, also, renders this infusion less appropriate for bowel and urinary disorders, to which the simple infusion is generally well adapted. It may be drunk freely.

INFUSUM LUPULI, *Br.* See INFUSUM HUMULI.

INFUSUM MATICÆ, *Br.*—INFUSION OF MATICO.

Tisane de matico, Fr.; *Matico-Aufguss*, G.

Preparation.—Take of Matico Leaves cut small half an ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for two hours, and strain. *U. S.*

Medical Uses.—This astringent but not very efficient preparation may be prescribed in *doses* of a fluidounce or more.

INFUSUM PAREIRÆ, *U. S.*—INFUSION OF PAREIRA BRAVA.

Tisane de pareira, Fr.; *Pareira-Infusion*, G.

Preparation.—Take of Pareira Brava bruised a troyounce; Boiling Water a pint. Macerate for two hours, in a covered vessel, and strain. *U. S.*

Medical Uses.—The infusion of pareira is the most suitable form for administering this drug in cases to which it is appropriate, such as chronic inflammations of the *urinary organs*, especially those which are attended with calculous deposits. In this country it is seldom used. *Dose*, one or two fluidounces.

INFUSUM PICIS LIQUIDÆ, *U. S.*—INFUSION OF TAR.

Aqua picis, P. G.; *Aqua picea.*—*Tar water*, E.; *Eau de goudron*, Fr.; *Theerwasser*, G.

Preparation.—Take of Tar a pint; Water four pints. Mix them, and shake the mixture frequently during twenty-four hours. Then pour off the infusion, and filter through paper. *U. S.*

The large quantity of resinous and oily principles present in tar interferes with the solvent action of cold water; hence the Pharmacopœia directs a large quantity of the former the more easily to saturate the latter, which during the brief contact will mainly extract acetic and other acids. The use of magnesia for dividing the tar is inadmissible on account of the formation of soluble salts. The German Pharmacopœia directs one part of tar to ten parts of boiling distilled water, and maceration for two days, with frequent stirring. The French Codex leaves the tar for a day in contact with thirty parts of water, and rejects this strongly acid infusion, the remaining tar being again macerated with thirty parts of water for eight or ten days. Magnes-Lahens (1876) observed that if tar be pulverized by the admixture of twice its weight of inert sawdust, 27 grams of this mixture will yield to 1 liter of water 6 grams of extract, which is a saturated solution. Lefort (1868) determined the amount taken up by hot water to be 2 grams to the liter.

Medical Uses.—Tar water is useful in chronic disorders of the mucous membranes of the pulmonary and urinary tracts, but in the former especially. It was once famous as a remedy for "consumption" and numerous other diseases, but its utility it now found to be limited to *chronic bronchitis*, in which it lessens the discharge, and gradually, and like other terebinthinates, restores the affected membrane more or less perfectly to its original integrity; and to mucous disorders of the *urinary organs*, in which it acts by impregnating the urine, as well as through the blood. In the last-named diseases tar and its preparations are less eligible than balsamic medicines, owing, probably, to the acid that it contains. *Dose*, one or two ounces three or four times a day, and increased without definite limitation.

INFUSUM PRUNI VIRGINIANÆ, *U. S.*—INFUSION OF WILD CHERRY.

Tisane d'écorce de cerisier sauvage, Fr.; *Wildkirschen-Thee*, G.

Preparation.—Take of Wild Cherry in fine powder half a troyounce; Water a sufficient quantity. Moisten the powder with six fluidrachms of water, and let it stand for an hour; pack it firmly in a conical glass percolator, and gradually pour water upon it until the filtered liquid measures a pint. *U. S.*

Made with cold water as directed by the Pharmacopœia, this infusion contains volatile oil and hydrocyanic acid, which are not generated by the use of hot water.

Medical Uses.—This is the best form in which wild cherry bark can be used, as a mild tonic and cardiac sedative. It is especially applicable to the treatment of irritative *dyspepsia*, *nervous cough*, the cough of early pulmonary *phthisis*, and the hectic irritation of the decline of that disease. *Dose*, two or three fluidounces several times a day.

INFUSUM QUASSIÆ, *U. S.*, *Br.*—INFUSION OF QUASSIA.

Tisane de quassie, F.; *Quassia-Aufguss*, G.

Preparation.—Take of Quassia rasped one hundred and twenty grains; Water a pint. Macerate for twelve hours in a covered vessel, and strain. *U. S.*

Take of Quassia Wood in chips sixty grains; Cold Distilled Water ten fluidounces. Macerate in a covered vessel for half an hour, and strain. *Br.*

We can perceive no objection to the use of warm water in making this infusion, whereby time might be materially economized, without interfering with the appearance or efficiency of the preparation.

Medical Uses.—Infusion of quassia is the purest of bitter infusions, and is the best form for administering this useful stomachic tonic. The *dose* is two fluidounces three times a day.

INFUSUM RHEI, *U. S.*, *Br.*—INFUSION OF RHUBARB.

Tisane de rhubarbe, Fr.; *Rhabarber-Aufguss*, G.

Preparation.—Take of Rhubarb bruised one hundred and twenty grains; Boiling Water half a pint. Digest for an hour in a covered vessel, and strain. *U. S.*

Take of Rhubarb Root in thin slices one-quarter ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for one hour, and strain. *Br.*

Rhubarb being easily permeated by water, it is preferable to employ it for this purpose cut into thin slices, instead of bruising it; in the latter case the finer powder should be sifted off. But in either case the preparation is unsightly, and becomes still more so by the long-continued digestion directed in the first formula. A handsomer though weaker infusion is obtained with the French Codex by maceration for four hours with cold water. In Germany a preparation has long been in use under the name of *Infusum rhei kalinum* or *Tinctura rhei aquosa*, which is now prepared as follows: Take of Rhubarb sliced one hundred parts; Borax and Potassium Carbonate, each ten parts; Boiling Distilled Water eight hundred and fifty parts. Infuse for fifteen minutes, add Alcohol one hundred parts, and macerate for one and a quarter hour; then express lightly, and to the filtrate add Cinnamon Water one hundred and fifty parts. The finished preparation will weigh 1000 parts, represents nearly 10 per cent. of rhubarb, and mixes clear with aqueous liquids, but is incompatible with all preparations which are decomposed by alkalies. It may be preserved for several months, if kept in small vials and in a cool place.

Medical Uses.—This infusion is seldom prescribed, either alone or as a vehicle for other purgatives. In the latter case it has been associated with salines, such as the tartrate of sodium or the bitartrate of potassium. The diluted form of this preparation is probably not without its advantages in maintaining a moderate and sustained operation on the bowels. *Dose*, one or two fluidounces, repeated, if necessary, in three or four hours.

INFUSUM ROSÆ COMPOSITUM, *U. S.*—COMPOUND INFUSION OF ROSE.

Infusum rosæ acidum, Br.—*Acid infusion of rose*, E.; *Tisane de rose composée*, Fr.; *Saurer Rosenaufguss*, G.

Preparation.—Take of Red Rose half a troyounce; Diluted Sulphuric Acid three fluidrachms; Sugar in coarse powder a troyounce and a half; Boiling Water two pints and a half. Pour the water upon the rose in a covered glass or porcelain vessel, add the acid, and macerate for half an hour; then dissolve the sugar in the liquid, and strain. *U. S.*

Take of Dried Red-Rose Petals broken up a quarter of an ounce; Diluted Sulphuric Acid one fluidrachm; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for one hour, and strain. *Br.*

This infusion should not be made in a metallic vessel; it has a fine red color and agreeable flavor.

Medical Uses.—The compound infusion of rose is employed as a coloring and flavoring ingredient of mixtures, and as an excipient and solvent for sulphate of magnesia and for sulphate of quinia, whose taste it partially covers. It forms an agreeable gargle for inflamed and ulcerated states of the *mouth* and *fauces*, and may be used to moderate profuse *sweats*. Its virtues are mainly due to the sulphuric acid it contains. *Dose*, from two to four fluidounces.

INFUSUM SALVIÆ, *U. S.*—INFUSION OF SAGE.

Tisane de sauge, Fr.; *Salbeiaufguss*, G.

Preparation.—Take of Sage half a troyounce; Boiling Water a pint. Macerate for half an hour in a covered vessel, and strain. *U. S.*

Medical Uses.—As sage is almost always administered in infusion, the reader is referred to the article Sage for an account of the virtues of sage tea. Suffice it in this place to say that the infusion is especially valuable internally for controlling profuse *sweats* and an excessive secretion of *milk*, and locally for healing aphthous *ulcers* of the mouth, and giving tone to relaxed mucous membranes generally. *Dose*, two or more fluidounces. As a gargle, it may contain in solution alum, or chlorate of potassium, with the addition of honey, vinegar, muriatic acid, etc.

INFUSUM SENEGÆ, *Br.*—INFUSION OF SENEGA.

Tisane de polygale de Virginie, Fr.; *Senega-Aufguss*, G.

Preparation.—Take of Senega Root bruised half an ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel, and strain. *Br.*

The U. S. Pharmacopœia directs a decoction of senega. (See page 497.)

Medical Uses.—This preparation is supposed to possess certain advantages over the decoction of seneka (*U. S. P.*) which was originally prescribed, and continues to be preferred in this country, but as the senegin is not altered by the heat of boiling water, it is probable that decoction extracts a larger proportion of it than infusion does. *Dose*, one to two fluidounces.

INFUSUM SENNÆ, *U. S.*, *Br.*—INFUSION OF SENNA.

Tisane de séné composée, Fr.; *Senna-Aufguss*, G.

Preparation.—Take of Senna a troyounce; Coriander bruised sixty grains; Boiling Water a pint. Macerate for an hour in a covered vessel, and strain. *U. S.*

Take of Senna one ounce; Ginger sliced thirty grains; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for one hour, and strain. *Br.*

We believe that the long-continued infusion increases the tendency of the senna to produce griping, particularly if digestion be resorted to. If the leaves have been cut or bruised, digestion for not over ten minutes will yield an active infusion. The flavor being a matter of taste, the selection of aromatics had probably best be left to the physician. A *compound infusion or mixture of senna*, used in Great Britain under the name of *black draught*, is made by dissolving four ounces of magnesium sulphate and half an ounce of liquorice, together with two and a half fluidounces of tincture of senna, and ten fluidrachms of compound tincture of cardamom, in sufficient infusion of senna to obtain one imperial pint. The German Pharmacopœia directs an *infusum sennæ compositum*, which is also known as *Aqua* (*s. Potio*) *laxativa Viennensis* or *Vienna draught;* it is made by macerating two parts of cut senna with twelve parts of boiling water, exposing it to the heat of a steam-bath for five minutes, and stirring frequently; the liquid is then expressed, and two parts of sodium and potassium tartrate, and three parts of manna dissolved in it; when finished it should weigh fifteen parts.

Medical Uses.—The coriander seed in this preparation lessens the tendency of the senna to gripe. If the infusion is allowed to macerate too long, the tendency is increased. This preparation is much less frequently used than a non-officinal infusion which contains also manna and sulphate of magnesia, with fennel seed, and is known as *black draught*. The *dose* of the officinal infusion is about four fluidounces. Of the other preparation the dose should vary with the proportions of the several ingredients, and these with the nature of the case. The most usual formula, however, is the following: ℞. Sennæ, ℥ss; Magnesiæ sulph., mannæ, āā ℥j; Sem. fœniculi, ʒj; Aquæ bull., Oss. Macerate in a covered vessel until the liquid cools. *Dose*, two to four ounces every three or four hours until it operates.

INFUSUM SERPENTARIÆ, *U. S.*, *Br.*—INFUSION OF SERPENTARIA.

Infusion of serpentary, E.; *Tisane de serpentaire*, Fr.; *Schlangenwurzel-Aufguss*, G.

Preparation.—Take of Serpentaria in moderately coarse powder half a troyounce; Water a sufficient quantity. Moisten the powder with two fluidrachms of water, pack it firmly in a conical percolator, and gradually pour water upon it until the filtered liquid measures a pint.

Or, macerate the serpentaria in a pint of boiling water for two hours in a covered vessel, and strain. *U. S.*

Take of Serpentary Root bruised one-quarter ounce; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for two hours, and strain. *Br.*

Medical Uses.—This preparation is preferable to the fluid extract and to the tincture of serpentaria. Its uses are fully detailed under Serpentaria, and it was, indeed, until recently the only preparation of the medicine in use. *Dose*, one or two fluidounces every two or three hours in typhoid conditions.

INFUSUM SPIGELIÆ, *U. S.*—INFUSION OF SPIGELIA.

Tisane de spigélie du Maryland, Fr.; *Spigelien-Aufguss*, G.

Preparation.—Take of Spigelia half a troyounce; Boiling Water a pint. Macerate for two hours in a covered vessel, and strain. *U. S.*

Medical Uses.—The anthelmintic and alterative operations of this medicine will be found treated of under Spigelia. The infusion is rendered more efficient as an anthelmintic for lumbricoid worms by the association of other medicines, as in the medicine known as *worm tea:* ℞. Spigelia, ℥ss; Sennæ, Sem. fœniculi, āā ʒij; Mannæ, ℥j; Aquæ bullient. Oj.—Infuse. *Dose* for a child two years old, one fluidounce.

INFUSUM TABACI, *U. S.*—Infusion of Tobacco.

Infusion de tabac, Fr.; *Tabakaufguss*, G.

Preparation.—Take of Tobacco sixty grains; Boiling Water a pint. Macerate for an hour in a covered vessel, and strain. *U. S.*

A similar preparation is officinal in the British Pharmacopœia as *Enema tabaci.* (See page 529.)

Medical Uses.—Infusion of tobacco has been applied externally as a wash to destroy cutaneous parasites, and in the treatment of *scabies*, *prurigo*, *pityriasis*, etc.; but numerous instances of poisoning by this mode of its application suffice to condemn it. Internally, infusion of tobacco has been used to relax *muscular spasm* of the glottis, bronchia, intestine, bladder, uterus, etc., in tetanus also, and in poisoning by strychnia. It has also been prescribed in various forms of *dropsy.* For details, see Tobacco. The preparation is not used internally, except by enema, when half a pint may be given, and, if required, the same quantity may be repeated in half an hour, if no sign of poisoning appear.

INFUSUM TARAXACI, *U. S.*—Infusion of Dandelion.

Tisane de pissenlit, Fr.; *Löwenzahn-Aufguss*, G.

Preparation.—Take of Dandelion bruised two troyounces; Boiling Water a pint. Macerate for two hours in a covered vessel, and strain. *U. S.*

Medical Uses.—The medicinal virtues of this preparation will be found described under Taraxacum. It possibly exerts some depurative action upon the digestive glandular system. *Dose*, two fluidounces two or three times a day.

INFUSUM UVÆ URSI, *Br.*—Infusion of Bearberry.

Tisane d'uva ursi, Fr.; *Bärentraubenblätter-Aufguss*, G.

Preparation.—Take of Bearberry Leaves bruised half an ounce; Boiling Distilled Water ten fluidounes. Infuse in a covered vessel for two hours, and strain. *Br.*

The corresponding preparation of the U. S. Pharmacopœia is made by boiling for 15 minutes (see page 498.)

Medical Uses.—This is a more convenient form than the decoction for extemporaneous use, and is perhaps sufficiently active, since it is certain that the amount of tannic and gallic acids which can be profitably absorbed from the stomach is not unlimited. *Dose*, one or two fluidounces.

INFUSUM VALERIANÆ, *U. S.*, *Br.*—Infusion of Valerian.

Tisane de valériane, Fr.; *Baldrian-Aufguss*, G.

Preparation.—Take of Valerian in moderately coarse powder half a troyounce; Water a sufficient quantity. Moisten the powder with two fluidrachms of water, pack it firmly in a conical percolator, and gradually pour water upon it until the filtered liquid measures a pint. Or, macerate the valerian in a pint of boiling water for two hours in a covered vessel, and strain. *U. S.*

Take of Valerian Root bruised one hundred and twenty grains; Boiling Distilled Water ten fluidounces. Infuse in a covered vessel for one hour, and strain. *Br.*

Medical Uses.—Although partially superseded by the more convenient fluid extract and tinctures, the infusion of valerian is, nevertheless, a valuable preparation, particularly where the medicine must be continuously given. *Dose*, two fluidounces.

INFUSUM ZINGIBERIS, *U. S.*—INFUSION OF GINGER.

Tisane de gingembre, Fr.; *Ingwer-Aufguss*, G.

Preparation.—Take of Ginger bruised half a troyounce; Boiling Water a pint. Macerate for two hours in a covered vessel, and strain. *U. S.*

Medical Uses.—This infusion, when given hot, is an excellent remedy for flatulent *colic*, and is sometimes useful in promoting expectoration in *senile catarrh.* As a gargle it may be employed to correct relaxation of the *uvula*, and *aphonia* due to a similar condition of the vocal cords. *Dose*, one or two fluidounces.

INJECTIO MORPHIÆ HYPODERMICA.—*Br. Add.*

Hypodermic injection of morphia, E.; *Injection hypodermique au morphine*, Fr.; *Subcutane Morphineinspritzung*, G.

Preparation.—Take of Hydrochlorate of Morphia eighty-eight grains; Solution of Ammonia, Acetic Acid, Distilled Water, of each a sufficiency. Dissolve the hydrochlorate of morphia in two ounces of distilled water, aiding the solution by a gentle heat; then add solution of ammonia so as to precipitate the morphia, and render the liquid slightly alkaline; allow it to cool; collect the precipitate on a filter, wash it with distilled water, and allow it to drain; then transfer the morphia to a small porcelain dish with about an ounce of distilled water, apply a gentle heat, and carefully add acetic acid until the morphia is dissolved, and a very slightly acid solution is formed. Add now sufficient distilled water to make the solution measure exactly two fluidounces. Filter and preserve the product in a stoppered bottle excluded from the light. *Br.*

The object of the above process is the preparation of acetate of morphia in solution of definite strength so that each fluidrachm shall contain five grains of that salt. On keeping the solution decomposes, acquiring a brown color and slowly separating morphia, the crystals being very long if the solution remained undisturbed. To prevent this decomposition Prof. C. Johnston (1873) recommended sulphurous acid, five drops of which were found by Jennings sufficient to protect a fluidounce. Squibb (1873) observed that one-sixth per cent. of pure carbolic acid would preserve such solutions, and Limousin (1876) has obtained satisfactory results by using one-fifth per cent. of salicylic acid.

Medical Uses.—The average hypodermic *dose* of this preparation is from one to six minims, equal to from one-twelfth of a grain to half a grain of the salt.

INULA, *U. S.*—ELECAMPANE.

Radix Helenii, P. G.; *Radix inulæ, Radix enulæ.*—*Racine d'aunée, Aunée commune* (*officinale*), Fr.; *Alantwurzel, Helenenwurzel*, G.

The root of Inula helenium, *Lin.* (Corvisartia helenium, *Merat*). Woodville, Med. Bot., t. 26; Bentley and Trimen, Med. Plants, 150.

Nat. Ord.—Compositæ, Asteroideæ.

Origin.—Elecampane is a native of Central Asia and Southern Siberia, and is found westward to Southern and Central Europe. It is not unfrequently cultivated, and has in many places escaped from gardens and become naturalized. In the United States it grows spontaneously along roadsides and in pastures, from New England south to the mountains of North Carolina, and westward to Illinois. It has a thick solid stem 3 to 6 feet high, large radical leaves decurrent on the long petioles, and sessile clasping stem-leaves, all being acute, somewhat toothed, and grayish hairy on the lower surface. The large flower-heads are terminal, and have a loosely imbricated involucre with an outer series of foliaceous ovate bracts; the numerous yellow pistillate ray-florets are ligulate, linear, and three-toothed, and the yellow disk-florets tubular and 5-toothed. The akenes are smooth, pale brown, four-sided, and crowned with a hairy pappus. The root is collected in the fall of the second or the spring of the third year.

Description.—The root is about six inches long and 1 or 2 inches thick, divided below into branches 6 to 12 inches long and $\frac{1}{2}$ to 1 inch thick, very fleshy, in commerce always sliced either longitudinally or transversely. The longitudinal slices have the bark overlapping; the transverse slices are concave, somewhat radially striate; externally irregularly wrinkled and brownish, internally white when fresh, grayish after drying, of a peculiar aromatic odor, and an aromatic, bitterish, and pungent taste. The root is hygroscopic and flexible in damp weather, but when dry breaks with a short fracture. The bark is $\frac{1}{8}$ inch and more thick, the inner portion radiate near the cambium line; the meditullium is not very distinctly radiate with small fibro-vascular bundles; all parts of the root are dotted with shining yellowish-brown resin cells.

Constituents.—Elecampane contains a little *volatile oil*, some acrid *resin*, a *bitter principle* not known as yet in the isolated state, *waxy matter, inulin*, etc. Since 1873, Kallen has investigated the body formerly known as helenin and elecampane camphor, which crystallizes from the concentrated tincture mixed with water. He isolated from it *helenin*, C_6H_8O, which is insipid, crystallizes in needles, and fuses at 110° C. (230° F.); *inulol*, which is a camphor isomeric with laurel-camphor, and the anhydrid of a peculiar acid called *inulic acid.* The odor and camphoraceous taste are due to inulol. *Inulin*, $C_{12}H_{20}O_{10}$, is contained in the subterraneous parts of compositæ, and is obtained by forcibly expressing the grated juicy roots, when a portion will deposit on standing, and the remainder may be precipitated by alcohol; dry roots are first deprived of coloring matter, etc., by cold water, then slowly heated with water, expressed, and precipitated by cooling or by alcohol. The autumn roots contain the largest percentage (elecampane 44 per cent.) of inulin, which by the following spring is to a considerable extent changed into mucilage, sugar, and levulin, and in some cases to glucosides. Inulin is a fine white powder, tasteless and inodorous, slightly soluble in cold water, more so in hot water, and then partly decomposed but mostly reprecipitated on cooling. It differs from starch by the absence of concentric layers, does not yield a jelly with water, and it is colored yellow (not blue) by iodine. Two monographs on inulin were published in 1870, one by Prof. Dragendorff, the other by Dr. K. Prantl.

Medical Action and Uses.—Inula was one of the most famous of ancient medicines, and continued in vogue until very recent times. It owed this reputation to its stimulant qualities. Even in the Hippocratic writings it is stated to be a stimulant of the brain, the stomach, the kidneys, and the uterus, qualities which continued to be ascribed to it, as well as a rubefacient action upon the skin. It had a special reputation in all pulmonary affections, and as a topical application in sciatica, gout, gravel, facial neuralgia, etc. One of its chief constituents, inulin, is probably quite negative; and whatever virtues the plant possesses must be due to the elecampane camphor, which it contains in small proportion, to its very minute quantity of volatile oil, and to the bitter extractive which it holds in as large a proportion as of inulin. These elements are apparently too insignificant to justify the ancient repute of elecampane. It continues to be used as a domestic remedy, rather than by physicians, in the treatment of chronic *bronchitis*, *dyspepsia*, *amenorrhœa* and other menstrual disorders. It is also preserved as a candy, like calamus, and is used to flavor the alcoholic beverage *absinthe*. Its retention in the United States Pharmacopœia seems quite superfluous. Elecampane is generally administered in a decoction prepared by boiling half an ounce of the root in a pint of water, and which may be given in the *dose* of two or more fluidounces.

IODINIUM, *U. S.*—IODINE.

Iodum, Br., P. G.—*Iode*, Fr.; *Jod*, G.
Symbol I. Atomicity univalent. Atomic weight 127.

A non-metallic element, obtained principally from the ashes of sea-weeds.

Origin.—Iodine is found in some minerals combined with mercury, silver, lead, and other metals, in Chili saltpetre principally as sodium iodate, in many mineral-spring waters, in sea-water, and in many plants and animals living in sea-water or near the sea coast. It is often a constituent of the atmosphere in minute quantities, and occasionally of the ashes of some plants growing inland.

Preparation.—Large quantities are made from *kelp*, the ash left on the burning of sea-weeds. The weed is first dried, and then charred or burned at as low a temperature as possible to avoid loss of iodine. The ash is exhausted with hot water, and the solution concentrated and cooled to remove by crystallization potassium chloride and sodium carbonate and sulphate. More of the latter salt will crystallize after the addition of some sulphuric acid, whereby the sulphides and hyposulphites present are decomposed. The mother-liquor is then mixed with binoxide of manganese, and in lead retorts heated to a temperature a little over 60° C. (140° F.), when iodine will distil over and is collected in glass receivers, several of which are connected with each other. The liberation of iodine from the sodium iodide of the liquor is explained by the following equation: $2NaI+3H_2SO_4+MnO_2=I_2+2NaHSO_4+MnSO_4+2H_2O$, acid sodium sulphate and manganium sulphate being formed at the same time. The mother-liquor obtained on the purification of Chili saltpetre contains sodium iodate and iodide; from the latter the iodine is separated by chlorine gas, from the former by sulphurous acid, in which case sodium sulphate is produced.

Purification.—In the crude state iodine is chiefly contaminated with water, but it sometimes contains also cyanogen iodide, and occasionally iodine chloride, ICl. Purification is effected by drying the product as much as possible by mechanical means, and then subliming it carefully, so that the more volatile compounds named may first sublime; afterwards the heat is raised, and the receiver changed. The product is the *resublimed iodine* of commerce.

Properties.—Iodine is in flat scale-like rhombic crystals of a grayish-black color and a bright metallic lustre, in thin splinters transparent with a red color. It is soft and friable, and has an odor suggestive of chlorine, and a very caustic and acrid taste. The skin or paper is transiently colored brown, and vegetable colors are slowly destroyed by it. It has the specific gravity 4.95, fuses near 115° C. (239° F.), congeals at 113.6° C. (236.5° F.), and boils above 175° C. (347° F.); its vapor has the density 8.7, and a reddish or purple, or, above the boiling point, a deep-blue color. Iodine dissolves in about 60 parts of glycerin, and in 7000 parts (Gay-Lussac) (65,000 parts according to Dossios and Weith) of water, and forms with it gradually hydriodic acid, which dissolves more iodine; its solubility in water is also increased by many salts, and particularly by iodides. It is freely soluble in alcohol and ether with a brown color, and in chloroform, carbon bisulphide, and hydrocarbons with a purplish or violet color. It combines in several proportions with oxygen, the most important compound being *iodic acid;* it unites with hydrogen to hydriodic acid, and combines with most of the other elements.

Tests.—Iodine is readily recognized by the blue color which it imparts to starch paste, and by which $\frac{1}{400,000}$ part of free iodine is still recognized. Water containing traces of free iodine will yield it to carbon bisulphide, etc., in which solution it is recognized by the purplish color and by the blue color produced with starch paste. Iodine in combination must previously be liberated by chlorine gas, avoiding an excess of the latter; or, if present as iodate, sulphurous acid or other deoxidizing agent will set it free.

Impurities and Adulterations.—At present, iodine is usually met with in commerce in a very pure condition, containing but minute quantities of impurities. An excessive proportion of water is indicated by the iodine adhering to the bottle, and may be removed by placing it under a bell-glass over oil of vitriol at a low temperature. The presence of cyanogen iodide and iodine chloride is detected by heating the iodine in a suitable apparatus for about 15 minutes to 100° C. (212° F.), and cooling the vapors well; the former impurity will sublime as white or yellowish needles, the latter as hyacinthine-red prisms or red-brown oil; both have a pungent odor. Fixed impurities, such as graphite, charcoal, sawdust, metallic compounds, etc., are left behind on volatilizing a little from a porcelain capsule. The British Pharmacopœia directs 12.7 grains of iodine to be dissolved in an ounce of water containing 15 grains of potassium iodide; if no impurities whatever are present, the solution requires for complete discoloration 1000 grain measures of the volumetric solution of hyposulphite of sodium.

Pharmaceutical Uses.—Iodine is used in the following preparations:—

AMYLI IODIDUM, Iodide of starch, *E.;* Iodure d'amidon, *Fr.;* Jodstärke, *G.* According to Quesneville (1868), it may be obtained both in a soluble and an insoluble state as follows: 1050 parts of starch and 100 parts of iodine, both in fine powder, are well mixed and then triturated with a mixture of 400 parts of water and 100 of alcohol, the liquid to be added gradually; the whole is left in contact for 15 or 20 days, and afterwards carefully dried. Thus prepared, it is a dark blackish-blue powder, has no odor of iodine, and contains 10 per cent. of this element. To obtain it soluble, it is heated in a porcelain or enamelled dish over a slow fire, and with continued agitation, until a pungent odor commences to be given off. This may be still further purified by making a concentrated solution in warm water, precipitating the clear liquid by alcohol, drying, and powdering the precipitate.

Fritzsche obtained it by adding tincture of iodine to a filtered solution of starch in concentrated hydrochloric acid. Bondonneau (1878) dissolves the starch first in caustic soda and precipitates the slightly acidulated solution with tincture of iodine. Liebig regarded iodide of starch as a mere mixture of starch with finely divided iodine; Payen and Fritzsche as a definite compound, $(C_6H_{10}O_5)_{10}I$, and Bondonneau gives it the formula $(C_6H_{10}O_5)_5I$, equal to 13 per cent. of iodine, the latter being dissolved by alcohol, but not by potassium iodide, benzin, sulphide of carbon, or other solvents. According to the process adopted, the amount of iodine varies, and though generally about 7.5 per cent., may be as low as 3.2 per cent., or, as obtained by Lassaigne, as high as 41.75 per cent.

Exposed to the sunlight, iodide of starch is decolorized; when heated with water to 65° C. (149° F.) it becomes colorless, and blue again on cooling; but when heated to boiling, iodine is given off, and may be completely expelled by continuing the heat for a sufficient length of time.

Syrup of Iodotannin.—Debauque observed that a solution of tannin will dissolve a considerable amount of iodine without reacting with starch. Demolon has suggested a syrup containing this compound, which is made by dissolving 3 grams of iodine and 18 grams of tannin in 300 grams of water, evaporating the solution until 60 grams are left, which are mixed with 960 grams of simple syrup.

Iodine is contained in the following officinal chemical compounds: Arsenici iodidum, *U. S.;* Cadmii iodidum, Ferri iodidum, *Br.;* Hydrargyri iodidum rubrum, Hydrarg. iodid. viride, *U. S.*, *Br.;* Iodoformum, *U. S.;* Plumbi iodid., Sulphuris iodidum, *U. S.*, *Br.*

The following pharmaceutical preparations likewise contain combined iodine: Linim. potass. iodidi cum sapone, *Br.;* Liquor arsen. et hydrarg. iodidi, *U. S.;* Pilula ferri iodidi, Syrup. ferri iodidi, *U. S.*, *Br.;* Unguent. cadmii iodidi, *Br.;* Ung. hydrarg. iodidi rubri, Ung. plumbi iodidi, Ung. potass. iodidi, Ung. sulphur. iodidi, *U. S.*, *Br.*

The following preparations contain free iodine: Linim. iodi, *Br.;* Liquor iodinii comp. (iodi), *U. S.*, *Br.;* Tinct. iodinii, *U. S.;* Tinct. iodinii comp. (iodi), *U. S.*, *Br.;* Ung. iodinii, *U. S.;* Ung. iodinii comp. (iodi), *U. S.*, *Br.;* Vapor iodi, *Br.*

Medical Action. *On Plants and Animals.*—Iodine, being one of the most widely diffused of elementary bodies, may be presumed to be in harmony with life, and, in fact, it does promote the growth of vegetable organisms, when its proportion is minute, while it hinders it and destroys their vitality when in excess. The proportion which may become hostile to animal life is exceedingly small, and it operates slowly and gradually by impairing nutrition, especially of glandular organs, while it occasions more or less irritation of the gastro-intestinal mucous membrane. The latter effect reaches ulceration when the dose is increased; and if a very large dose be at once given, the effects are those of a corrosive poison.

On Man.—Applied to the skin in ointment or in solution, iodine occasions a sense of warmth in the part, which, if the preparation be very strong, may amount to painful burning, and cause redness and swelling of the surrounding integument. The tincture stains the skin yellow; the color is more or less permanent, and may only disappear with the exfoliation of the cuticle. It may be removed by solution of ammonia. It has generally been believed that iodine is absorbed by the skin; but carefully conducted experiments appear to show that, at least in adults, when efficient means are taken to prevent the iodine vapors from reaching the mouth and nostrils, no trace of the substance can be found in the secretions. The rare cases of alleged poisoning by the application of iodine to the unbroken skin, are contradicted by the experiments referred to. In children, however, the tincture of iodine applied to the unbroken scalp is said to have been absorbed, since its presence was detected in the urine, which, at the same time, becomes slightly albuminous.

The raw cutis, the mucous and the serous membranes, and the connective tissue, present an easy access for this substance to the bloodvessels. It does not usually occasion severe inflammation when so applied, probably from the rapidity of its absorption. When the vapors of iodine are inhaled, they irritate the mucous membranes and occasion headache, coryza, lachrymation, and cough. Their prolonged operation, as in certain manufactures, gives rise to dryness of the respiratory tract, dizziness, nervous disorder, etc. Absorbed iodine is readily detected, combined with sodium or potassium, in the blood, milk, tears, saliva, urine, serous effusions in closed cavities, etc. It is excreted chiefly by the kidneys, as an alkaline iodide, even when it is taken into the stomach, and sometimes it occasions a temporary albuminuria.

The direct effects of large doses of iodine (5–6 grains), taken internally, are those of an irritant poison, such as heat and constriction of the throat, nausea, eructation, salivation, epigastric pain, vomiting, diarrhœa, and collapse. If reaction takes place, the skin is apt to become intensely red. Notwithstanding the great severity of the symptoms, the death of a previously healthy person by the internal use of iodine is extremely rare, a circumstance due, doubtless, to its rapid absorption and elimination. On the other hand, medicinal doses have been known to occasion spasm of the larynx and severe gastric irritation, while very large doses have been taken at once, or excessive amounts in the course of a few weeks, without serious consequences. As an example of the former sort, may be mentioned the case of a young man who swallowed a solution containing more than two and a half drachms of iodine, without experiencing any remarkable effects; and, as an instance of the latter, the case of a woman who, in the course of eighty days, took nine hundred and fifty-three grains of iodine, in the form of tincture, without injury.

The chronic effects of iodine are manifested by all the organs. In the nasal passages, throat, and alimentary canal, there are signs of irritation, with coryza, dryness, burning pain, dyspepsia, and diarrhœa; there is a tendency to loss of flesh, and to wasting of certain glandular organs, especially the mammæ and the testicles; the nervous system suffers from mental and sensory debility, impaired muscular power, and even general paralysis; the hair and the skin are apt to grow darker; and the latter is the seat of various eruptions. Usually on ceasing the use of the medicine recovery from these effects gradually takes place. In medicinal doses iodine appears to promote nutrition, and to stimulate glandular secretion. It is thought to excite the genital organs and increase the menstrual flow. Finally, it tends to prevent or to limit putrefaction, and thereby to correct the fetor arising from this process.

Medical Uses.—In the following description of the internal uses of iodine, its tinctures are intended, unless it is otherwise stated. In *intermittent fever* iodine displays decidedly curative virtues both in tropical malarial regions and in those of the temperate zones. The tincture has been given in doses of from five to fifteen minims three times a day largely diluted. *Typhoid fever* and other febrile affections have been treated by iodine, but without evident advantage. *Mercurial salivation* may be diminished by its internal use. The iodide of potassium is less certain in its effects; indeed, if we might reason from its evident power of reviving mercury long quiescent in the system, its action should be mischievous when salivation already exists. *Constitutional syphilis* has sometimes been treated with iodine, but the potassic iodide has supplanted it in this respect. *Hypertrophy* of glandular organs is often reduced by iodine, especially of the mammæ, testes, liver, and spleen, and of the thyroid gland in goitre. Indeed, it is probable that all cases of true goitre in persons under middle age are curable by iodine. For this purpose the compound solution should be administered in doses of from five to ten drops three times a day. Its action upon the other organs mentioned, unless, perhaps, the mammæ, is more equivocal. It has been used to reduce *polysarcia.* In all cases care should be taken to prevent the medicine from injuring the stomach, by giving it largely diluted, while the internal is supplemented by the external use of the medicine. In *scrofula* iodine is most efficient in the glandular forms unconnected with a characteristic deposit; over the latter it has no direct influence. On the other hand, it is of great service in promoting the healing of scrofulous ulcers, and caries of the same nature, especially in the chronic stages of that process. There is reason to believe that even *tabes mesenterica*, or scrofula of the mesenteric glands, may sometimes be cured, and often palliated, by this medicine, especially if it is given, as in other scrofulous affections, with cod-liver oil. In some cases of *ascites* dependent upon obstruction of the spleen, liver, or mesenteric glands, iodine has proved curative; but in such cases the iodide of potassium is preferable. *Chronic articular rheumatism*, and that peculiar disease known as *nodosity of the joints*, have been treated with iodine internally, the former more successfully than the latter. *Excessive lactation* has been controlled by this agent in small and repeated doses, which are also sometimes successful in arresting the *vomiting* of pregnancy. The dose in the latter case should not exceed two or three dops of the tincture, and should be largely diluted. Uterine disorders, indicating impaired activity of function, sometimes appear to be benefited by this medicine.

As a *topical* application iodine is used for its counter-irritant and its absorbent effects. *Erysipelas*, when superficial, has often been arrested by the use of the tinctures of iodine, and, as far as any local treatment can go, they would seem preferable to solutions of nitrate of silver, and other more or less caustic lotions. In *smallpox* it seems to retard the maturation of the vesicles, or even to prevent it altogether, and with this effect to avert pitting. But its operation is not too confidently to be relied on. Lieutenant Payer states that a mixture of iodine and collodion proved most efficacious against *frost-bite* during the Arctic voyage of the "Tegethoff" in 1872. In *burns* and *scalds* its stimulant, substitutive, and protective operations are often useful; and the same may be said of certain cutaneous diseases, as *psoriasis*, *herpes*, *acne*, *favus*, and *lupus*. In the two last-named affections a saturated solution of iodine in alcohol must be employed. The stimulant operation of iodine, as well as its deodorizing influence, are useful in *ozæna;* it is a valuable agent for inhalation in chronic affections of the air-passages, especially in *laryngitis* and *bronchitis*, both in their original form and in that which accompanies *phthisis*. Like other local irritants, it may cure *aphonia* depending upon relaxation or upon nervous debility. Iodine has been used topically in *diphtheria*, and probably with more advantage in this way than nitrate of silver. It is a most valuable topical agent in *leucorrhœa*, vaginal or uterine, and in chronic engorgements of the uterus. The same may be said of its utility in *gleet*, chronic *vesical catarrh*, and chronic *dysentery*. A gargle made with half an ounce of compound tincture of iodine in half a pint of water is efficient in mercurial *ptyalism;* and a weak solution, as of one grain of iodine in an ounce of water, is one of the best means of retarding or curing *retraction of the gums*. A strong solution of iodine forms one of the best applications to chronic *ulcers of the tonsils*, *fauces*, and *uterus*, and in *granular pharyngitis* and *conjunctivitis*, and in *blepharitis*.

In various chronic enlargements, especially of the superficial *glands*, iodine locally employed hastens the cure; and the same may be said of *mammary abscess*, and of more chronic forms of inflammation, such as affect the *joints*. It sometimes promotes the removal of *pleural* effusions, and is adapted to relieve *muscular rheumatism* of the chest and *pleurodynia*, and probably to mitigate *chronic peritonitis*. Injected into the tunica vaginalis testis, the tincture of iodine has long been used for the cure of *hydrocele*, after being diluted with two parts of water. In like manner it has been employed to produce adhesion of the opposite sides of other serous cavities, such as *hernial sacs*, *synovial bursæ*, and even *large joints*, as in the case of white swelling or *hydrarthrosis; ascites* independent of organic mechanical causes has been cured in this manner; but, as such cases are extremely rare, the evidence in regard to the value of the operation is scanty. When paracentesis is practised in *chronic pleurisy*, tincture of iodine is often injected, either to hasten the adhesion of the opposite pleural surfaces, or to correct the fetor of the pleural secretion, or both at once. In recent cases the injection may consist of a watery solution of iodine in the proportion of from two to five grains in a pint of water; in more chronic ones, a solution of one part of the compound tincture of iodine to four or five of water has sometimes been used. A similar method has been successfully employed in *hydrorachis*, and unsuccessfully in *hydrocephalus*. Injection of the tinctures of iodine has been extensively used in the case of *cysts* containing either serum, pus, blood, hydatids, or melicerous or atheromatous matter. In the case of ovarian serous cysts the operation has been remarkably successful when the tumor was unilocular. The puncture for evacuating the cyst and injecting the iodic liquid should be made above Poupart's ligament. Indolent *abscesses* and *fistulæ* of all kinds are curable by injections of a solution of iodine, which appears to act by covering the diseased surface with a protecting film, by stimulating its curative processes, and by correcting the fetor of its secretions. In the first and last respects iodine is superior to nitrate of silver. The tincture of iodine has also been injected into *pulmonary cavities* by means of the needles usually attached to aspirators, and the result appears to be that the operation is less mischievous than might have been expected. Indeed, in some cases where a single superficial cavity existed, the expectoration and general symptoms have for a time abated.

The best antidotes for a poisonous dose of an iodic preparation is starch or wheaten flour mixed with tepid water. White of egg and also milk are efficient. A solution of carbonate or bicarbonate of sodium may also be given as a chemical antidote. Free vomiting should be encouraged as long as the liquid rejected tinges blue a solution of starch. Opiates, counter-irritants, and rest of the stomach, are indicated to allay gastric irritation.

Administration.—Its dose in other forms represents about one-fourth of a grain of iodine. Iodine is seldom given, in substance, by the stomach. Its vapors are sometimes inhaled in laryngeal and pulmonary affections, and externally it is applied to the skin as iodized cotton, or in bags or pads containing it in powder. These latter methods are more efficient than painting the skin with solutions of iodine. The discoloration of the skin produced by it may be removed by ammonia, carbolic acid, soap liniment, or sulphite of soda. For internal administration the simple or the compound tincture is to be preferred.

IODINII BROMIDUM.—BROMIDE OF IODINE.

Bromure d'iode, Fr.; *Jodbromid*, G.
Formula IBr_5. Molecular weight 527.

Preparation.—Twenty parts of iodine are dissolved in sixty-three parts of bromine, and the solution heated for some time in a large flask to about 60° C. (140° F.) until it yields a clear solution with six or eight parts of water.

Properties.—Pentabromide of iodine is a dark reddish-brown liquid, resembling bromine in appearance and sensible properties, but yielding a perfectly transparent brown-red solution with less than six parts of water. Such a solution, containing 15 per cent. of the bromide, is found in commerce. When the compound is kept for some time at or above 63° C. (145.4° F.), the boiling point of bromine, a portion of the latter distils off, and monobromide of iodine, IBr, is left as a dark-brown sublimable crystalline mass.

Medical Uses.—A solution of two drops in a fluidounce of mucilage has been applied in *diphtheria*.

IODOFORMUM, *U. S.*—IODOFORM.

Iodoformium, P. G.—*Iodoforme*, Fr.; *Jodoform*, G.
Formula CHI_3. Molecular weight 394.

Preparation.—Iodoform is produced by the action of iodine in the presence of alkalies upon alcohol, aldehyd, ether, acetic ether, methylic alcohol, and in minute quantities when acting upon carbohydrates or protein compounds. Wilder (1875) recommends Bouchardat's process as an easy one, and Filhol's as one giving a large yield. By following the former, 100 parts iodine, 100 potassium bicarbonate, 1200 water, and 250 alcohol are mixed in a flask with a long neck and slowly heated to between 60° and 80° C. (140° and 176° F.), until the color has disappeared, when 25, 20, and 10 parts of iodine are to be added, waiting after each addition, until the iodine color has disappeared, and adding, at the close, if necessary, a little potassa; after setting aside for 24 hours the crystals are collected upon a filter. About one-third of the iodine is recovered as iodoform, the remainder appearing in the mother-liquor chiefly as iodide of potassium, and may be obtained by supersaturating with sulphuric and then adding a little nitric acid.

In Filhol's process this iodine is utilized by liberating it by means of chlorine and converting it into iodoform. The proportions recommended are two parts of crystallized sodium carbonate, ten of water, and one of alcohol, warmed as before; one part of iodine is added in small portions, and after cooling the crystals are collected. The filtrate is again warmed, two parts sodium carbonate are added, and a rapid current of chlorine gas is passed through the liquid as long as iodoform is separated, which is again collected, while the filtrate may be made to yield a little more iodoform by repeating the treatment. As much as 72 per cent. of crystals may thus be obtained.

Rother (1873) recommended the acidulation of the mother-liquor with hydrochloric acid, the adding of some potassium bichromate to generate chlorine, then of potassium carbonate to render the liquid alkaline, and of some iodine and alcohol, and finally the warming of the mixture. The process will thus be continuous until the accumulation of the salts becomes too great.

The production of iodoform may be explained by the simultaneous formation of potassium iodide, water, and carbonic acid, as follows: $C_2H_6O + 4I_2 + 2KHCO_3$ yields $2CHI_3 + 2KI + 3H_2O + 2CO_2$. The reaction, however, is never so simple, formiate of potassium being perhaps always one of the products, in which case the reaction, according to Liebig, is thus explained: $C_2H_6O + 4I_2 + 6KHCO_3$ yields $CHI_3 + 5KI + KCHO_2 + 5H_2O + 6CO_2$. At the same time other reactions take place, one resulting in the formation of acetic ether, another in the production of ethyl iodide and hydriodic acid; and from great variations of the yield observed it is evident that the result is greatly influenced by the relative proportion of the material and the temperature.

Properties.—Iodoform is in lemon-yellow pearly scale-like crystals, which have a saffron-like odor, and a peculiar sweetish taste. It is insoluble in water, but dissolves readily in alcohol, ether, chloroform, carbon bisulphide, and the fixed and volatile oils. It volatilizes slowly on exposure, fuses at about 115° C. (239° F.), and sublimes partly unaltered, but is mostly decomposed into iodine and hydriodic acid with a residue of glossy charcoal. Heated with water it volatilizes with the vapors without decomposition; but when boiled with potassa solution, a portion of it is decomposed, yielding formiate and iodide of potassium, and when distilled with alcoholic solution of potassa, an oily liquid of an ethereal odor and containing iodine is obtained in the distillate.

The odor of iodoform adheres persistently to the vessels in which preparations of it have been made; it may be removed by solution of potassa, aided by alcohol or boiling water.

Impurities are not likely to be present; the physical properties, and particularly its odor and behavior to solvents, determine the absence of impurities which might result from the process of manufacture. Fixed impurities would be left behind on heating a portion upon platinum foil until the charcoal has been consumed.

Medical Action and Uses.—Given to animals, iodoform occasions a certain degree of hebetude, muscular debility, staggering, and anæsthesia, and, in large doses, muscular rigidity and opisthotonos. Thirty grains were found to be fatal to a guinea-pig, forty-five grains to a rabbit, and sixty grains to a dog of medium size. After death no evidence of irritation is found in the stomach, whose lining membrane, on the contrary, is rather pale. But all the organs exhale the characteristic smell of the medicine. In man, doses of from two to five grains occasion no signs of a caustic operation; but seven or eight grains have caused a decline of the pulse-rate from 72 to 60. Applied to the sound skin and mucous membranes and to ulcers, it is not in the least irritating; on the contrary, it appears to allay all local painful sensations in them, and even blunts common sensibility. Thus it may render the anus so insensible that the passage of the fecal mass will not be perceived. It appears to be eliminated with the breath and all the secretions, and very speedily after its administration.

Directly or indirectly this preparation is stimulant and also anæsthetic. The first successful application of it was for the relief of *pain*, and through that for allaying the congestive and inflammatory processes upon which pain so often depends. This quality was conspicuously displayed in the treatment of *cancer* of the uterus, breast, and other parts; for the progress of the local disease was rendered slower, and the exhaustion of the patient's strength retarded. Indeed, not a few tumors (cancroid), supposed to be cancers, were entirely cured under this treatment. Venereal and all other chronic *ulcers* are most favorably influenced by the application of this substance, the more so in proportion as they are irritable and painful. A solution of one part of iodoform in six or seven of ether is considered by some surgeons preferable to the former agent alone, since it acts in smaller quantity and also as a protective to the sore. Carded cotton thoroughly impregnated with iodoform has also been found very useful for applying the medicine to the nostrils, vagina, and rectum. It promotes the healing of blistered surfaces, and of ulcers left by burns. In some cases of ulcerated fissure of the *anus* it has proved a very useful palliative, as well as in certain hemorrhoidal affections attended with pain in defecation. It may be used with similar effect in *vaginismus*. The gangrenous *vulvitis* which is so common under certain conditions of constitution and recent sickness in hospital practice, is more successfully controlled by powdered iodoform than by any other agent, and in other forms of hospital *gangrene* it is efficacious. The anodyne virtues of iodoform displayed in these affections, as well as in various other painful disorders of the rectum, bladder, and uterus, the mouth and the nasal passages, are also exhibited in some internal disorders, and particularly in those of the stomach. *Gastralgia*, alone or associated with simple *gastric ulcer*, is relieved by it, and sometimes permanently cured. Other *neuralgiæ* have, it is said, been cured by iodoform; but as in every case it was associated with iron, the cure, very probably, was due to the latter medicine. The internal exhibition of the medicine has also been used in the treatment of *syphilis*, particularly when it affected the mouth or throat. But such a method is, in reality, a topical use of the medicine.

Administration.—The *dose* of iodoform internally is from one to three grains, three times a day, in pill. It may be applied topically in powder, the part being previously dried; or, in ointments or suppositories, each application containing at least two grains of iodoform. It may also be used, dissolved in oil or glycerin, as a liniment. The following formulæ have been recommended: ℞. Iodoform, ʒj–ʒiss; Glycerin, fʒxij; Alcohol, fʒiv.—M. ℞. Iodoform, gr. xxx; Alcohol, q. s.; Lard, ℥j.—M. A solution for topical application may be made by dissolving one gramme (15 grs.) of crystallized iodoform in four grammes (60 grs.) of sulphuric ether (60° Baumé).

IPECACUANHA, *U. S.*, *Br.*—IPECACUANHA.

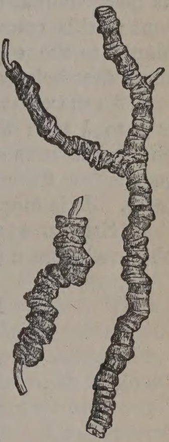
Radix ipecacuanhæ, P. G.—*Ipecac*, E.; *Ipécacuanha*, *Racine brésilienne*, Fr.; *Brechwurzel*, *Ruhrwurzel*, G.

The root of Cephaëlis ipecacuanha, *A. Richard; C.* emetica, *Pers.;* Callicocca ipecacuanha, *Brotero.* Steph. and Church, Med. Bot., plate 62; Woodville, Med. Bot., t. 274; Bentley and Trimen, Med. Plants, 145.

Nat. Ord.—Rubiaceæ, Coffeæ.

Origin.—Two varieties of the plant are known, one with a woody and the other with an herbaceous stem, both being indigenous to the damp forests of Brazil, New Granada, and the northeastern portion of Bolivia, between about 8° and 22° S. lat. The plant has a spreading root, a stem 12 to 18 inches high, opposite, nearly entire, and somewhat hairy leaves, and small white flowers in a dense head, followed by a cluster of dark purplish-blue berry-like fruits, each containing two plano-convex hard nuts. The plant has been introduced into India, and is cultivated to some extent in Sikkim with but moderate success. In Brazil the roots are collected at all seasons, but principally from January to March; they are dug up by means of a stick and pulling the stems, fragments of the roots remaining, which again produce plants. The roots are dried in the sun, and finally packed in bales. About 15,000 pounds are annually imported into the United States.

Fig. 93.



Ipecacuanha.

Description.—The young, thin, and thread-like roots are rejected; the older roots are in pieces of three to five inches in length, and about one-sixth of an inch thick; are mostly simple, bent, and contorted, and consist of a thin, toughish, white, and finely porous ligneous cord, with indistinct medullary rays, and of a thick bark, which is finely wrinkled and closely annulated by projecting circles, the depressions between the rings being often fissured to the wood. The root breaks with a granular and waxy fracture in the brittle bark, which constitutes 75 to 80 per cent. of the weight, and is easily separable from the wood. The color is usually of a dull gray, but occasionally of a reddish or blackish tint. A variety imported from Carthagena is usually thicker, about a quarter of an inch in diameter, less conspicuously annulated, and with distinct medullary rays. Small portions of the thin non-annulated stem are not unfrequently found attached to some of the commercial roots. The odor of ipecacuanha is slight, but heavy and nauseous, and the taste bitterish, somewhat acrid, and nauseating. The root yields a light brown-gray powder.

Constituents.—The common constituents of the root are starch, gum, pectin, sugar, a little fat, and a trace of volatile oil; the important principle is the alkaloid *emetia* or *emetina*, which is combined with *ipecacuanhic acid.* Emetia was discovered in 1817 by Pelletier and Magendie, and is obtained by evaporating the alcoholic tincture of the root to a syrupy consistence, adding potassa in excess and in a well-filled bottle, to prevent access of air, and agitating with chloroform; the chloroformic solution is evaporated, the residue treated with a weak acid, filtered from the resinous matter, and precipitated by ammonia. It is a grayish or whitish inodorous powder, having a bitter taste and an alkaline reaction to test-paper. It is sparingly soluble in cold water, freely so in alcohol and chloroform, slightly soluble in ether and fixed oils. Nitric acid yields with it a slightly soluble brown salt; other dilute acids dissolve it readily, and yield non-crystallizable salts, the solutions of which are precipitated by the general reagents for alkaloids, and by potassium nitrate at 70° C. (158° F.). Emetia fuses like wax, and at a higher heat burns without leaving a residue. Its formula, according to Lefort (1869), is $C_{30}H_{44}N_2O_8$; the yield is little over 1 per cent. By titration with Mayer's solution Zenoffsky (1872) found 3.75 per cent of emetia; much larger yields have occasionally been reported, but are probably over-estimated. Power (1877) observed that emetia is colored bright-yellow or orange by chlorinated lime; a little acetic acid favors the reaction.

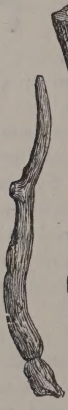
Ipecacuanhic acid, $C_{14}H_{18}O_7$, was, by former investigators, supposed to be identical with gallic acid. Willigk separated it from the precipitate obtained in the decoction by lead acetate, by dissolving in acetic acid and precipitating with subacetate of lead. It is amorphous, brown, very bitter, hygroscopic, soluble in alcohol, little so in ether, colors ferric salts green, and is a glucoside. It appears to be related to caffeo-tannic acid.

Substitutions.—Besides small portions of the stem, the commercial root is usually free from impurities; but several emetic roots known in South America as ipecacuanha, or by the Brazilian designation *poaya*, have occasionally been sent to this country as substitutes; none, however, have any particular resemblance to the cephaëlis root. The following, of which the plants yielding the three first belong to the natural order of Rubiaceæ, are the most important:—

1. STRIATED IPECACUANHA, from Psychotria (Ronobea, *Rich.*) emetica, *Mutis*, is $\frac{1}{4}$ to $\frac{1}{3}$ inch thick, blackish-gray, longitudinally striate; the bark has deep circular fissures at irregular distances, is thick, internally purplish-brown. The root is free from starch, contains much sugar, and has a sweet, afterwards bitter taste. It is employed in New Granada and Peru.

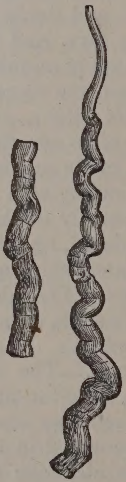
2. SMALL STRIATED IPECACUANHA, noticed by Planchon (1872), probably obtained from a species of *Richardsonia*, resembles the preceding, but is much smaller and only $\frac{1}{12}$ to $\frac{1}{10}$ inch thick, gray-brown, finely striate, has a thick porous wood, and contains starch.

Fig. 94.



Striated Ipecacuanha.

Fig. 95.



Undulated Ipecacuanha.

3. UNDULATED OR FARINACEOUS IPECACUANHA, from Richardsonia scabra, *Lin.*, a native of Brazil, is, in the fresh state, white, when dry, brownish externally and white farinaceous internally; it is irregular undulate, fissured on alternate sides, and of a somewhat knotty appearance.

4. White ligneous ipecacuanha, from Ionidium ipecacuanha, *Vent.*, *Nat. Ord.* Violaceæ, indigenous to Brazil. The root is several inches long, about $\frac{1}{4}$ inch thick, several-headed, somewhat tortuous, not annulate, light gray or yellowish, internally whitish, and with a yellowish wood.

5. Bastard ipecacuanha, from Asclepias currasavica, *Lin.*, *Nat. Ord.* Asclepiadaceæ, indigenous to the West Indies and South America. It has a very short root-stock, which is abruptly divided into numerous thin, pale yellowish-brown, and internally whitish rootlets. It is used in the West Indies like ipecacuanha.

6. Indian ipecacuanha, from Tylophora (Asclepias, *Lin.*) asthmatica, *Wight and Arn.*, *Nat. Ord.* Asclepiadaceæ (Bentley and Trimen, Med. Plants, 177). The root-stock is short, knotty, about $\frac{1}{8}$ inch thick, emitting a considerable number of thin, wiry, brittle, and pale yellowish-brown rootlets.

Off. Prep.—Extract. ipecacuanhæ fluid., *U. S.;* Pilula conii comp., Pilula ipecac. cum scilla, *Br.;* Pulvis ipecac. comp., *U. S.*, *Br.;* Syrup. ipecac., *U. S.;* Trochisci ipecac., Trochisci morphiæ et ipecac., Vinum ipecacuanhæ, *U. S.*, *Br.*

Emetinum coloratum, which is sometimes used in Europe, is made by exhausting ipecacuanha with alcohol, evaporating the tincture to a syrupy consistence, diluting with water, filtering, evaporating the filtrate to dryness, and powdering.

Physiological Action.—Pure emetia is a powerful local irritant, occasioning inflammation and even ulceration of the tissues to which it is applied. Powdered ipecacuanha produces similar but less intense lesions. Friction of the skin with an ointment containing either substance excites, sooner or later, a pustular eruption like that produced by tartar emetic. Two grains of pure emetia suffice to kill a dog. In less toxical doses, it occasions vomiting, great depression of muscular power and of temperature, and diminished frequency and tension of the pulse. After death, the mucous membrane of the stomach and bowels is, according to some, injected, and according to others, pale. These varying results appear to occur whether the poison be given by the stomach, rectum, or veins, or even hypodermically. Moreover, if long continued by either mode of administration, it occasions ulcers of the stomach and small intestine, which are limited to the mucous glands of these organs, and hence are attributed to the elimination of the poison through the glands. The balance of opinion is in favor of the view that nausea and vomiting from ipecacuanha are due to its action upon the nervous centres, and not to its influence upon the gastric terminations of the pneumogastric nerve. Other experiments appear to favor the belief that ipecacuanha excites the brochial secretions, and, in poisonous doses, causes pulmonary congestion. Rutherford and Vignal found that sixty grains of powdered ipecacuanha, mixed with a small quantity of bile and placed in the duodenum, powerfully stimulated the liver; but, owing to the admixture of bile with the drug, this experiment was inconclusive.

In man, the effluvium or dust of ipecacuanha is apt to occasion coryza, and congestion of the larynx and bronchia, causing dyspnœa, cough, and sometimes the rejection of fibrinous sputa. Some persons have a special susceptibility to these effects. In exceptional cases, the conjunctival inflammation reaches a high grade, and is accompanied by neuralgia of the face and scalp. Internally, and in small and repeated doses, ipecacuanha occasions malaise, depression, yawning, salivation, eructation, and nausea, with retching or vomiting. Its emetic operation is not protracted and distressing like that of tartar emetic; but it tends to relax the bowels, if they were previously normal, and to augment the purgative action of cathartics.

Like many other medicines, ipecacuanha in repeated doses, sooner or later, brings about toleration, and produces very different effects from the primary emetic phenomena. But the dose of ipecacuanha is not, at any time, a sure criterion of the effects to be expected from it. Often, four or five grains of it will vomit as much as twelve grains; and while one-tenth of a grain of emetia given to an adult occasioned vomiting, in another case twelve grains were administered within twenty-four hours without exciting either vomiting or diarrhœa. Allowance must be made for the varying degrees of activity of the preparations employed, as well as for the state of the patients who received them.

Medical Uses.—Although the experimental investigations above referred to indicate very little action of ipecacuanha upon the lungs, it is in affections of these organs that the medicine has been so generally employed, that it has come to be classed among *expectorants*. The conditions to which it is appropriate are dryness of the respiratory mucous membrane on the one hand, and excessive secretion or obstruction upon the other. Its mode of action in the two cases is different; in the former, given in small doses, it promotes the bronchial and laryngeal secretions, and thereby renders the cough less painful and frequent, and more productive; in the latter, administered in large doses, it acts as an emetic, producing an expulsion of the contents of the air tubes, while it renders their secretions less tenacious. It is in the former of these ways that it is so efficient in the commencement of the attacks referred to; and in the latter when the bronchia become filled with mucus, serum, or fibrin, as in *whooping cough*, *suffocative catarrh*, *capillary* and *chronic bronchitis*, *bronchorrhœa*, etc. In addition, perhaps, to these two modes of action, a third or antispasmodic action may be recognized in its cure of *spasmodic croup* (spasmodic laryngitis); but quite as probably the relaxation of spasm it occasions is secondary to its sedative, and therefore, so far as the local disorder is concerned, depletory action. A similar operation, no doubt, explains the reputation of the medicine in *spasmodic asthma*. In *membranous croup* it is not without utility in virtue of the same influences, which, however, are inadequate to the occasion. It is far more efficient in the several diseases mentioned, when they occur in children than in adults. The utility of ipecacuanha in *pneumonia*, which has been affirmed, is probably limited to two occasions, the forming, or congestive, stage of the disease, before solidification has taken place, and the declining stage, when the bronchia are apt to become obstructed with softened exudation matter and mucus. In both conditions the emetic action of the drug is appropriate.

Whether by direct stimulation, or by indirectly promoting secretion, there is no doubt that this medicine has proved advantageous in *atonic dyspepsia*, that is to say, when digestion is laborious, painful, attended with flatulence, depression of spirits, cold extremities, etc. The *dose* should not exceed one grain, in pilular form, and may be taken in the morning fasting, or else immediately after meals. The *vomiting of pregnancy* is sometimes arrested by hourly doses of a single drop of wine of ipecacuanha. We have known it to arrest this symptom, in a single day, after it had continued for several weeks.

The title, *radix antidysenterica*, originally applied to ipecacuanha, denotes the estimate then held of its dominant virtue. In Brazil it was the specific for dysentery, and its mode of administration was such as to produce vomiting first, and afterwards tolerance of the medicine. The efficiency of such a method is intelligible in a country where dysentery is apt to assume a bilious type, and an analogy with it is found in a like treatment of the acute febrile diseases of hot climates which is everywhere adopted. In the present instance, antibilious and antipyretic virtues were united in the same remedy. Other forms of acute dysentery than the bilious are not always as advantageously treated by ipecacuanha, and where in such forms the medicine has appeared to be most useful it was usually combined with opium, whose share in the cure should not be overlooked. Of whatever type the dysentery may be, the remedy is most efficient the nearer to the commencement of the attack it is administered. It ought to be given on an empty stomach, and no liquid should be taken for an hour or two after it is swallowed, the patient meanwhile keeping as still as possible. The original Brazilian method of administration was as follows: An infusion was made with 120 grains of the bruised root in six ounces of boiling water, and allowed to stand for twelve hours before the decanted liquid was used. A similar quantity of fresh water was then added to the dregs, for the second day; and the same process was repeated on the third day. Each infusion was divided into two or more portions, one of which was given at intervals of two or three hours if the attack was mild, but both at one dose if the attack was severe. If vomiting occurred, the medicine was, after an interval, repeated. There can be no doubt that when it operates favorably the stools soon lose their dysenteric character and are voided without pain. In Peru it has been the custom to administer the powdered root mixed with a little syrup, and, at the same time, enemas made with an infusion of the root with the addition of laudanum. The enema has been found by many practitioners, in Europe and elsewhere, to be sufficient by itself, when prepared in the following manner: "Take of bruised ipecacuanha 150 grains, and boil it in five fluidounces of water for ten minutes; strain off the liquid and repeat the operation with a fresh portion of water a second and a third time; mix the three portions of liquid and evaporate them in a sand-bath to four ounces; divide this product into two equal parts, and administer one night and morning by enema, directing them to be retained as long as possible." (*Polichronie.*) A simpler, and, apparently, as efficient a formula, is to boil sixty grains of bruised ipecacuanha for ten minutes in five ounces of water; let it infuse for one or two hours, and strain off the decoction. It is only in chronic cases with decided ulceration that any nausea is excited by these enemas. The advantages claimed for the treatment of acute dysentery by ipecacuanha are, the simplicity, safety, and promptness of its operation, its efficiency in curing, and the rapidity of the cure. Even in *chronic dysentery* the same method of employing it has been very successful.

The medicine has long been used in the treatment of *chronic diarrhœa*, either alone or associated with calomel and opium. Of late it has been administered alone, or guarded with opium to prevent its rejection, in *infantile diarrhœa*, in *tuberculous diarrhœa*, and in chronic *dyspeptic diarrhœa*. Of these forms, the one most beneficially influenced by the medicine is the infantile. If the patient is not much exhausted, the medicine may be given at first by the mouth, otherwise by enema, and in the form of infusion. The diarrhœa of consumption, being due sometimes to intestinal ulcers, and sometimes to debility, as well as in both cases to the swallowing of sputa, the results of any treatment must vary with the cause of the symptom. In this case the utility of the medicine is least when the cause is most permanent. If it is too long employed it may create an irritation as great as that which it is fitted to relieve. Whether it acts by substitution, or astringency, or as a stimulant of the vaso-motor nerves, it very certainly diminishes the secretions of the affected part, and apparently does so during its elimination after absorption. The same mode of operation is probable in the case of *hectic sweats*, which are sometimes completely suspended by enemas of ipecacuanha infusion, when other remedies have proved ineffectual. The treatment of *cholera morbus* and of *epidemic cholera* by this medicine has been advocated by numerous physicians who presented ingenious reasons for its use; but neither their opinion nor their practice has prevailed.

The utility of ipecacuanha emetics in *hemorrhage* from the lungs, stomach, uterus, etc., has long been known, but more recently the use of repeated small doses of the medicine, without vomiting, has been very successful in such cases. Probably in hæmoptysis and hæmatemesis a full emetic dose should be first prescribed, after which smaller and only nauseating doses may be substituted. According to the modern views of the action of the medicine, it may be supposed to control hemorrhage by contracting the capillaries, but the earlier explanation, that the heart was depressed and the blood no longer circulated so vigorously, should not be lost sight of.

In bilious *remittent* and *intermittent fevers*, when gastro-hepatic congestion is indicated by the muddy eye and skin, the foul tongue, nausea, bitter taste, distended epigastrium and hypochondria, and, perhaps, bilious vomiting and diarrhœa, an emetic dose of ipecacuanha promptly palliates these symptoms, and renders the action of quinia more immediate and certain. Ordinary *intermittent fever* is alleged to have been cured by doses of one or two grains every three or four hours. In all cases of *indigestion* due to the presence of food in the stomach, of *urticaria* produced by the same cause, and of *poisoning* where it is desired to expel the offending substance, ipecacuanha emetics may be advantageously employed.

As a local application to the eye in purulent *ophthalmia*, when the active inflammatory symptoms have subsided, but chemosis remains with a red and flabby state of the conjunctiva and cloudiness of the cornea, a decoction of ipecacuanha has been found efficient. It may be made by boiling thirty grains of bruised ipecacuanha for ten minutes in five ounces of water. When cool the liquid should be strained off and instilled into the eye.

Administration.—As an emetic, the *dose* of powdered ipecacuanha is twenty grains, or five or ten grains may be repeated every ten minutes, the patient drinking freely of warm chamomile tea, or simply of warm water, as soon as the first signs of nausea appear. Or an *infusion*, prepared with 120 grains of the bruised root in six fluidounces of boiling water, may be given in doses of a fluidounce at intervals of four or five minutes. A *decoction* and its uses have been already described. As a *nauseant*, one or two grains of the powder may be repeated at short intervals; the same *dose*, at longer intervals, may be used as a diaphoretic and expectorant. For infants the syrup is preferable.

IRIS FLORENTINA, *U. S.*—FLORENTINE ORRIS.

Rhizoma iridis, P. G.; *Radix iridis Florentinæ*, *Radix ireos*.—*Orris root*, E.; *Iris de Florence*, Fr.; *Veilchenwurzel*, G.

The rhizome of Iris Florentina, *Lin.* Stephenson and Church, Med. Bot. I. t. 27; Bentley and Trimen, 273.

Nat. Ord.—Iridaceæ.

Origin.—Florentine orris or *white flag* is found in dry localities from the southern shores of the Black Sea westward along the north shore of the Mediterranean; though wild near Florence and Lucca, Hanbury does not regard it as indigenous to these places. It has large sweet-scented white flowers, the sepals with a yellow beard and brownish veins. It is cultivated together with Iris pallida, *Lam.*, which is likewise indigenous to Southern and Southeastern Europe, has a rather tall stem, and pale-blue or purplish flowers, and with Iris germanica, *Lin.*, which is indigenous to Southern and Central Europe, and is met with in Northern Africa and Northern India; it has a lower stem, bears deep-blue or purplish-blue flowers, and it is known in England as *blue flag*. The rhizomes of the three species are collected, and, as it appears, those of the last two much more frequently than of the first. They resemble each other very closely, and, though the branches of the second species are usually broad and stout, there are no permanent characters by which they may be distinguished. The rhizomes are collected in the latter part of summer, peeled, and dried in the sun. 28,000 pounds of orris root reach the United States annually.

Description.—The horizontal rhizome is composed of joints, which are 2 to 4 inches long, the broadest part near the apex about an inch wide, tapering below, and abruptly narrowed above to the circular stem-scar, from two sides of which similar joints are produced. The rhizome is vertically compressed, and, when peeled, of a white or whitish color externally and internally. The leaf-scars on the upper side are indicated by the transverse lines of vascular bundles, and the rootlets on the lower surface by circular brownish scars, which are more crowded near the upper end. The texture is firm, the rhizome breaking irregularly, and shows upon the transverse fracture, near the surface and parallel with it, a distinct nucleus sheath inclosing a number of scattered wood-bundles. Orris root has an agreeable violet-like odor, which is slowly developed on drying, and a mealy, afterwards bitterish and somewhat acrid, taste. The powder has a whitish color.

Constituents.—Orris root contains a minute quantity of volatile oil, which is solid, crystalline, and of a pearly lustre, as described by Dumas (1835). By distillation with steam, a solid crystallizable substance is obtained which Flückiger found to consist mainly of *myristic acid* impregnated with a little volatile oil; this acid, however, does not pre-exist in the rhizome. This constitutes the commercial *oil of orris root;* but a *liquid oil of orris* has recently appeared in the market, which is said to be made by adding oil of cedar-wood to the crushed rhizome, and distilling the mixture with water. Orris root contains also a large quantity of starch in very small granules, some soft brownish resin of an acrid taste, and a little tannin which colors ferric salts green.

Adulterations.—The rhizomes of other species of Iris in most cases resemble the officinal one in shape, but are destitute of its agreeable odor; those of *Iris pseudacorus*, Lin., and *I. fœtidissima*, Lin., which are indigenous to Europe, have a darker color and a more astringent and acrid taste. The adulteration of powdered orris is best detected by the microscope, from the different shape of the starch-granules contained in the material employed for the purpose.

Medical Action and Uses.—The fresh root is said to possess irritant properties, and, taken internally, to cause colic, vomiting, and purging, while the dry root acts as a moderate digestive stimulant. When powdered and applied to the nostrils it excites sneezing and increased secretion, and in the mouth a flow of saliva. It is asserted that when freely sprinkled in the hair it has caused alarming nervous symptoms. It was formerly used along with more active medicines in the treatment of *chronic diarrhœa* and *bronchitis*, and also as a diuretic and sternutatory. A piece of the root was, and occasionally is still, employed for children to bite upon while teething; it probably excites salivation and mitigates the pain of the process. Iris is also used to make issue "peas," is often added to dentifrices on account of its aromatic flavor and its favorable action on the gums, and is an ingredient in *pastilles* used for the same purpose, or to conceal fetor of the breath. Its liability to be attacked by insects renders care in its use as an issue "pea" desirable.

IRIS VERSICOLOR, *U. S.*—BLUE FLAG.

Rhizome d'iris varié, Glaïeul bleu, Fr.; *Verschiedenfarbige Schwertlilie*, G.

The rhizome of Iris versicolor, *Lin.* *Nat. Ord.*—Iridaceæ.

Origin.—The blue flag is common in wet and swampy meadows of Canada and the United States, and flowers in the latter part of spring. The sword-shaped leaves are about as long as the stout stem, which bears a few showy blue flowers, having the three outer lobes of the corolla with a yellow blue-veined base, and the inner lobes paler.

Description.—The rhizome is horizontal, and like the preceding grows in annual shoots or joints, bearing a flowering stem at their end, and producing two or often four lateral branches. The joints are 2 to 4 inches long, cylindrical at the base, the upper portion vertically flattened and $\frac{3}{4}$ to 1 inch broad; they have an annulated appearance from the projecting leaf-scars, and at the lower side are beset with simple rootlets, 4 to 6 inches long, and somewhat crowded near the broader end of the joint. The color of the fresh rhizome is yellowish-brown, when dry gray-brown, and internally gray or brownish. Nucleus sheath, and arrangement of wood-bundles are as in the preceding. The dry rhizome has no marked odor; its taste is acrid and nauseous.

Constituents.—The rhizome contains starch, tannin, and acrid resinous matter; the latter may probably represent its medicinal virtues. An analysis, however, is very desirable.

Medical Action and Uses.—The fresh root has an acrid taste, and its expressed juice is emetic and cathartic, and produces great prostration. Diuretic and cholagogue virtues are also ascribed to it. It was a medicine highly esteemed by the aborigines of this country. Its activity appears to depend upon its oleoresin, which may be used as a purgative in the dose of one or two grains. The *dose* of the dried root is stated to be from ten to twenty grains.

JALAPA, *U. S.*, *Br.*—JALAP.

Tuber jalapæ, P. G.; *Radix jalapæ.*—*Jalap*, Fr.; *Jalape*, *Jalapenknollen*, G.

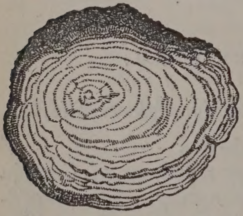
The tuber (tubercules) of Exogonium purga, *Bentham*, Bot. Mag., vol. lxxiii. plate 4280. (Ipomœa purga, *Hayne;* Convolvulus purga, *Wender.;* C. jalapa, *Schiede;* Ipomœa schiedeana, *Zucc.;* Ipom. jalapa, *Nutt.*)

Nat. Ord.—Convolvulaceæ.

Origin and Collection.—This twining herbaceous perennial is indigenous to the damp and shady woods on the eastern slope of the Mexican Andes at an altitude of from 5000 to 8000 feet. It has been introduced into India, and flourishes well in the Nilgherry Mountains. It has alternate cordate leaves, acute at the apex and the basal lobes, and axillary cymes of 3 to 5 dark pink-colored flowers, with a long tube, spreading border, and protruding stamens. The tubers (hypertrophied roots, *Bentley*) are collected during the whole year, but principally in the spring. Owing to the wet climate the drying cannot be effected by exposure to the sun, but is accomplished by suspending the tubers in a net over a wood fire; the smaller pieces are dried entire; the larger ones are incised to facilitate the drying. The supply of jalap is very variable.

Description.—Jalap, when fully developed, is napiform or depressed globose in shape, above marked by the scar of the overground stem, below suddenly contracted into a thin root. The tubers are often pyriform, ovate, oblong, or nearly cylindrical in shape, and vary in size from that of a walnut to 3 or 4 inches in diameter. They are externally of a dark brown color, and usually of a smoky appearance, more or less longitudinally wrinkled, and beset with brown broad corky warts, becoming transversely confluent. Jalap is hard and tough, and breaks irregularly; the transverse fracture is not fibrous, and shows a distinct concentric arrangement. The bark is quite thin, gray-brown, with a large number of resin cells, forming a dense zone near the cambium line. The central portion of jalap resembles the bark, except that the resin cells are arranged in concentric circles, which vary in width, a zone of 3 or 4 rows of resin cells, usually alternating with one of a single row. Jalap has a very faint radiate appearance, the fibro-vascular bundles being small and not very numerous. It has a slight smoky and sweetish odor, and a sweetish afterwards acrid taste. Good jalap should not be deeply wrinkled or sticky externally, but should be plump, heavy and hard, and when fractured should present a resinous appearance.

Fig. 96.



Transverse section of Jalap.

Impurities and Substitutions.—Jalap appears to be sometimes collected in an immature state or at an improper season; at least many of the tubers frequently contain little resin, but otherwise present all the characteristics of genuine jalap. Occasionally jalap has been met with which has been previously deprived of the resin, and is then sticky upon the surface, and of a dark color internally. A *mealy jalap* has been observed, which resembles true jalap externally but has few scattered resin cells and a mealy fracture. The so-called *jalap stalks, male, fusiform or woody jalap*, consist of the tuberous root of Ipomœa orizabensis, *Pelletan*, often cut into transverse slices 2 to 3 inches broad, light brown and more fibrous in texture; it is spindle-shaped, 2 feet long, and contains resin which is entirely soluble in ether. *Tampico jalap*, from Ipomœa simulans, *Hanb.*, forms globular or elongated tuberous pieces, which are often smaller, but occasionally larger than true jalap, deeply wrinkled, and destitute of transverse scars: the resin contained in it is completely soluble in ether.

The tuberous root of Mirabilis jalapa, *Lin.*, or Four-o'clock, resembles jalap somewhat in shape, but is darker externally, and contains a large number of acicular crystals.

Radix mechoacannæ, probably obtained from a convolvulacea, is found always in sections, of a whitish or gray color, destitute of resinous circles; it cannot be mistaken for jalap.

Constituents.—Jalap contains starch, gum, sugar, and extractive matter; its medicinally important constituent, however, is *resin*, of which selected pieces may contain 22 per cent., but which varies in good commercial jalap between 12 and 18 per cent. About $\frac{1}{12}$ or $\frac{1}{10}$ of the resin is soluble in ether, of a brown color, acid reaction and acrid taste; it is soluble in alkalies, and reprecipitated from these solutions by acids. It is contained in the officinal resin of jalap, the main constituent of which is the resin insoluble in ether; this, investigated by Kayser (1844), was named *rhodeoretin*, and by W. Mayer (1852), *convolvulin*. When pure it is colorless, transparent in thin layers, inodorous and tasteless; it consists of $C_{62}H_{100}O_{32}$, dissolves readily in caustic alkalies, and is not reprecipitated by acids, but converted into *convolvulic acid*, $C_{62}H_{106}O_{35}$, of which convolvulin is the anhydrid. Both are glucosides, and when boiled with dilute acids, yield sugar and *convolvulinol*, $C_{26}H_{50}O_7$, which crystallizes in needles, is bitter and acrid, and when treated with alkalies, loses water, and is converted into *convolvulinolic acid*, $C_{26}H_{48}O_6$. Convolvulin and its derivatives, on being oxidized with nitric acid, are finally converted into oxalic and *ipomic acids*, the latter being $C_{10}H_{18}O_4$.

W. Mayer (1855) has very improperly given the name of *jalapin* to the resin obtained from orizaba root, which with all its derivitives is homologous to the preceding. *Jalapin*, $C_{68}H_{112}O_{32}$, closely resembles convolvulin, but is soluble in ether. Dissolved in alkalies it is converted into *jalapic acid*, $C_{68}H_{118}O_{35}$, which is soluble in water; when treated with dilute acids, into sugar and *jalapinol*, $C_{32}H_{62}O_7$, which is acrid, and with alkalies yields *jalapinolic acid*, $C_{32}H_{60}O_6$. Nitric acid oxidizes these compounds to oxalic and ipomic acids. Spirgatis (1860) considers jalapin chemically identical with *scammonin*.

The resin of the tampico root is likewise homologous. Spirgatis (1870) calls it *tampicin*, $C_{68}H_{108}O_{28}$, which yields with alkalies *tampicic acid*, $C_{68}H_{120}O_{34}$, and with diluted acids sugar and *tampicolic acid*, $C_{32}H_{64}O_6$.

Allied Plants.—Of the numerous species of Ipomœa which have been used like jalap, we mention the following in addition to those named above:—

I. pandurata, *Meyer*, s. Convolvulus panduratus, *Lin.*, grows in sandy banks in the United States, and is known by its pointed, heart-shaped leaves, which are sometimes contracted near the middle, and fiddle-shaped. The root is elongated, cylindrical, two or three feet long, one to several inches thick, abruptly contracted above to the thickness of a finger. It is pale-brownish externally, grayish-white internally, and emits, when wounded, a resinous milk juice. It is known as *manroot*, *man of the earth*, *wild jalap*, and *wild potato*, and is feebly cathartic.

I. turpethum, *R. Br.*, *Turpeth root*, is indigenous to India and the East Indian Islands. The root is met with in commerce in pieces of various length, ½ to 1 inch thick, frequently with pieces of the woody stem attached, reddish-brown externally, internally grayish or brownish. The bark is thick, mealy, and contains numerous small brown resin cells in concentric rows, and several, or in older roots numerous woody groups. The central wood is pale brown, porous, and divided by narrow medullary rays into four or six parts. The resin, *turpethin*, $C_{34}H_{56}O_{16}$, is insoluble in ether, and resembles jalap resin in its behavior to alkalies and dilute acids.

I. nil, *Roth*, s. Convolvulus (Pharbitis, *Choisy*) nil, *Lin.*, is indigenous to the tropics, and grows spontaneously in the Southern United States. The seeds are about ¼ inch long, black, somewhat triangular, rounded on the back, of a rather heavy odor while fresh, and of a sweetish, afterwards acrid taste. The seeds, which contain a fixed oil and resin, are known in India as *kaladana*, and roasted or in powder, are used as a purgative, like but somewhat weaker than jalap.

Off. Prep.—Extract. jalapæ, Pulv. jalapæ comp., *U. S.*, *Br.*; Pulv. scammonii comp., *Br.*; Resina jalapæ, Tinctura jalapæ, *U. S.*, *Br.*

Medical Action and Uses.—Jalap, and its resinous principle, convolvulin, act as local irritants, and, taken into the stomach, produce irritation of that organ, with nausea, vomiting, colic, and mucous, watery, and even bloody dejections, according to the dose. When given to dogs in excessive doses it may occasion death, after which the gastro-intestinal mucous membrane has been found inflamed. Although it is said to produce analogous effects in these animals when rubbed into the skin, it is, on the other hand, denied that this effect takes place in man, and affirmed that the milk of nursing women is not rendered purgative by its use. So, too, convolvulin, which purges if taken into the stomach, has no such effect when it is injected into a vein, or hypodermically. Its special virtues depend upon its being a hydragogue cathartic, whose operation is not rendered less decided by the repetition of the medicine. Hence it is profitably employed for the removal of *dropsical effusions*, from whatever cause they arise, the permanence of its usefulness depending upon the organic cause of the dropsy. It is usually associated with bitartrate of potassium for this purpose; and with calomel in congested states of the liver or spleen. It is to be commended in states of *constipation* attended with habitual dryness of the intestine, when it should be given in a dose of two or three grains in the morning fasting, and followed within an hour with a draught of cool water. A grain or two of aloes the night before renders its operation more certain, and is apt to promote the biliary secretion. It is not an anthelmintic, but a *vermifuge*, and is associated habitually with proper vermicide medicines.

Administration.—The dose of jalap is from fifteen to twenty grains. Its powder should be thoroughly triturated with sugar flavored with an aromatic oil. The resin is estimated to be from two to four times as strong as jalap. The syrup of rhubarb is said to completely dissolve it, and to increase its efficiency.

JEFFERSONIA.—TWINLEAF.

Jeffersonia diphylla, *Barton*. *Nat. Ord.*—Berberidaceæ.

Origin.—The twinleaf is an herbaceous, acaulescent perennial, growing in woods in the Middle, Southern, and Western United States. The leaves are on long petioles, composed of two obliquely ovate leaflets: the scape is about 10 inches high, bearing a white flower an inch broad, which has 4 fugacious sepals, 8 spreading petals, and 8 stamens, and produces an obovate capsule with many seeds. It flowers in April and May.

Description.—The rhizome is horizontal, knotty, beset with long, fibrous, and matted roots of a yellowish or dark-brown color, somewhat corrugated, and transversely fissured; the bark is brown, of a resinous appearance, and has a bitter and acrid taste. The pale-yellowish wood is destitute of taste.

Constituents.—The rhizome was analyzed by E. S. Wayne (1855), and contains, besides the ordinary vegetable principles, tannin, precipitating ferric salts dark-green, a bitter principle and an acrid acid analogous to polygalic acid. F. F. Mayer (1863) states that the rhizome contains a small quantity of *berberina*, a larger proportion of a *white alkaloid*, and a considerable amount of *saponin*.

Medical Action and Uses.—No recent observations seem to have been made of the virtues of this plant. It is said to be diuretic, tonic, and expectorant in small, and emetic in large doses. It has been compared to seneka.

JUGLANS, *U. S.*—BUTTERNUT BARK.

Écorce de noyer gris, Fr.; *Graue Wallnussrinde*, G.

The inner bark of the root of Juglans cinerea, *Lin.* (J. cathartica, *Mich.*; J. oblonga, *Mill.*) Bentley and Trimen, Med. Plants, 247.

Nat. Ord.—Juglandaceæ.

Origin.—A handsome tree, thirty to forty feet high, growing in forests and bottom lands in Canada and the greater portion of the United States. The leaves are composed of about fifteen sessile oblong-lanceolate, serrate, and underneath pubescent leaflets; the staminate flowers are in aments about four inches long; the pistillate flowers, to the number of about five, form a spike; the fruit is ovoid-oblong and viscid pubescent. The tree flowers in April and May, and ripens its fruit in September and October. The bark is collected in May and June, and is deprived of its corky layer.

Description.—The liber of which the medicinal article exclusively consists is white when fresh, but rapidly turns yellow and deep brown. The outer surface has often thin patches of cork adhering; the inner surface is smooth and striate. The tangential arrangement of the brownish bast fibres alternating with the white parenchyma, and crossed by the numerous fine white medullary rays, gives the cross section a delicately checkered appearance. The bark breaks readily with a short fracture both transversely and longitudinally. It has a feeble odor and a bitter, somewhat acrid taste. If collected in April it has a sweetish, insipid taste, and is said to be less active.

Constituents.—The bark has been examined by Thiebaud (1872), and by Dawson (1874). The latter found a little tannin, trace of volatile oil, a little resin, and 14 per cent. of fixed oil; also a volatile acid, called by Thiebaud *juglandic acid*, but which is doubtless identical with the *nucin* of Reischauer and Vogel (1856), discovered by them in the pericarp and leaves of *Juglans regia*, Lin. Nucin has an acrid taste, an acid reaction to test-paper, and is sparingly soluble in water, more so in alcohol, and readily so in ether; it crystallizes as orange-yellow needles, and acquires, with alkalies and with the alkaline borates and phosphates, a handsome purple color. If the properties of the bark depend wholly or in part on this principle, it is easily explained why continued boiling should render it less efficacious.

The green pericarp and the leaves of *Juglans cinerea*, Lin., or English walnut, have been used for similar purposes. The young fruit of both species is used for pickles, and when ripe their kernels yield a bland and drying fixed oil, known as *nut oil;* it is greenish or pale yellow, congeals like lard at about —18° C. (0° F.), and acquires a red color with nitric acid, and a dark-brown one with a mixture of nitric and sulphuric acids.

Off. Prep.—Extractum juglandis, *U. S.*

Medical Uses.—It is employed medicinally in the form of the officinal extract alone.

JUJUBA.—JUJUBE BERRIES.

Jujube, Fr.; *Brustbeeren*, *Judendornbeeren*, G.

The fruit of Zizyphus vulgaris, *Lin.*, and Z. lotus, *Lam.*

Nat. Ord.—Rhamnaceæ.

Origin.—The jujube shrubs are indigenous, the former to Asia Minor and Syria, the latter to Northern Africa, and are cultivated in Southern Europe. They are shrubby, or sometimes tree-like, and have alternate ovate and serrate three-nerved leaves at the base, with two prickly, afterwards spiny stipules. The fruit is a two-celled and two-seeded, or by abortion one-celled and one-seeded, drupe.

Description.—Jujubes are nearly an inch long, bright-red, or after drying brownish-red, wrinkled, with a thin leathery pericarp, a soft mucilaginous and sweet sarcocarp, and an ovate, acute, wrinkled, and usually one-seeded endocarp. The fruit of the second species is about one-half the size of the first.

The fruits of Ziz. jujuba, *Lam.*, a slender East Indian tree, and of several other species, possess similar properties.

Constituents.—Jujubes contain mucilage and sugar. The bark contains tannin.

Pharmaceutical Uses.—MASSA DE JUJUBIS, Jujube paste, *E.*, Pâte de jujubes, *Fr.*, is prepared by extracting 5 parts of jujubes in sufficient water to obtain 35 parts of infusion, in which are dissolved gum arabic 30 parts and sugar 20 parts; the solution is evaporated, 2 parts of orange-flower water added, kept slowly boiling for twelve hours, and then poured into moulds. *F. P.* In the jujube paste, as sold in the United States, the jujubes are usually omitted.

Medical Action and Uses.—In the native countries of the jujube its fruit is ranked with figs and raisins and other more or less saccharine and acidulous fruits, which are used in tisanes for acute irritations of the throat and air-passages, much as in this country we employ the syrup and jelly of currants, blackberries, etc. The so-called jujube paste seldom contains any of the fruit, but is made of gum arabic and sugar with some flavoring ingredient and a variable proportion of opium.

JUNIPERUS, *U. S.*—JUNIPER.

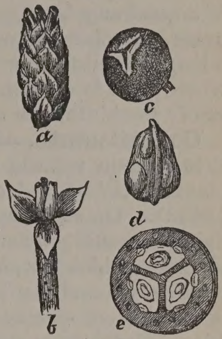
Fructus juniperi, P. G.; *Baccæ juniperi.*—*Juniper berries*, E.; *Genièvre*, *Fruits* (*Baies*) *de genièvre*, Fr.; *Wachholderbeeren*, G.

The fruit of Juniperus communis, *Lin.* Woodville, Med. Bot., t. 6; Bentley and Trimen, Med. Plants, 255.

Nat. Ord.—Coniferæ, Cuppresseæ.

Origin.—Juniper is indigenous to the northern hemisphere, and is found in North America from the Southern United States to Canada and Greenland, and westward to the Pacific, throughout Asia from the Himalayas northward, in Northern Africa, and throughout Europe. It is commonly a shrub four to six feet high, sometimes arborescent, or, in the variety *alpina* (*Jun. nana*, Willd.), prostrate and spreading, the latter being met with in arctic and mountainous localities. The numerous leaves are persistent, spreading, in whorls of three, linear and sharp-pointed; the staminate flowers are arranged in short ovate catkins; the pistillate form a short cone consisting of about five imbricate whorls, each of three scales. Three naked ovules are situated at the base of the upper whorl, and after fructification, these scales enlarge, coalesce, become fleshy and ultimately inclose the seeds, forming the officinal berry-like galbulus, which ripens during the second year.

Fig. 97.



Juniperus communis, *Lin.*—*a*, fertile catkin; *b*, the same deprived of lower scales; *c*, galbulus; *d*, seed (magnified) with oil glands; *e*, transverse section of galbulus.

Description.—Juniper berries are nearly globular, about one-third of an inch in diameter, dark-purplish, and covered with a whitish bloom; the short stalk at the base contains one or two whorls of the small scales, and the apex is marked by three radiating furrows, which are surrounded by ridges inclosing a triangular space. The three bony seeds are ovate in shape, triangular above, have six to ten large oil sacs on their surface, and are imbedded in a brownish pulp which likewise contains oil cells. Juniper berries have an aromatic, somewhat balsamic odor, and a sweet, terebinthinate, bitterish, and slightly acrid taste. The trade is mostly supplied from Southern and Central Europe.

Constituents.—Juniper berries were analyzed by Trommsdorff (1822), Nicolet (1831), Steer (1856), and Donath (1873). They contain from ½ to 2½ per cent. of volatile oil, about 30 per cent. of sugar, resins amounting to 10 per cent., 4 of protein compounds, fat, wax, formic and acetic acids, malates, and *juniperin*, which is light-yellow, slightly soluble in water, freely so in alcohol and ether, and with a golden-yellow color in ammonia.

Other Products of Juniper.—*Juniper wood, lignum juniperi*, is used in Europe as an alterative and diaphoretic in diseases of the skin and rheumatic affections. The resinous exudation found in the bark, *resina juniperi*, is sometimes called *German sandarac.* (See also Oleum juniperi.)

Off. Prep.—Infusum juniperi, *U. S.*

Medical Action and Uses.—Juniper is stimulant, stomachic, carminative, diuretic, and emmenagogue. It communicates a special odor to the urine. It is much used in the treatment of *dropsies*, and especially of scarlatinous and other forms of dropsy due to tubular obstruction of the kidneys. (Juniperi contus., Potassii bitart., āā ℥ss; Aquæ fervent., Oj. Make an infusion, to be used in divided doses, during twenty-four hours. Acetate of potassium may be substituted for the bitartrate in this formula, but in half the quantity. The diuretic virtues of the infusion may be increased by the addition of parsley, buchu, horse-radish, etc.) In chronic catarrhal affections of the *urinary passages* juniper is sometimes useful, and also when sabulous matter is habitually voided. As an anodyne for painful *swellings*, and generally for *local pains*, bruised juniper berries are sometimes used, and fumigations made by throwing the berries upon hot coals may be employed to relieve rheumatic pains.

JUNIPERUS VIRGINIANA, *U. S.*—Red Cedar.

Cèdre de Virginie, Fr.; *Virginische Ceder, Rothe Ceder*, G.

The tops of Juniperus virginiana, *Lin.* *Nat. Ord.*—Coniferæ, Cuppresseæ.

Origin.—Red cedar is shrubby or is more frequently a tree 50 or sometimes 90 feet high, growing in sterile or rocky soil in Canada and the United States, south to the Mexican Gulf and westward to the Pacific. It has a compact, reddish, and odorous wood, horizontal branches, the older leaves spreading and awl-shaped; the young leaves appressed and imbricate, and a small non-pendulous fruit. The young branches, on which the leaves are still appressed, are collected for medicinal purposes.

Description.—The branchlets resemble savine, are about one inch long, and of a quadrangular appearance from their four rows of scale-like leaves, which are ovate lanceolate, obtuse, or rather acute, appressed, and imbricated. They have a longitudinal furrow on the back, which gradually deepens towards the base, where there is contained a circular or oblong gland. They have a not unpleasantly terebinthinate odor, and an aromatic bitterish and somewhat acrid taste.

Constituents.—Red cedar was analyzed by W. J. Jenks (1842) who found it to contain volatile oil, resin, fat, tannin, and other common constituents of plants. *Oil of red cedar*, distilled from the wood, was examined by Walter (1842). On exposing it to cold, expressing the congealed mass, and recrystallizing the solid portion from alcohol, *cedren camphor*, $C_{15}H_{26}O$ (*Gerhardt*), was obtained, which has an aromatic odor and a slight taste. The liquid portion, after rectification and distillation over potassium, is *cedren*, $C_{15}H_{24}$ (*Gerhardt*), which is colorless, of specific gravity 0.98, boils at 237° C. (458.6° F.), has an aromatic odor differing from that of the camphor, and an aromatic afterwards pepper-like taste.

Medical Action and Uses.—The leaves of red cedar are said to possess in a less degree the qualities of savine, but definite information upon the subject is wanting, so far as their internal operation is concerned. An ointment prepared with them is employed as a dressing to maintain the discharge of suppurating surfaces. An infusion of the berries is reported to be diuretic; and the small, gall-like excrescences found on the branches are eaten as an anthelmintic medicine.

KALMIA.—MOUNTAIN LAUREL.

Calico-bush, *Spoonwood*, E.; *Kalmie*, Fr., G.

The leaves of Kalmia latifolia, *Lin.* *Nat. Ord.*—Ericaceæ, Ericineæ.

Origin.—This shrub is found in Canada and the United States, west to Ohio and Kentucky, and is abundant in many places, preferring woods on rocky hills and damp soil. It is usually about 6 feet high, but sometimes tree-like and 15 or 20 feet high. The elegant but inodorous flowers appear in May and June, are in dense racemose corymbs, and have a rose-red or whitish subcampanulate corolla, which, in its lower part, is furnished with 10 cavities, holding the 10 anthers until they begin to shed their pollen. The Indians are said to have made spoons from the wood.

Description.—The leaves are alternate, two or three inches long, petiolate, coriaceous, oval-lanceolate or elliptic, entire, acute at both ends, smooth and green on both sides. They are without odor, and have an astringent and bitterish taste.

Constituents.—Chas. Bullock (1848) proved the leaves to contain tannin, a principle resembling mannit, an acrid principle, resin, gum, and other common constituents of plants. Kennedy (1875) isolated *arbutin*, which appears to be present in smaller proportion than in uva ursi.

Allied Plants.—KALMIA ANGUSTIFOLIA, *Lin.*, known as *sheep-laurel*, *sheep-poison*, and *lamb-kill*, has opposite or ternate linear-elliptic leaves, which are 1 or 2 inches long and whitish or brownish beneath. The small flowers are of a deep crimson color.

KALMIA GLAUCA, *Ait.*, *Swamp-laurel*, has pale purple flowers and subsessile lanceolate leaves, which are glaucous beneath, about an inch long, and opposite on the two-edged branches.

ANDROMEDA MARIANA, *Lin.*, or *stagger-bush*, is likewise reported to be poisonous to lambs and calves. It is a shrub 2 or 3 feet high, produces clusters of white, nodding, ovate-cylindrical flowers, and has thick, but deciduous, smooth, oval or oblong, entire leaves, about 2 inches long.

OXYDENDRUM ARBOREUM, *D. C.*, s. Andromeda arborea, *Lin.*, *sorrel tree*, or *sourwood*, is about 40 feet high. The leaves are deciduous, oblong-lanceolate, pointed serrulate on the margin, and nearly smooth. They resemble peach leaves in shape, and have a refreshing acidulous taste.

All the species named above belong to North America.

Medical Action and Uses.—The leaves and berries of the mountain laurel have long been known to be poisonous; but their action has chiefly been learned through the effects produced in man by eating the flesh of partridges (*Tetrao umbellus*) that have fed upon the berries. From a number of cases observed or collected by Dr. Jacob Bigelow, he prepared (1857) the following summary of the symptoms of this poisoning. The flesh of the bird "acts as a direct sedative poison, impairing the functions of the brain, and, in connection, those of the digestive and circulating systems. The cerebral symptoms, in a majority of the cases, have been vertigo, loss of sight, tinnitus aurium, and in bad cases general loss of the power of sensation and voluntary motion. Respiration has been slow, sometimes to a great degree. In the circulating system there has been syncope, feeble and sometimes irregular action of the heart; weak, slow, and sometimes imperceptible pulse; cold surface, and pale or livid complexion. In the digestive system there are oppression, nausea with a tendency to vomit, and in many cases pain in the abdomen extending through to the back. In more rare cases pain has been felt in the head and limbs. . . . The poison of the partridge has never, to my knowledge, proved fatal." One of the most recent cases was published by Dr. Homans in 1871, and answers trait for trait to the summary given above. The connection of these symptoms with laurel poisoning has been questioned, and they have been attributed to the partial putrefaction of the bird's meat when it was eaten. But as they are identical with the effects observed by Stabler in himself after taking a strong decoction of laurel leaves, there need be no doubt of their having been referred to their true source. The medicinal value of this plant is almost entirely conjectural. The bruised leaves and also a decoction are said to have been applied to certain cutaneous eruptions, and it is added that alarming symptoms have sometimes resulted, probably because the skin was not whole. It might be profitable to test their efficacy in neuralgic and other local pains, by applying them in the same manner.

KAMALA, *Br.* See ROTTLERA.

KINO, *U. S.*, *Br.*—KINO.

Gummi (s. Resina) Kino.—*Kino*, Fr., G.

The inspissated juice, obtained from incisions made in the trunk of Pterocarpus marsupium, *D. C.* (*Roxb. Corom.*, plate 116; Bentley and Trimen, Med. Plants, 81), and of other plants.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The kino tree, called *buja* in Bengal, is about 60 feet high, has numerous spreading branches, a red inner bark, unequally pinnate deciduous leaves, yellowish flowers in loose racemes, and nearly orbicular and winged pods, which contain a single kidney-shaped seed. It is indigenous to India and Ceylon, and, on incisions being made through the bark, yields a red juice, which is dried by exposure to the air and sun. Some kino is also yielded by *Pter. indicus*, Willd., a native of Southern India.

Description.—East India or Malabar kino is met with in small, angular, dark-red, glistening, and brittle pieces, which in thin layers are transparent, and of a ruby-red color; it softens between the teeth, is inodorous, and has a very astringent and sweetish taste. It is partly soluble in water, leaving a flocculent residue, entirely soluble in alcohol, and insoluble in ether.

Constituents.—By treating kino with ether, Eissfeldt (1854) obtained a minute quantity of *pyrocatechin*. The products of the dry distillation of kino contain a larger quantity of the same substance, which may be obtained pure by subliming in a benzoic acid apparatus. Kino contains no *catechuic acid*, but its tannin, *kino-tannic acid*, seems to be chemically related to the former, since it yields similar decomposition products; but it has not yet been obtained in a pure condition, being accompanied by red coloring matter, and according to Hennig (1853) by a pectin compound, from which it cannot easily be freed. The aqueous solution of the acid gives with pure ferrous salts when carefully neutralized a violet color, and with ferric salts a blackish-green one. Mineral acids and many metallic salts produce precipitates; hot nitric acid converts it into oxalic acid. In solution it is darkened by alkalies; and when treated with fusing potassa it is decomposed into *protocatechuic acid* and *phloroglucin*. On exposure to air, the aqueous solution yields a red precipitate, slowly at the ordinary, more rapidly at the boiling temperature; this is *kino red*, an amorphous, tasteless mass, the alcoholic solution of which has a slight acid reaction. Kino yields about 1.3 per cent. of ash.

Other varieties of Kino.—AFRICAN or GAMBIA KINO exudes naturally from Pteroc. erinaceus, *Poir.*, of Western Africa, and agrees with the Bengal kino in behavior; it is not an article of commerce.

AUSTRALIAN or BOTANY BAY KINO is usually referred to Eucalyptus resinifera, *Smith* (Myrtaceæ); but F. von Mueller sent exudations from sixteen different species to Wiesner (1871), who found the products of E. rostrata, *Schlech.*, E. corymbosa, *Sm.*, E. piperita, *Sm.*, and of some others to agree well with Malabar kino, while the exudation of E. resinifera, E. gigantea, *Hook.*, and others, contains much gum, which is colored red by a kino-like substance. A kino-like substance is occasionally obtained from E. globulus, *Lab.*

BENGAL or PALAS KINO; *Butea gum*, from Butea frondosa, *Roxb.* (*Leguminosæ*), is in dark ruby-colored tears and fragments, of which only about one-half is soluble in hot alcohol; it yields about 1.8 per cent. of ash.

JAMAICA, WEST INDIAN, or CARACAS KINO, from Coccoloba uvifera, *Lin.*, or *sea-side grape* (*Polygonaceæ*), is obtained by boiling the wood and bark, and evaporating the decoction. It resembles Malabar kino in appearance, but is of a more brownish tint, less glossy, and has a bitterish rather than a sweetish taste; it is soluble in both alcohol and water to the extent of about 90 or 93 per cent. The tannin of this kino seems to be closely related to, if not identical with, that of the officinal article.

Off. Prep.—Pulv. catechu comp., Pulv. kino comp., *Br.;* Tinctura kino, *U. S.*, *Br.*

Medical Action and Uses.—This astringent is more lenitive than other medicines of the same class, in consequence, probably, of the pectin it contains. Its modified astringency renders it in some degree a local tonic. It is chiefly used in the treatment of *diarrhœa*, and of that form of gastric disorder known as *pyrosis*. In the former it may be profitably employed when pure astringents would be too irritating, and generally associated with opium, as it also should be in the treatment of water-brash. It has sometimes been given with apparent advantage to check *sweating* in phthisis, urination in *diabetes*, and bleeding in *menorrhagia*. Its solution may be used as an injection in diarrhœa, *dysentery*, and *leucorrhœa;* as a dressing for flabby *ulcers*, and as a gargle in ulcerated *sore throat.* In powder it has been employed as a *hæmostatic.* But as a local application it is inferior to other astringents, and especially to tannin.

Kino may be prescribed in powder in the *dose* of from ten to twenty grains. An infusion may be made with one hundred and twenty grains of kino in eight fluidounces of boiling water. When cool, it should be strained, and given in doses of one or two tablespoonfuls. Owing to the tendency of its gummy matter to coagulate, it is less eligible than catechu as an ingredient of the chalk mixture.

KRAMERIA, *U. S.*—RHATANY.

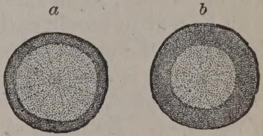
Krameriæ radix, Br.; *Radix ratanhæ*, P. G.; *Radix ratanhiæ.*—*Rhatany root*, E.; *Ratanhia*, Fr.; *Ratanhawurzel*, G.

The root of Krameria triandra, *Ruiz and Pavon, Flor. Peruv.* Steph. and Church, Med. Bot., plate 72; Bentley and Trimen, Med. Plants, 30.

Nat. Ord.—Polygalaceæ, Kramerieæ.

Origin.—The *ratanhia* is a low shrub with spreading branches, a native of Bolivia and Peru, and grows in sandy localities in the mountains at an altitude of 3000 to 8000 feet; it has a striking appearance from the leaves, which are densely covered with silvery hairs, and from the flowers, which have four scarlet sepals arranged in the form of a cross, and four small dissimilar red petals.

Fig. 98.



Transverse section of—*a*, officinal; *b*, Savanilla rhatany root.

Description.—The root has several knotty heads, and consists of a woody main root, which is 1 or $1\frac{1}{2}$ inch thick, and from 2 to 4 inches long, when it divides into several spreading and bent branches, 10 to 18 inches long, and varying in thickness from $\frac{1}{8}$ to $\frac{1}{2}$ inch. The latter constitute what is sometimes called *long rhatany*, while the less desirable heads and main root are called *short* or *stumpy rhatany.* The bark is smooth, or in the older roots scaly; of a peculiar rust-brown, or blackish-brown color; somewhat resinous in the outer, and rather fibrous and brownish-red in the inner, layer. The wood is from six to ten times thicker than the bark, of a pale brownish or reddish color, radially striate by numerous fine medullary rays, very tough, and nearly tasteless. The bark, like the wood, is inodorous, but has a strongly astringent taste, which accounts for the superiority of the *long* root.

Constituents.—The most important constituent is *ratanhia-tannic acid*, which has been investigated by Wittstein (1854). It is precipitated dark-green by ferric salts, and flesh-colored by gelatin, but not precipitated by tartar emetic. Grabowski (1867) observed that by fusion with potassa it is decomposed into *protocatechuic acid* and *phloroglucin;* and that the *ratanhia-red* of Wittstein, which is obtained by boiling with dilute sulphuric acid, has the same composition, $C_{26}H_{22}O_{11}$, as the similar product obtained by Rochleder (1866) from the tannin of the horsechestnut, and by Rembold (1868) from that of tormentil. The tannins obtained from the three plants appear to have the composition $C_{26}H_{24}O_{11}$. The other constituents of rhatany root are wax, gum, and uncrystallizable sugar.

From an extract of rhatany formerly exported from South America, Wittstein isolated a crystalline body which he regarded as identical with *tyrosin*, but which Städeler and Ruge (1862) found to be $C_{10}H_{13}NO_3$; they named it *ratanhin.* Gintl (1869) proved it to be identical with the *angelina* of Peckolt, obtained from the *resina d'angelim pedra*, the exudation of *Ferreira spectabilis*, Allem., and suggested that some kino-like extracts from this and allied plants had been used as substitutes or adulterations of the extract of rhatany.

Other Rhatany Roots have occasionally appeared in commerce.

PARA OR BRAZILIAN RHATANY was described by Berg (1865), and by J. G. S. Cotton (1868), in two varieties, as *Ratanhia des Antilles.* It has a dark-brown or blackish bark, which adheres more firmly to the wood, and is longitudinally striate or transversely fissured, and without a fibrous fracture. Flückiger and Hanbury refer it to Krameria argentea, *Mart.*

SAVANILLA OR NEW GRANADA RHATANY is obtained from Kram. tomentosa, *St. Hil.*, which Cotton proved to be identical with Kr. grandifolia, *Berg*, and Kr. ixina β. granatensis, *Triana.* It resembles the Peruvian rhatany, but is always less knotty, and more slender; its bark has a distinct purplish hue, is smooth or longitudinally striate externally; the wood is only three or four times thicker than the bark, the tannin of which appears to differ somewhat from that of the officinal variety.

TEXAS RHATANY has been described by Berg; it is derived from Kr. secundiflora, *D. C.*, and consists of a roundish root stock, about two inches thick, from which a number of long roots emanate, which have a blackish-brown, internally reddish bark of the same thickness as the wood.

Off. Prep.—Extract. krameriæ, *U. S.*, *Br.;* Extr. krameriæ fluid., *U. S.;* Infusum krameriæ, *U. S.*, *Br.;* Pulv. catechu comp., *Br.;* Syrup. krameriæ, *U. S.;* Tinct. krameriæ, *U. S.*, *Br.*

Medical Action and Uses.—In small doses slightly tonic, in larger doses astringent, in still larger doses rhatany causes dyspeptic uneasiness and oppression, with constipation, effects probably due to its astringent qualities. It has been chiefly employed to restrain *hemorrhages* of every variety, but is most efficient in those of the passive sort, and particularly in that form of uterine hemorrhage in which the flow, without being profuse, is habitual. It is not without utility, as an internal medicine, in *uterine leucorrhœa.* It may be used with benefit in atonic and chronic *diarrhœa*, and in *incontinence of urine* from debility of the urinary organs.

Locally it is applied by injection to the treatment of *dysentery*, vaginal *leucorrhœa*, and *gleet*, and has enjoyed considerable reputation as a remedy for *fissure of the anus.* Its mode of action is thought to consist partly in constringing the walls of the rectum, and thereby preventing the formation there of a large fecal mass, which tends to exaggerate the fissure, and render defecation more painful. But it appears also to promote directly the healing of the fissures by limiting the amount of blood that reaches them. The mode of using the remedy consists merely in emptying the rectum with an emollient enema, and half an hour later throwing into the bowel a solution of sixty or ninety grains of extract of rhatany in five ounces of water. This operation is repeated night and morning, and on both occasions the enema is retained only for a few moments; or else it is allowed to run out at once, and is again thrown into the bowel; and this process is renewed for several minutes at a time. The bowels are meanwhile prevented from becoming confined by the use of appropriate food, or of gentle laxatives, such as sulphur, cassia, etc.; or, as has been especially recommended, the administration of powdered belladonna root, in the dose of a grain or less, given at night. The administration of the enemas, which is painful at first, gradually and indeed rapidly ceases to be so, and, if steadily persevered in, is usually successful in effecting a cure.

A watery solution of rhatany, or its extract, is of service in the treatment of *fissured nipples.* A mixture of the extract with white of egg may also be employed. The part should be cleansed when the child nurses, which ought to be as seldom as possible. In non-syphilitic *ozæna* an infusion of rhatany is sometimes serviceable, introdued into the nostrils with a sponge, or injected with a nasal douche, several times a day. The addition of chlorinated soda is advantageous; or chloride of lime may be added to the infusion in the proportion of from five to ten grains to the ounce of liquid, which, after standing for a time, should be strained.

Administration.—Powdered rhatany is seldom employed; the infusion, extract, tincture, and syrup are officinal.

LABDANUM.—LABDANUM.

Resina ladanum.—Labdanum, Ladanum, E., Fr., G.

A resinous exudation of Cistus creticus, *Lin.;* C. cypricus, *Lam.;* C. ladaniferus, *Lin.*, and of other species of Cistus. Bentley and Trimen, Med. Plants, 24.

Nat. Ord.—Cistaceæ.

Collection.—The resinous exudation of these handsome shrubs, indigenous to Greece and the Levant, is collected during hot weather by means of the *labdanisterion*, consisting of a wooden handle, with many narrow leather bands on one end, which are drawn over the branches, the resin being afterwards scraped off, and often kneaded together with sand and other material. An inferior kind is obtained from the wool and hairs of sheep and goats, which feed on the plants, either by combing or after shearing, by boiling with water.

Description.—Labdanum is met with in two forms, either as blackish or dark-brown masses, which soften and become glutinous in the hands, and are gray upon the fresh fracture, the color soon becoming darker. Or it is seen in cylindrical rolls, about the thickness of a finger, and rolled spirally into flat pieces. Sometimes it is also in cylindrical sticks, somewhat of the shape of liquorice. Good labdanum is insoluble in water, almost completely soluble in alcohol, fusible, burns, when ignited, with a bright flame, and has an agreeable, balsamic odor, and a bitter taste. The roll and stick labdanum are frequently adulterated or artificially made.

Constituents.—According to Guibourt, cake labdanum contains 86 per cent. of resin and volatile oil, 7 of wax, 1 of extractive matter, and 6 per cent. of insoluble impurities. Pelletier found in roll labdanum only 20 per cent. of resin and 72 per cent. of sand.

Medical Action and Uses.—The singularly grateful odor of this resin led to its being used in the most ancient times for the fumigation of rooms and clothing, and as a medicine both internally and externally for the same purposes as other articles of the same class. It was used internally and through its fumes for chronic bronchitis, and locally in leucorrhœa and other uterine affections; it was also prized as a diuretic. Later it was an ingredient of various stimulant plasters. Its use is now obsolete.

LABURNUM.—LABURNUM.

Golden-chain, Bean-trefoil, E.; *Faux ébénier, Cytise*, Fr.; *Goldregen*, G.

Cytisus laburnum, *Lin.* *Nat. Ord.*—Leguminosæ, Papilionaceæ.

Description.—This is a tall shrub or low tree, indigenous to Southern Europe and planted in this country for ornament. It grows to the height of 15 or 20 feet, and has a smooth bark. The *leaves* are on slender petioles, trifoliate, with nearly sessile oval-oblong, obtuse, and mucronate leaflets, which are about two inches long, smooth, and dark-green above, soft hairy and grayish beneath; they have a somewhat saline, bitterish, and slightly acrid taste. The golden-yellow *flowers* are in long hanging racemes, and produce linear, obtuse legumes containing dark-brown nearly reniform *seeds* of a disagreeable bitter and acrid taste.

Constituents.—Chevalier and Lassaigne obtained the bitter principle of the ripe seed in an amorphous condition and named it *citysin.* T. Scott Gray (1862) obtained, in addition thereto, *laburnic acid* and two neutral bitter principles, *cystin* and *laburnin,* which are present chiefly in the seed and bark. The *citysina* of Husemann and Marmé (1865) is a white crystallizable alkaloid, of a bitterish taste and strong alkaline reaction, easily soluble in water and alcohol, but nearly insoluble in ether, chloroform, benzol, and carbon bisulphide. Its composition is $C_{20}H_{27}N_3O$. The leaves contain only traces of it; it is likewise found in the seeds of other species of cytisus.

Physiological Action. *On Animals.*—According to Dr. T. S. Gray, who elaborately investigated the composition of this drug and its operation, its effects upon dogs, cats, and rabbits are nearly identical. The decoction, however administered, is apt to cause vomiting, and also languor and muscular relaxation, the breathing and pulse-rate are accelerated, and there is always a greater or less tendency to sleep, which, however, is never comatose or profound. No irritant effects due to laburnum or any of its constituents are found after death. After fatal doses vomiting first takes place, and then, after more or less of the symptoms before enumerated, but with spasm rather than resolution, death follows gradually, the heart continuing to pulsate until the end. After death the brain and spinal cord are engorged, as are also the veins of the right side of the heart, but the lungs are collapsed, and the left side of the heart is empty. Cytisine, laburnine, and laburnic acid, considered as separate active elements of laburnum, appear to act in very nearly the same manner.

On Man.—In medicinal doses it induces a slight degree of languor and tendency to sleep, rather confines than relaxes the bowels, and very slightly, if at all, increases the urinary secretion. Larger doses are very apt to produce a slightly soporific effect, and are very sure to excite vomiting and sometimes purging, as well as some quickness of the pulse and giddiness. The same effects are induced by cytisine, and each of the other alleged proximate principles appears to cause some drowsiness and contraction of the pupils. In cases of poisoning by the bark or berries, and which have been very numerous in Europe, the effects observed are remarkably uniform. They comprise the following phenomena: Vomiting, pain in the stomach which is sometimes excruciating; purging; dryness, heat, and constriction of the throat; faintness, languor, vertigo, drowsiness, or a narcotic sleep with slow and stertorous breathing followed by insomnia; the eyes are dull and sunken, the pupils dilated, and the eyelids dusky; the pulse is very weak or fluttering, varying between 90 and 100; thirst is usually marked, and in the worst cases muscular twitchings of the neck and face are observed. No headache or other pain, except that in the stomach, is complained of, nor do general convulsions occur. In no case has death been observed.

Medical Uses.—Laburnum has been recommended by Dr. Gray in *bilious dyspepsia* with periodical attacks of bilious vomiting, diarrhœa, and constipation in the intervals. It should be taken in small doses which do not sicken the patient, thrice daily before meals, and continued for six or eight weeks. He also regards it as efficient in cases of children who *vomit* after eating, as a palliative of *whooping-cough,* of the *nausea* and sickness of pregnancy, of *asthma* connected with emphysema of the lungs, etc. These recommendations have not, as yet, been confirmed by experience. The author of these statements proposes for use a decoction of laburnum concentrated until it attains a specific gravity of 1.034, to be given in *doses* of from two to forty minims. The *dose* of the extract is stated to be from one-tenth of a grain to one grain; of cystinia, from half a grain to four grains; of laburnic acid, from one to six grains; and of laburnine, from five to twelve grains.

In cases of poisoning the stomach should be evacuated by warm water, and ammonia and alcohol administered internally.

LAC, *Br.*—MILK.

Lac vaccinum.—*Lait*, Fr.; *Milch*, E.

The fresh milk of the cow, Bos taurus, *Lin.*

Class Mammalia. *Order* Ruminantia.

Description.—Cows' milk is an opaque white liquid having a slight peculiar odor and a bland and sweet taste; its specific gravity is about 1.030. Viewed under the microscope it is seen to be a clear and transparent liquid in which a large number of minute globules are suspended. On standing, these rise to the surface as a yellowish stratum, the *cream*, which constitutes about 5.0 per cent. of the milk, and consists mainly of fat mixed with some casein and retaining some serum. By churning the globules unite to form *butter*, and the liquid which separates and is known as *buttermilk* is essentially a solution of *milk sugar* and the saline constituents of milk, and contains some casein and butter. The milk from which the cream has been separated is called *skimmed milk.* If left to itself, it becomes acid and separates the casein in a coagulated condition called *curds;* the same effect is produced by rennet and by acids. The liquid separated from the coagulum is called *whey*, and contains chiefly milk sugar and some salts.

Constituents.—The chemical constituents of the milk of mammals are qualitatively alike, but quantitatively vary very much for different species, for different individuals, and even for the same individual, depending in the latter case upon the length of time since the last birth, upon the kind and quantity of food, and upon the exertion or rest of the individual. The following table is compiled from the averages given by Lehman and others (*Physiol. Chemistry*):—

	MILK OF—					
	Woman.	Cow.	Mare.	Goat.	Sheep.	Sow.
Albumenoids (protein compounds)	2.5	4.1	1.7	5.0	4.5	6.2
Fat (butter)	3.6	4.0	0.8	3.7	4.2	5.8
Milk sugar	6.5	4.2	8.8	4.5	5.0	5.3
Salts (chiefly phosphates)	0.5	0.7	0.4	0.6	0.7	0.9
Total solids	13.1	13.0	11.7	13.8	14.4	18.2
Water	86.9	87.0	88.3	86.2	85.6	81.8

The albumenoids consist of *casein* and *lactoprotein.* Casein is not coagulated by heat, but on evaparating its aqueous solution it becomes insoluble and separates in the form of a thin skin; acetic and other acids coagulate it; so does rennet, and after this ceases to have any further effect, acetic acid will produce another coagulation. The protein compounds of the different milks, however, vary slightly in their behavior to some reagents.

Butter, as obtained by the churning of cream, is a very complex mixture of fats with small quantities of an odorous principle, casein, milk sugar, salts, and water; the fats are glycerides of butyric, capronic, caprinic, myristic, palmitic, stearic, and oleic acids, some of which are gradually decomposed, whereby the liquid fatty acids are liberated and the butter turns *rancid.*

As stated above, milk left to itself becomes acid; the change takes place in consequence of the fermentation of milk sugar (see Saccharum lactis) induced by the casein, whereby *lactic acid* is generated. The change is prevented, for some time at least, by the addition of certain compounds, for which purpose borax has been recommended; but boric acid in the proportion of 1 to 1000 milk, as recommended by Hirschberg (1871), is preferable as not altering the taste. Salicylic acid (1 to about 5000 milk) has also been found serviceable. If kept in vessels closed by Appert's method, it separates into several strata, but remains unchanged. More recently, however, *concentrated* or *condensed milk* has been introduced, which is simply fresh milk mixed with a certain proportion of sugar, evaporated at a low temperature to the consistence of a thick syrup or soft extract, in which condition it will keep well.

Adulteration.—When milk is mixed with water, its specific gravity is lowered; skim-milk, on the other hand, has a higher density. To detect adulterations, the quantity of the solids is determined by evaporation to dryness; from this the amount of fat is ascertained by treating with ether or petroleum benzin, and the residue is either incinerated to determine the amount of mineral constituents and estimate the albuminoids and sugar combined by the loss in weight; or the residue isoluble in ether is treated with alcohol and water, which leave casein, and dissolve the sugar and salts. Since the milk residue is dried and afterwards exhausted, some chemists prefer to evaporate the milk mixed with a known quantity of dry sand, calcium sulphate, or similar material.

Various instruments, called *lactometers*, have been constructed with the view of ascertaining rapidly the purity of milk, by determining either the density, the degree of opacity, the percentage of cream, or the amount of butter.

Pharmaceutical Uses.—Milk is used in preparing Mistura scammonii, *Br.*, and in the preparation of wheys, which are officinal in several European Pharmacopœias.

SERUM LACTIS, *P. G.;* SERUM LACTIS DULCE.—Whey, *E.;* Petit-lait, *Fr.;* Molken, *G.* Take of fresh cows' milk 200 parts, rennet wine 1 part, mix and warm to 35° or 40° C. (95° or 104° F.), and after coagulation strain from the curd.

SERUM LACTIS ACIDUM, *P. G.*, s. Serum lactis, *F. P.*—Acid whey, *E.;* Petit-lait acidue, *Fr.;* Saure Molken, *G.* Heat fresh cows' milk 100 parts to boiling, add 1 part of potassium bitartrate (or 0.1 part of citric acid dissolved in 1 part of water), and when completely coagulated strain.

SERUM LACTIS ALUMINATUM, *P. G.*—Alum whey, *E.;* Petit-lait alumineux, *Fr.;* Alaunmolken, *G.* It is prepared like the preceding, except that 1 part of powdered alum is used to effect the coagulation.

SERUM LACTIS TAMARINDINATUM, *P. G.*—Tamarind whey, *E.;* Petit-lait tamariné, *Fr.;* Tamarinden-Molken, *G.* The coagulation of 100 parts milk is effected with 4 parts of tamarinds, and the strained whey has a brownish color.

Medical History.—In the Hebrew Scriptures milk is constantly referred to for its precious qualities as food, and no more striking figure could be employed to represent the exuberant riches of a country than that it was a "land flowing with milk and honey," that is to say, suitable for raising herds and grain. Milk is the most essential article of food for man before his teeth are matured for mastication; as well as in that second childhood when "the grinders cease because they are few," especially when it is associated with wine, which is "the milk of old age." Not less does it become the essential and most salutary food of man when, at any period of his life, he is enfeebled by disease. The qualities that adapt it to these several states or conditions of life are, the facility of eating it, for it needs no mastication; the rapidity of digesting it, since it needs but little change to convert it into assimilable material; and the small amount of waste which it involves and of digestive power which it requires, since the fecal residue of its digestion is less than from any other food.

The ancients used milk from the cow, the camel, the mare, the ass, the goat, and the sheep, and attributed to several among them special virtues or defects; thus sheep's milk was considered binding, asses and goat's milk rather relaxing, and to cow's milk intermediate qualities were attributed. A full summary of the subject is furnished by Pliny, who represents human milk as the most nutritious and goat's milk next in strength, calling to memory the myth that Jupiter was suckled by a goat. The mildest milk, according to Pliny, is the camel's. He very correctly remarks that crude milk is more flatulent and less wholesome than boiled milk. He states that milk is used for all manner of internal inflammations, including those of the kidneys, bladder, bowels, throat, and lungs; and externally for itching and watery eruptions of the skin, and refers to its use, as Celsus also did, in the cure of phthisis. He speaks of its value in other cachexiæ, and especially of the cure of chronic gout by asses' milk, and also of milk in general in the treatment of dysentery, and of poisoning by colchicum, conium, etc. He refers particularly to asses' milk in marasmus and other wasting diseases, and to the use in affections of the spleen of milk from goats that had fed on ivy. He describes the mode of preparing whey, and its uses in epilepsy, melancholy, paralysis, and diseases of the skin. Milk was also applied topically in ophthalmia, in ulcerations of the mouth, throat, and uterus.

Medical Action and Uses.—The special action of milk considered as a therapeutical agent is that, while it affords sufficient nutriment, it moderates the stimulating action of the blood, and restricts the excrementitious waste derived from the food, thereby enabling the organs which are obstructed by blood, by secretions, or by more or less plastic exudations, to purge themselves of these hindrances to a free and normal action. In a word, it gives rest, which is the primary condition of cure, and removes hindrances to a return of that functional activity which is an essential condition of health. The milk treatment is essentially a "hunger treatment," and is analogous to that natural and instinctive abstinence from food which is observed in all acute febrile diseases, and in the greater number of chronic disorders. It is the cry of nature to be let alone, to be spared that officious assiduity which is as mischievous in dietetics as in medicinal therapeutics. This we conceive to be the simple explanation of the curative powers of milk. Tortured as it may be by physiological experiment, it reveals no special action upon this or that organ or anatomical element, but so modifies the whole system as to restore its soundness without the aid of drugs, or else enables them to produce results which without its aid they would have been unable to accomplish.

Of all forms of food that can be used in *fevers* and *inflammations*, there is no doubt that milk is the best whenever the decline of the fever and the process of wasting have begun. Before this period watery preparations of starchy products, especially of barley and rice, are sufficient; but as soon as tissue waste shows itself, a portion of milk should be added to them and gradually increased until it forms the principal part of the nourishment, or is supplemented by the stimulant operation of beef-tea. In less acute affections and especially in those attended with suppuration, or an excessive discharge of blood, serum, or mucus, nothing so well as milk maintains the strength without tending to excite fever. When in the stomach or bowels inflammatory or ulcerative lesions exist, the use of milk can hardly be dispensed with. In *simple gastric ulcer* it is the one remedy which may be depended upon for a permanent cure; and in *cancer* of the stomach or bowels it is infinitely the best palliative, and the only one by means of which life may with any certainty be prolonged. But in these and similar cases the quality of the milk employed must be carefully adjusted to the tolerance of the digestive organs, and, if necessary, its retention favored and its assimilation promoted by the addition of lime-water, or by preceding the administration of each portion with a dose of bismuth. The same remarks apply to *dysentery*, both in its acute and chronic forms, provided that in the acute disease whey, or milk and water, or buttermilk is employed rather than pure milk. The last is most efficient in the chronic form, if it be administered with due regard to its tolerance by the patient. In not a few cases, *albuminuria* due to desquamative nephritis has been cured by the persistent use of an exclusive milk diet alone, and in others by an association with it of ferruginous-saline mineral waters, or of officinal preparations of iron. Even in those less curable cases of interstitial nephritis associated with hepatic and cardiac lesions, there can be no doubt that this method tends to remove the dropsy, and at the same time quiet the morbid violence of the heart's action, while it greatly improves the nutrition of the system. Some years ago several physicians announced the cure of *diabetes* by a milk diet, but longer observation showed that they must have been deceived, and that the treatment by milk aggravates the disease. In regard to a milk diet in *chronic diseases of the chest*, whether tuberculous or bronchitic with their associated affections pleurisy and emphysema, it suffices to say that, as a rule, it is contraindicated, as affording too little nutriment when there is need of all that can be assimilated. In point of fact a milk diet, as such, never cured or even ameliorated any one of them; but its use has been followed by favorable results, even in consumption, when it has been associated with other favorable hygienic influences, such as a pure, dry atmosphere, active and regular exercise, a complete change in the habits of living, abstention from the use of perturbative drugs, and a nutritious diet fitted to compensate for the defects of the milk regimen in this respect. A milk and vegetable diet has long been used in the treatment of *epilepsy*, and its operation is intelligible by analogy when we consider that every remedy that has been most useful in this disease, from the time of Aretæus, who declared, " From flesh in particular the patient is to be entirely restricted," down to the introduction of the bromides, has been a sedative of the nervous and circulatory systems. Milk is one of the most convenient and efficient antidotes for nearly all corrosive *poisons*, acids, alkalies, and metallic salts, because with some of them it forms compounds that are not readily soluble, and all of them it envelops in its curd and thus tends to prevent a corrosive action or absorption, until proper emetics can be administered. The close analogies of milk and chyle are illustrated by the effects of its injection into the veins, which was tried by Donné in 1842, and without causing any alarming symptoms. Later it was employed, fruitlessly, by Bovell and by Herepath in *cholera*, and about 1860 by Hodder, of Toronto, in a case of complete collapse, in which reaction and recovery followed. Subsequently Dr. Howe and then Dr. Thomas, of New York, made use of the same method, the one in *phthisis*, the other in *traumatic hemorrhage*, and in no case did any alarming symptoms arise when the milk employed was perfectly fresh.

Administration.—According to Karell, a chief apostle of the " milk cure," it is essential that the patient abstain from all other food but milk, and this he must take at fixed hours and in determinate quantities. This milk, we are told, must be skimmed, but that degree of exaction is not required by others who employ the method. It should be warmed, not hot, in winter, cool but not iced in summer, and should be swallowed by small mouthfuls and slowly. If the stools are consistent, the quantity of milk may be gradually increased, until from four to six pints a day are taken. Almost always a primary effect of the treatment is to produce constipation, which must be overcome by a little castor oil or rhubarb, or by a roasted apple or stewed prunes. Sometimes much more energetic modes of treatment are called for. If the patient is thirsty he may drink pure water or carbonated water. Towards the third week of this process, if he grows weary of it he may be allowed a little stale bread once a day, or grits or other analogous preparations may be added to the milk. To carry out this discipline requires the patient to be endowed with a degree of courage approaching heroism; but, in certain cases, it brings a due reward, the flesh and strength, which had before been declining under the combined influence of pain, indigestion, and scanty nourishment, begin to improve, and thus persons of resolution are encouraged to endure their martyrdom and reap its reward.

It may be stated here that *condensed milk* is in many cases a valuable substitute for fresh milk, in all cases of sickness calling for the use of milk, and especially in places where good milk cannot be procured from the cow. This is notoriously the case at most of our sea-side resorts, and it occurs also where the drinking-water is unduly mineralized.

Serum Lactis; *Whey.*—This preparation, which contains little else than sugar of milk and a fractional percentage of salts, and is nutritious chiefly through its watery element, has been used from time immemorial as a drink in fevers. It is agreeable to the taste, or may be rendered so by lemon juice, or by tamarinds, as was the custom in Sydenham's day, and is also more or less diuretic and laxative. Taken copiously and hot, it was at that time the favorite diaphoretic at the commencement of febrile attacks due to cold. When whey is drunk to the extent of a pint or two every day, and for several weeks together, it tends to derange the stomach, impair the appetite, and produce diarrhœa, and is, therefore, improper in all chronic diseases in which the digestive organs are already enfeebled. On the other hand it may, as far as it goes, prove useful in chronic blood disorders like *gout*, *rheumatism*, and *gravel*, with congestion of the brain or of the portal circulation, owing to its depurative and somewhat diuretic qualities. But, in Germany, where alone the "whey-cure" is systematically employed, it is pursued in localities in which pure air and exercise, to say nothing of the mineral waters usually taken at the same time, doubtless have much more to do with the cure of disease than the systematic drinking of whey.

BUTTERMILK, or the thin sour milk separated from the cream by churning, contains caseum, but very little butter. Even by many persons in health it is considered a most refreshing drink, and there is no form of *fever* in which it is not apt to be relished, probably on account of its acidulous taste. It is one of the very best remedies that can be employed in acute and even in chronic *dysentery*, promptly allaying the tenesmus and modifying the bloody mucous stools of the acute form, and lessening the frequency of the evacuations in the chronic disease. Its effects in *typhoid fever* are scarcely less striking. It renders the discharges less numerous, and moderates the tympanites. It should be given in doses of from two to four ounces every three or four hours, and always as fresh as possible.

KOUMISS is a drink imitated from the Tartars, and which may be considered a peculiar form of milk punch, since it contains the saline and protein constituents along with the sugar, fat, and lactic acid of the milk, together with carbonic acid and alcohol, these constituents varying with the length of time employed in the fermentation. It is, therefore, a nourishing and stimulating drink, sometimes even an intoxicating one, since the longer it is kept the more alcohol it contains. One analysis states that at the end of sixteen days it yields upwards of twenty parts of alcohol in a thousand. The effects of drinking two or three glasses of koumiss are identical with those of alcohol: a general diffusive glow, a quickening of the pulse, a pleasurable excitement of mind and body. Like alcohol, indulged in overmuch, it impairs the appetite for food, tends to constipate the bowels, renders one dull and sleepy, and augments the urinary solids. Moderately used, it promotes digestion and nutrition, or at least increases the weight by augmenting the fat, precisely like milk punch. Like that familiar drink, it is of more or less use in various wasting diseases, including consumption and nervous exhaustion. It is not to be wondered at that in Germany a counterfeit koumiss is prepared with milk, lemon, and rum. There is good reason to fear that the general fondness for sparkling wines and other effervescing drinks may tend to render fashionable a draught which, under the disguise of a medicine, partakes more or less of their intoxicating qualities, and may become the prime cause of a baleful habit of intoxication. There is much danger, also, lest its votaries overlook the essential condition of its utility, active exercise in the open air and those other hygienic measures upon which the utility of alcohol and other hydrocarbons in all chronic wasting diseases essentially depends.

LACCA.—LAC.

Resina (*Gummi*) *lacca.*—*Laque, Gomme lacque,* Fr.; *Lack, Gummilack,* G.

A resinous exudation produced by the puncture of Coccus lacca, *Kerr.*

Origin.—The hemipterous insects thus named congregate in large numbers upon the tender branchlets of various East Indian laticiferous trees, and become surrounded with the resinous exudation, which gradually hardens. The impregnated much enlarged female insects, imbedded in the resin, contain a red coloring matter, in which the young larvæ are developed. These finally eat a passage through the incrustating material and escape. The branches are collected with the incrustation, which is considered more valuable if still containing the red coloring matter. Among the trees yielding lac are the following: Aleurites laccifera, *Willd.* (Croton, *Lin.*), *Nat. Ord.* Euphorbiaceæ; Ficus indica, *Roxb.*, F. bengalensis, *Lin.*, F. religiosa, *Lin.*, F. tsjela, *Hamil.*, *Nat. Ord.* Urticaceæ; and several others.

Description.—The thin branches almost completely covered with numerous small resin-nodules constitute the *stick-lac.* The separate nodules or tears are red-brown, and contain in the interior a dark blackish-red powder; after the escape of the young insects, the resin is brown. The same resin, after having been detached from the twigs, constitutes the *seed-lac* or *grain-lac.* It is in irregular fragments, of the size of a pea and smaller, yellowish-brown or reddish, somewhat shiny, and nearly tasteless. After boiling the stick-lac or seed-lac with water, fusing the resin, and congealing it upon a smooth surface, *shellac* is obtained; it comes in thin, glossy, and more or less transparent fragments. Sometimes *grape-lac* and *lump-lac* have been distinguished, the former of which consists of agglutinated incrustations separated from the twigs; the latter is identical with shellac, except that it has not been congealed in thin layers. When chewed, stick-lac softens, and colors the saliva purplish-red, a slight bitterish and astringent taste being perceived; when burned, it gives off a strong and agreeable odor. The water in which red stick-lac has been boiled, on being treated with alum, yields *lac-dye.*

Shellac is soluble in potassa, soda, borax, muriatic and acetic acids, and when digested with ammonia in close vessels, swells to a gelatinous mass. By treating the alkaline solution with chlorine or sulphurous acid, bleached shellac is obtained.

In the year 1876–1877, the importation of stick and seed-lac amounted to 47,000 pounds, and of lac-dye to 454,781 pounds. In 1867 over 784,000 pounds of shellac were imported.

Constituents.—Lac is a complex body, containing, according to Unverdorben, five distinct resins, besides wax, fat, coloring and extractive matter. The resins may be separated by their different behavior to alcohol, ether, and alkalies.

Uses.—Shellac is used in the preparation of *varnish* and of *sealing wax,* the latter by fusing from 5 to 8 parts of it with 1 part of turpentine, and coloring the mixture with a suitable pigment. An *ink,* useful for laboratory purposes, is obtained by mixing lampblack with a solution of 100 grains of shellac and 20 grains of borax in four ounces of water.

Medical Action and Uses.—Having in a slight degree some of the qualities of the resins, lac has been used in combination with astringents as an application to indolent *ulcers,* especially of a scrofulous and scorbutic sort. It is rarely employed in medicine.

LACMUS.—LITMUS.

Lacca cœrulea, Lacca musica.—Tournesol, Laque bleu, Fr.; *Lackmus*, G.

A blue pigment obtained from Lecanora tartarea, *Acharius*, Roccella tinctoria, *Ach.*, R. fuciformis, *Ach.*, and from other lichens.

Preparation.—The lichens are powdered, mixed with some potash and urine, or other ammoniacal liquid, and exposed to the air. The liquid acquires a red, purple, and finally blue color, and is mixed with sufficient chalk to be formed into small rectangular cakes. It is manufactured in Holland.

Description.—Litmus is in earthy friable cakes, of a deep blue or purplish-blue color, and a slight saline and somewhat pungent taste. It effervesces with acids, and is partly soluble in water with a blue, and in dilute alcohol with a purplish-blue color, which is changed to red by acids.

Constituents.—Besides the earthy matter, Kane (1841) separated from litmus four coloring matters, namely: *erythrolein*, a purplish-red fatty matter, soluble in ether, fusible at 38° C. (100° F.), and yielding with ammonia a purple-colored solution; *erythrolitmin*, red, crystalline, insoluble in ether, soluble in alcohol, and changed to blue by alkalies; *azolitmin*, brown-red, amorphous, turned blue by ammonia; and *spaniolitmin*, present in minute quantity only, light red, soluble in water.

Pharmaceutical Uses.—Litmus is employed as a reagent for acids and alkalies. Litmus paper is made by making a strong aqueous solution of the coloring matter (*tincture of litmus*), and dipping white unsized paper into it. To make *red litmus paper*, dilute muriatic acid is carefully added to the blue solution until the color has just changed to red, carefully avoiding excess of the acid. When litmus is used for testing by gaslight, the change of color is best observed through a green glass.

Allied Pigments.—Archil or Orchil, *E.*, Orseille, *Fr. G.*, is made from the same lichens which yield litmus. The lichens are heated for a week with diluted ammonia, when sulphuric acid and table salt are added. Archil is a pasty mass, of a deep purple color.

Cudbear, *E.*, Orseille de terre, *Fr.*, Persio, *G.*, is made in precisely the same manner, except that, instead of adding acid and salt, the mixture is dried and powdered.

The lichens which are used for the production of the above pigments contain a number of chromogenes, which are ternary compounds, and, in the presence of water and ammonia, are converted into various nitrogenated red pigments. The most important of these chromogenes, as far as they have been investigated, are *erythric acid*, $C_{20}H_{22}O_{20}$, *alphaorsellic acid*, $C_{32}H_{28}O_{14}$, *betaorsellic acid*, $C_{34}H_{32}O_{15}$, and *evernic acid*, $C_{34}H_{32}O_{14}$. On being boiled for a long time with water or baryta, they yield *lecanoric acid*, $C_{16}H_{14}O_7$, afterwards *orsellic acid*, $C_8H_8O_4$, and finally *orcin*, $C_7H_8O_2$, which crystallizes in large colorless needles, has a sweet taste, turns red in contact with air, and yields with ammonia, *orcein*, $C_7H_7NO_3$; this is brown, and dissolves in alkalies with a beautiful red color. Orcin is also obtained from aloes by fusing it with caustic potassa.

Medical Uses.—The only use of litmus in medicine is to determine the acidity or alkalinity of the animal fluids. Litmus paper is a necessary adjunct of all apparatus for examining the urine.

LACTUCA, *Br.*—LETTUCE.

Herba lactucæ, P. G.; *Herba latucæ virosæ.—Laitue vireuse*, Fr.; *Giftlattich*, G.

The flowering herb of Lactuca virosa, *Lin.* Woodville, Med. Bot. t. 31; Bentley and Trimen, Med. Plants, 160.

Nat. Ord.—Compositæ, Liguliforæ.

Description.—This biennial herb, which grows to the height of 3 to 6 feet, has a cylindrical, somewhat prickly, pale green and often purplish-spotted stem. The large radical leaves are petiolate, obovate-oblong, obtuse, irregularly spinously toothed, wavy or nearly entire at the margin, pale green beneath, and prickly on the midrib. The stem leaves are smaller, alternate, horizontal, sessile, with a sagittate amplexicaul base, and an acute spinous apex, otherwise resembling the radical leaves, the floral ones reduced to small pointed bracts. The flower-heads form a loose terminal panicle, and are on short axillary peduncles; the involucre is oblong or conical, and composed of imbricated lanceolate bracts in about three rows; the florets are neutral, pale yellow, ligulate; the akenes are oval, flattened, black, and prolonged into a long whitish beak, bearing at its apex a pappus, consisting of numerous soft white capillary bristles. The plant has a disagreeable rather narcotic odor, and a bitter and saline taste.

It is indigenous to Western and Southern Europe, is less frequent in Central Europe, and has been naturalized in some parts of New England. It is closely allied to *L. scariola*, Lin., which is indigenous to Europe, but is found more frequently in the central part, and is distinguished from the preceding mainly by its spinescent deeply cut toothed or pinnatifid vertical leaves, but possesses the same disagreeable odor and taste, though in a rather milder degree.

Constituents.—The older analyses by Pfaff, Dublanc, and others have demonstrated the presence of principles common in herbs; among the inorganic constituents, potassium nitrate was found by Pfaff and Bley. More recently, the investigations have been confined to lactucarium, which is partly obtained from this plant.

Off. Prep.—Extractum lactucæ, *Br.*

Medical Action and Uses.—The ancients ascribed to strong-scented lettuce soporific and anaphrodisiac properties, and it was even used by them for adulterating opium. It was held to be peculiarly adapted to allay wakefulness produced by over-stimulation of the mind. Whatever may have been the virtues of lettuce in ancient Greece, they are certainly very faintly represented by the plant grown in this country and in Western Europe. They are contained in their most concentrated and available form in lactucarium. That preparation is officinal, and to the article treating of it the reader is referred for further information.

LACTUCARIUM, *U. S.*—LACTUCARIUM.

Lactucarium, Fr., G.; *Giftlattichsaft*, G.

The concrete milk-juice obtained from Lactuca sativa, *Lin.* (L. virosa, *Lin.*, *P. G.*), obtained by incision and spontaneous evaporation.

Origin and Collection.—*Lactuca virosa* and *L. scariola*, Lin., have been described above. *L. sativa*, Lin., is the common garden lettuce. *L. altissima*, Bieb., a tall Caucasian herb, is cultivated in Auvergne in France for lactucarium; Planchon regards it as a variety of *L. scariola*, Lin. We prepared (1867) very efficient lactucarium from several varieties of *L. canadensis*, Lin.

of this country, but found the milky juice, which yielded from 22 to 32 per cent. of air-dry residue, to congeal rapidly and to dry into irregular tears. Commerce is supplied with lactucarium almost exclusively from Germany and Great Britain, from plants cultivated for the purpose. Thos. Fairgrieve, who described the preparation in 1873, states that he cultivates *L. virosa* var. *montana*. The collection of the milky juice is commenced about the middle of July or beginning of August, when the flowers are just appearing, and continued for six or eight weeks until the latter part of September. The collectors proceed over the field, cutting the head of each stalk and scraping the juice into their vessels, one person who cuts being followed by two who collect the juice. This process is repeated six or seven times a day, a new cut being made each time a little lower down the stalk. In the evening, when the juice has thickened into a viscous mass, it is turned out of the vessels, suitably divided, and dried by the aid of heat, about five days being required for it.

In Germany, near the town of Zell on the Mosel, the collection lasts from May to September; the milky juice is taken up by the finger and transferred to hemispherical earthen cups, in which it quickly hardens, so that it can be turned out. It is then dried in the sunshine until it can be cut into four pieces, when the drying is completed by exposure to the air for some weeks on frames. (*Pharmacographia.*)

The lactucarium prepared in France by Aubergier is rarely if ever met with in this country. Fairgrieve obtained 1 lb. of lactucarium from 4 lbs. of juice, and estimates the average yield of each plant to be between 40 and 50 grains. By frequently puncturing the stems, Schütz (1823) obtained from *L. sativa*, *scariola*, and *virosa*, respectively, 17, 25, and 56 grains of lactucarium.

Description.—German lactucarium generally comes in sections of plano-convex circular cakes which are of a gray-brown color externally, usually white or yellowish and of a waxy lustre internally. English or Scotch lactucarium is met with in irregular sized angular pieces of a brown color and earthy appearance. Both kinds have a strongly bitter taste, and a strong narcotic odor suggesting that of opium.

What is usually sold here as French lactucarium is *extractum lactucæ*. (See page 576.)

Constituents.—Nearly one-half the weight of lactucarium is soluble in alcohol, but dilute alcohol dissolves only between 36 and 44 per cent. 50 to 60 per cent. of lactucarium consists of *lactucerin* or *lactucon*, $C_{16}H_{26}O$, which was obtained crystallized by Lenoir (1847) by exhausting lactucarium with boiling alcohol and recrystallizing the product; it forms thin colorless needles, which are inodorous and tasteless, insoluble in water, soluble in alcohol, and more freely so in ether, fixed and volatile oils. The bitter taste of lactucarium is due to three principles, two of which are uncrystallizable and freely soluble in water, while the crystallizable *lactucin*, $C_{11}H_{12}O_3.H_2O$, requires over 60 parts of cold water for solution, but dissolves more readily in hot water and in alcohol. Kromayer (1861) obtained only 0.3 per cent., which does not, perhaps, represent the whole amount present, but the much larger yields (18 to 28 per cent.) previously observed by Buchner and Ludwig must be due to impurities. Lactucin forms pearly scales, or rhombic plates, when crystallized from very dilute alcohol, has a neutral reaction, turns red and brown with alkalies, and is deprived of bitter taste; it is not a glucoside, but reduces from alkaline cupric solutions cuprous oxide. *Lactucic acid* and *lactucopicrin* have been found in the mother-liquor of lactucin; the former is light-yellow, amorphous, crystallizes on long standing, and reduces alkaline copper solutions. Lactucopicrin is brown, amorphous, insoluble in ether, soluble in alcohol, not precipitated by subacetate of lead, and appears to be produced by oxidation of lactucin.

The other constituents of lactucarium, which have been observed by different investigators, are a trace of volatile oil, asparagin, mannit, sugar, albumen, gum, resin, oxalic, citric, and malic acids, and between 8 and 10 per cent. of ash.

Off. Prep.—Syrupus lactucarii, *U. S.*

Medical Action and Uses.—With one accord the ancients attributed to lettuce soporific and anaphrodisiac qualities; but all the researches and observations made to discover its medicinal action in recent times agree in showing that its hypnotic and anodyne virtues are too slight to entitle it to much regard. That they exist, however, in a feeble degree is proved by the familiar fact that even garden lettuce used as a salad tends to produce drowsiness. It is probable that the lettuce of Greece was a much more active plant than our own. The utility of retaining lactucarium as an officinal medicine is very doubtful. It may possibly be desirable as a hypnotic for very impressionable persons with whom faith in a remedy supplies its want of intrinsic efficiency. If it have any virtues of the sort ascribed to it, they would peculiarly adapt it to cases of infantile disease. The *dose* of lactucarium is indefinite. Two grains may be given to an infant.

LAPPA, *U. S.*—BURDOCK.

Radix bardanæ, P. G.—*Bardane*, Fr.; *Klettenwurzel*, G.

The root of Lappa officinalis, *Allioni* (Arctium lappa, *Lin.*, A. majus, tomentosum, and minus, *Schkuhr.*).

Nat. Ord.—Compositæ, Cynareæ.

Origin.—We follow Gray in uniting the three forms which are often regarded as distinct, and described as *Lappa major*, Gaert., *L. tomentosa*, Lam., and *L. minor*, D. C. They are found in waste places and along roadsides in Northern Asia and throughout Europe, and have been naturalized in North America, where the variety *major* is more frequently met with than the others. They are coarse-looking biennial weeds, with branching stems 2 to 4 or 6 feet high, and cordate-oblong, nearly entire or toothed, rough, petiolate leaves. The globose involucre has the numerous scales appressed at the base, and contracted to a recurved sharp point above. The numerous tubular florets are purplish, or, rarely, whitish; the akenes are flattened and have a pappus of numerous short bristles. The variety *major* has rather large heads with a smoothish involucre; var. *tomentosa* has the involucre and peduncles woolly; var. *minor* has the heads much smaller, the involucre at first cottony, finally smooth, and the leaves usually unequally rounded or tapering at base. They bloom from July to September. The root should be collected in the autumn of the first year's growth, or early in the succeeding spring.

Description.—The root is nearly simple, 10 to 18 inches long, about 1 inch thick, gradually tapering, fleshy, and, when dry, longitudinally wrinkled, rounded at the top, and often with a tuft of white, soft, hairy leaf-stalks. It has a grayish-brown color externally, pale-brownish internally, the cross-section displaying a thickish bark, which in the inner layer is radially striate, and by a dark cambium line separated from the meditullium; this is about four times thicker, has finely porous ligneous rays, and the medullary rays of about the same width. The latter, as well as the parenchyma of the bark, are frequently partly destroyed, leaving merely the white dead tissue, which is spongy and full of holes. Burdock has a rather disagreeable, but weak, odor, and a mucilaginous, afterwards sweetish and bitterish, taste.

Constituents.—Burdock root is free from starch, but contains in its stead *inulin*. (See Inula, p. 760.) Mucilage, sugar, a bitter principle, a little resin, and some tannin have been observed in it.

Medical Action and Uses.—Burdock has had the reputation in Europe and in this country of being a depurative, as well through diaphoretic and diuretic virtues as by a more gradual and insensible modification of nutrition. It has been in vogue for the cure of *rheumatism*, *gout*, chronic *cutaneous diseases*, and chronic *pulmonary catarrhs;* it has been reputed to be diuretic (especially its seeds), and to promote the discharge of *urinary deposits;* to be alterative, also, and beneficial in constitutional *syphilis* and *scrofula*. These virtues, if they are real, would indicate that the medicine operates by promoting all the secretions, much as sarsaparilla is supposed to do. But, like that medicine, burdock is seldom given unless associated with more active agents. Externally, the expressed juice of the leaves, the fresh leaves bruised, and liniments made by boiling the leaves or the roots with oil, have been much used as popular remedies for *burns*, *wounds*, *ulcers*, and *eruptions*. Although an agent of secondary value, it is not quite just, as has been done, to call it "one of the illusions of the materia medica." Burdock is generally given in a decoction prepared by boiling two ounces of the recent bruised root in three pints of water to two pints. At least a pint a day of this decoction should be taken. Possibly the concentrated syrup or fluid extract, equally diluted, would answer equally well.

LARICIS CORTEX, *Br. Add.*—LARCH BARK.

Écorce de mélèze, Fr.; *Lärchenrinde*, G.

The bark, deprived of its outer layer, of Larix Europæa, *D. C.* (Abies Larix, *Rich.;* Pinus Larix, *Lin.*)

Nat. Ord.—Coniferæ, Abietineæ.

Origin.—The European larch is a forest tree of Southern and Central Europe, where it grows chiefly in mountainous localities up to an altitude of about 5000 feet. It is often cultivated in Europe, and has been introduced in North America as an ornamental tree. It attains a height of 80 to 100 feet, has the narrow linear deciduous leaves in fascicles of 20 to 40, and oblong ovoid erect cones, which are about 1 inch long. The bark is collected from the trunk and the branches.

Description.—The bark has a brown-gray or when older a reddish-brown fissured corky layer, which is to be removed. The liber has a reddish or pinkish hue, the inner surface is smooth, of a yellowish or pale brown color. It breaks with a short somewhat fibrous fracture, displaying rather indistinct medullary rays and some resin ducts. Larch bark has an agreeable terebinthinate odor, and a balsamic and astringent taste.

Constituents.—Stenhouse (1861) found larch bark to contain a good deal of peculiar *tannin*, which yields olive-green precipitates with salts of iron, turns red on being boiled with dilute sulphuric acid, but does not yield any *sugar*, which however is contained in the decoction of the bark, together with a considerable quantity of *mucilage* and *resinous matter*. He obtained also a volatile acid, by evaporating the warm infusion of the bark to a syrupy consistence, and then distilling it. The *larixinic acid*, $C_{10}H_{10}O_5$, crystallizes partly in the neck of the retort, the remainder is obtained by carefully concentrating the distillate and purifying the product by sublimation. The bark of the branches and of trees not over thirty years old yields the largest proportion. It forms long colorless crystals resembling those of benzoic acid, sublimes at 93° C. (199.4° F.), fuses at 150° C. (302° F.), has a bitterish and astringent taste, and a camphoraceous odor. Its combinations with alkalies are red-brown, and decomposed by carbonic acid; baryta solution causes a bulky precipitate; ferric salts produce a purple color, and on boiling it with silver salts, the metal is separated; nitric acid oxidizes it to oxalic acid. It is sparingly soluble in ether, and freely soluble in alcohol and hot water. It is allied to pyrogallic acid and pyrocatechin.

Other products of the larch are Venice turpentine and Briançon manna.

The bark of the American larch, *Larix Americana*, Mich., which is more slender, and has shorter leaves and smaller cones, deserves to be investigated.

Off. Prep.—Tinctura laricis, *Br.*

Medical Action and Uses.—Its action does not differ from that of other terebinthinate and balsamic remedies, but it has a less disagreeable flavor. With the inner bark a saturated tincture has been prepared, and highly recommended in *chronic bronchitis* and in chronic inflammation of the *urinary* mucous membrane. It has also been used in *purpura hemorrhagica.* The *dose* of the tincture is from twenty to thirty minims.

LAUROCERASI FOLIA, *Br.*—CHERRY LAUREL LEAVES.

Folia laurocerasi, P. G.—*Feuilles de laurier-cerise*, Fr.; *Kirschlorbeerblätter*, G.

The fresh leaves of Prunus laurocerasus, *Lin.* (Cerasus lauro-cerasus, *Loisel.*). Steph. and Church, Med. Bot., plate 117; Bentley and Trimen, Med. Plants, 98.

Nat. Ord.—Rosaceæ, Amygdaleæ.

Origin.—The cherry laurel is a small evergreen tree, or is frequently a shrub 15 to 20 feet high, with a smooth brownish bark and pale green branches, and produces pendulous racemes of dark purple shining cherry-like drupes. It is a native of Western Asia from Northern Persia to Asia Minor, but it has been naturalized in Southern Europe, and is cultivated in the open air as an ornamental shrub northward to Southern Germany and England.

Description.—The leaves are leathery, glossy and dark green above, pale green beneath, oblong in outline, narrowed above to an obtuse point, and below to a short petiole. They are about 4 to 6 inches long, and 1½ to 2½ inches wide, somewhat revolute on the margin, with distant and small but sharp serratures. The midrib is quite prominent on the lower surface, and has near its base one or two pairs of depressed glands. The unbroken fresh leaves are inodorous, but when broken they have a strong bitter almond odor; their taste is aromatic, bitter, and somewhat astringent.

Constituents.—Cherry laurel leaves contain some sugar, tannin, wax, fat, and, according to Stange (1823), an acid allied to if not identical with malic acid. The same author recognized also the production of *benzoic acid* from the volatile oil in the presence of oxygen. Liebig and Wöhler did not succeed in isolating amygdalin, from which they supposed the volatile oil to be derived. F. L. Winckler (1839) obtained the bitter principle as a soft transparent wine-yellow mass, which, when treated with dilute sulphuric acid and manganic binoxide, yielded a distillate of a very agreeable odor, which did not contain hydrocyanic acid. When treated with emulsion of sweet almonds, the taste became gradually less bitter, and the odor of bitter almonds became afterwards apparent. It seems therefore as if the leaves contained a compound from which amygdalin must be first produced before the volatile oil can be obtained, which has the same composition as oil of bitter almonds. Broeker (1867) observed that the watery distillate is strongest in hydrocyanic acid if the leaves were collected in the summer. Schoonbroodt (1869) obtained from the aqueous extract, on treatment with ether, some bitter crystals, which reduced cupric oxide.

Off. Prep.—Aqua laurocerasi, *Br.*

Medical Action and Uses.—Cherry laurel leaves are officinal in the British Pharmacopœia chiefly as the source from which cherry laurel water is obtained. Their medical virtues depend upon the hydrocyanic acid which they furnish. Its action and uses are treated of under Aqua laurocerasi and Acidum hydrocyanicum. The bruised fresh leaves are used as anodyne applications to painful parts.

LAURUS.—Laurel.

Bay, Sweet bay, E.; *Laurier commun*, Fr.; *Lorbeer*, G.

Laurus nobilis, *Lin.* *Nat. Ord.*—Lauraceæ.

Origin.—The bay tree is indigenous to the Levant, and grows wild in the countries bordering the Mediterranean. It is a small tree or large shrub with umbellate clusters of yellowish flowers. The leaves and fruit have been used.

Description. 1. The Leaves.—They are 3 or 4 inches long, an inch or more broad, shortly petiolate, coriaceous, smooth, pellucid-punctate, oblong or oblong-lanceolate, acute at both ends, entire, glossy above, veined beneath, and when dry of a yellowish- or brownish-green color. They have a pleasant aromatic odor, and an aromatic and bitterish taste.

2. The Fruit.—The so-called *bay-berries* are oval drupes about one-third of an inch long. When dry they are greenish-black or blackish-brown, slightly wrinkled, and fragile, the integuments, including the reddish-brown endocarp, being thin and brittle. The loose oval seed is easily separated into the two plano-convex brownish cotyledons, which have an aromatic oily and bitter taste. By expression of the bruised fruit, after steeping it in hot water, oil of bays, *Oleum lauri* (*s. laurinum*), P. G., is obtained. It has the consistence of lard, a granular appearance, a green color, and an aromatic odor and taste. It is soluble in ether, partly soluble in alcohol, and does not yield its coloring matter to water.

Constituents.—The leaves and fruit contain a volatile oil. The volatile oil of bay-berries is pale yellow, of the spec. grav. 0.91, congeals at a low temperature, contains oxygen, and is easily soluble in alcohol; it contains a more volatile elæopten and a solid stearopten. The seeds contain, according to Bonastre (1824) about 20 per cent. of fat, 2 per cent. of volatile oil, and 1.5 per cent. of resin. The solid fat of oil of bays is principally *lauro-stearin*, the glyceryl compound of *lauric acid* $C_{12}H_{24}O_2$.

Medical Action and Uses.—Bay leaves and berries were anciently held in high esteem as stimulant, stomachic, and astringent, and in substance or decoction were much used for the stings of insects, eruptions of the scalp, and vaginal relaxation with leucorrhœa; a decoction of the root bark was given internally in diseases of the urinary organs and in dropsy, and was regarded as a powerful emmenagogue. More efficient medicines have supplanted it, and it is now seldom used except in the form of its volatile and fixed oils for relieving local rheumatic and other pains. In Europe the fresh leaves continue to be employed for flavoring pastry and rendering it more digestible.

LAVANDULA, *U. S.*

Flores lavandulæ, P. G.; *Flores lavendulæ.*—*Lavender, Lavender flowers*, E.; *Fleurs de lavande*, Fr.; *Lavendelblüthen*, G.

The flowers of Lavandula vera, *D. C.* (L. spica, var. α, *Lin.*; L. angustifolia, *Ehrh.*; L. officinalis, *Chaix*). Bentley and Trimen, Med. Plants, 199.

Nat. Ord.—Labiatæ, Nepeteæ.

Origin.—Lavender is a native of Southern Europe, from Italy to Spain and to Northwestern Africa, growing upon sunny hillsides and mountains. It is extensively cultivated as an ornamental garden plant, and in Europe also for the purpose of distilling the volatile oil. (For an account of the cultivation of lavender at Hitchin, England, see *Proc. Amer. Pharm. Assoc.*, 1876, p. 819–821.) The plant is shrubby, about two feet high, has a brown-gray bark, which is much cleft when old; opposite, sessile, entire, and linear leaves, with revolute margins and long stalked terminal spikes, on which the lower whorl of flowers is remote from the others. The flowers are collected in June and July, before fully expanded, and require to be carefully dried.

Description.—The calyx is tubular, contracted and naked at the mouth, with the upper tooth roundish, rhomboid, and the remaining four teeth obsolete, densely covered with short hairs and minute glands, and of a blue-gray color. The corolla exceeds the calyx, and is violet-blue, tubular, enlarged above, hairy and glandular on the outside, and two-lipped, the upper lip being erect and two-lobed, and the lower lip spreading and three-lobed. The four stamens are quite short, and inserted in the middle of the hairy corolla tube. Lavender flowers have an agreeable aroma, which becomes more apparent on bruising and rubbing them, and a bitterish aromatic, somewhat camphoraceous taste.

Constituents.—Besides some tannin, resin, and other widely diffused principles, lavender flowers contain volatile oil, when fresh yielding about 1 per cent. (See Oleum lavandulæ.)

Medical Action and Uses.—Lavender is a stimulant aromatic, remarkable for its refreshing perfume. It is seldom used internally, unless in the form of oil or spirit, and then associated with other medicines. The infusion is said, when too freely taken, to occasion colic. Fomentations made with lavender inclosed in bags allay local pains, like other plants of the labiate family.

LEDUM.—MARSH TEA.

Marsh cistus, *Wild rosemary*, E.; *Lédon*, *Romarin sauvage*, Fr.; *Sumpfporst*, *Wilder Rosmarin*, G.

The leaves of Ledum palustre, *Lin.* *Nat. Ord.*—Ericaceæ, Ericineæ.

Origin.—This shrub grows in marshy locations in the northern sections of North America, Asia, and Europe. It is about three feet high, and has white or pale rose-red five-petaled flowers in umbellate clusters.

Description.—The leaves are coriaceous, about an inch long, linear or lance-linear, obtuse, with a revolute margin, dark-green, smooth and with depressed veins above, and clothed with a rusty wool on the lower side. They have a peculiar heavy aromatic odor, and a bitter aromatic somewhat camphoraceous taste.

Constituents.—Meissner's results (1827) with marsh tea were further investigated by Willigk (1852) and others. The tannin, *leditannic acid* $C_{14}H_{12}O_6$, was obtained as a reddish powder, which dissolves in water and alcohol, and colors ferric salts dark green. The volatile oil, about 1½ per cent., is yellow, pungently aromatic, and contains a stearopten, *ledum camphor*, probably $5C_{10}H_{16}.3H_2O$, which has been examined by Grassmann (1831) and Buchner (1856); it is in silky needles, fusible and sublimable. Frœhde (1861) recognized in the volatile oil the presence of valerianic and other volatile acids, and of *ericinol* $C_{10}H_{16}O$; this is likewise contained in other ericaceous plants, or obtainable from them as a decomposition product of the glucoside *ericolin* $C_{34}H_{56}O_{21}$, which has been discovered by Rochleder and Schwarz (1852), and is brown-yellow, bitter, soluble in water, alcohol, and alcoholic ether, and not precipitated by lead salts. The remaining constituents of marsh tea are citric acid, resin, wax, and other ordinary vegetable principles.

Allied Plants.—LEDUM LATIFOLIUM, *Ait.*, known as *Labrador tea* and *James tea*, is indigenous to the Northern United States and to British America. The leaves resemble the preceding, but are broader, elliptic-oblong, and occasionally slightly heart-shaped at the base. They probably contain the same constituents.

ANDROMEDA POLIFOLIA, *Lin.*, indigenous to marshes of Northern Asia, Europe, and America, is also known as *wild rosemary*. The leaves are about an inch long, linear-lanceolate, acute, strongly revolute at the margin, greenish-white beneath, otherwise resembling the preceding. They are considered to possess acrid and somewhat narcotic properties.

Medical Action and Uses.—This plant has been ranked with acrid-narcotic medicines, and is stated, in large doses, to occasion headache, restlessness, sleeplessness, dyspnœa, cough, dilatation of the pupils, a sort of intoxication, with pain in the limbs, increased secretion of urine, saliva, and especially of sweat, with itching and an eruption of papules or pustules on the skin. It is said to have been used in the manufacture of beer to render it more intoxicating. It was formerly employed in diarrhœa, dysentery, whooping-cough, croup, gouty and rheumatic pains, and all sorts of chronic cutaneous eruptions. Its use for such purposes is, however, obsolete. A strong decoction of the plant is used to destroy cutaneous parasites in horses and neat cattle, and to cleanse bedsteads of vermin; and the leaves and twigs of the fresh plants are laid among woollen clothing to protect it against moths.

LEONURUS.—MOTHERWORT.

Agripaume, Cardiaire, Fr.; *Herzgespann, Wolfstrapp,* G.

Leonurus cardiaca, *Lin.* *Nat. Ord.*—Labiatæ, Stachydeæ.

Description.—Motherwort is a perennial herb growing in waste places and near dwellings throughout Europe, Northern Asia, and North America. It is 3 or 4 feet high, and has a quadrangular rather rough stem. The lower leaves are roundish, often heart-shaped at the base, and palmately five to seven-lobed; the upper ones are oblong, acutely three-lobed, and have a wedge-shaped base. The pale purplish flowers have awl-shaped or spiny-toothed calyx teeth, and are in dense axillary cymules. The plant has a rather unpleasant aromatic odor, and a bitter taste.

Constituents.—It evidently contains volatile oil; the bitter principle has not been isolated.

Allied Plants.—Of the numerous plants belonging to the tribe Stachydeæ the following seem to deserve a brief notice (see also Marrubium and Scutellaria):—

STACHYS PALUSTRIS, *Lin.*, Hedge nettle, *E.*, Ortie rouge, *Fr.*, Stinknessel, Sumpfziest, *G.*, grows in wet places in Europe and North America. The stem is stiff-hairy. The leaves are mostly sessile, about 3 inches long, varying between ovate and linear-lanceolate, round or heart-shaped at the base, rather obtuse, hairy, and on the margin crenately serrate. The flowers are in whorls of 6 to 10, have sharply subulate calyx teeth, and a purple somewhat spotted corolla.

GALEOPSIS TETRAHIT, *Lin.* Hemp nettle, *E.*; Chanvre bâtard, Galeopside, *Fr.*; Hanfnessel, Hohlzahn, *G.*—Introduced from Europe into North America. The stem is densely bristly-hairy below the joints; the leaves are about 2 inches long, ovate, usually acute, rather rounded at the base, coarsely serrate. The flowers are in dense axillary clusters, have long spiny-toothed calyx teeth, and a white or yellowish corolla, with a purple spot on the lower lip.

The allied species, Gal. ochroleuca, *Lam.*, and G. grandiflora, *Roth*, at one time attracted attention in Europe as the principal ingredients of a nostrum sold as *Blankenheim tea* or *Lieber's consumption herbs.*

BALLOTA NIGRA, *Lin.* Black horehound, *E.*; Marrube noir (fétide), *Fr.*; Schwarzer Andorn, *G.*—Sparingly naturalized in New England. The stem is hairy, often red-brown; the leaves are about 1½ inch long, wrinkled, hairy, ovate, slightly heart-shaped, acute, and crenately toothed. The reddish-purple flowers are in axillary clusters of 5 to 9.

LAMIUM ALBUM, *Lin.* Dead nettle, *E.*; Ortie morte, *Fr.*; Taubnessel, *G.*—It has likewise been introduced from Europe, has ovate, heart-shaped, pointed and coarsely serrate, somewhat hairy, petiolate leaves, and white or whitish flowers in dense axillary clusters, and slender calyx teeth. Lamium amplexicaule, *Lin.*, and L. purpureum, *Lin.*, are more frequent in the United States; they have roundish leaves and smaller purplish flowers.

Many other species of the above genera have been employed in Europe and Asia, and like the above contain volatile oil and a bitter principle.

Medical Action and Uses.—A decoction of motherwort is sometimes used in Europe to promote digestion and quicken the functions of the skin. In the same countries L. lanatus is regarded as a vascular stimulant and diuretic, and also as a general tonic; it is employed in dropsy, especially of hepatic origin, and is stated to impart to the urine a dark-brown color; it is also used in chronic gout and rheumatism, and to relieve uterine obstructions.

LEPTANDRA, *U. S.*

Leptandra, Culver's root, Culver's physic, Black root, E.; *Racine de leptandra, s. de véronique de Virginie,* Fr.; *Leptandra-Wurzel,* G.

The rhizome with the rootlets of Leptandra virginica, *Nuttall* (Veronica virginica, *Lin.*). Bentley and Trimen, Med. Plants, 196.

Nat. Ord.—Scrophulariaceæ.

Origin.—Leptandra is indigenous to Canada and the United States as far west as the Mississippi Valley; in its southern locations it grows in mountain valleys, and further north in low grounds and rich woodlands. It sends up an obtusely angular stem, 3 to 6 feet high, has the short-petioled, lanceolate and serrate leaves in verticils of 4 or 5, and the white flowers with the two much exserted stamens in panicled spikes, 3 to 6 inches long. It flowers in July and August, and produces ovate, two-celled, and many-seeded capsules.

Description.—The rhizome is 4 to 6 inches long, and about $\frac{1}{4}$ inch thick, horizontal, somewhat bent and branched, blackish-brown to brown-black, nearly free from wrinkles, but the bark is sometimes transversely fissured. The upper side has short remnants of the stems or cup-shaped scars, $\frac{3}{4}$ to 2 inches apart; the numerous rootlets, which are chiefly attached to the lower side, are blackish, about $\frac{1}{16}$ inch thick, longitudinally wrinkled, quite fragile, and therefore usually detached and much broken. The rhizome is hard, and breaks with a woody fracture, showing a large purplish-brown pith, and few medullary rays dissecting the yellowish wood, which is 8 to 10 times thicker than the blackish-gray bark. The ligneous cord of the rootlets is of about the same thickness as the bark. Leptandra has no odor; its taste is bitter and feebly acrid.

Constituents.—According to the analysis of Prof. Wayne (1856), leptandra contains, besides widely diffused principles, like tannin, gum, resin, and a trace of volatile oil, a principle having the nauseous bitter taste of the drug, and therefore deserves to be called *leptandrin*. It is soluble in water, alcohol, and ether, and was obtained by precipitating the infusion with subacetate of lead, removing the excess of lead from the filtrate by sodium carbonate, and passing the liquid through a column of animal charcoal; this was washed with water and then treated with boiling alcohol, and the extract left on evaporation treated with ether; on evaporating the ether spontaneously, a portion of leptandrin crystallized; the remainder was contaminated with coloring matter, which prevented it from crystallizing. The so-called *leptandrin* of the eclectics, which is obtained by precipitating the concentrated tincture with water, appears to owe its efficacy to the accidental presence of the principle described. From the mother liquor of this eclectic preparation, Wayne (1859) obtained *mannit.* F. F. Mayer (1863) observed the bitter principle to be at least partly precipitated by tannin, and that portion to be a glucoside; he also found *saponin*, some *citric acid*, and a small quantity of a *volatile alkaloid*.

A fluid extract of leptandra is sometimes employed; it is prepared by exhausting the drug with alcohol.

Medical Action and Uses.—Although this medicine has long been in use, and is officinal, we do not learn that it has commended itself to educated physicians by its peculiar virtues, although they are sufficiently marked to merit greater attention. The root, when fresh or recent, acts violently as an emeto-cathartic, and the impure resin obtained from it, and ignorantly called leptandrin, as if it were itself the proximate active principle of the plant, produces similar effects, when the dose is excessive. Like all gastro-intestinal irritants, it probably promotes the secretions of the mucous glands, the pancreas, and the liver, but has no specific influence upon the last-named organ, as has been confidently assumed. The *dose* of the powder is stated to be from twenty to sixty grains, and of leptandrin from two to four grains. It has also been given in tincture and fluid extract.

LEVISTICUM.—LOVAGE.

Radix levistici, P. G.—*Livèche, Ache de montagne*, Fr.; *Liebstöckel*, G.

The root of Levisticum officinale, *Koch*, s. Ligusticum levisticum, *Lin.*

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—Lovage is indigenous to the mountainous districts of Southern Europe, has a stem about 5 feet high, terminal umbels of yellow flowers, and elliptical or oval fruits with winged ribs, and one or more oil-tubes in each groove. The plant is sometimes cultivated in gardens.

Description.—The root is about 6 inches long, 1 or 1½ inch thick, several-headed, indistinctly annulate, longitudinally wrinkled, somewhat branched below, yellowish-brown externally, and pale-yellowish internally. It has a thick bark, which is radially striate from the medullary rays, fissured in the outer portion, and contains numerous orange-yellow resin-cells, arranged in irregular concentric circles. The meditullium is denser, but soft, has narrow medullary rays, and in the upper portion a central pith. It has a strong balsamic odor, somewhat resembling that of angelica, and a mucilaginous, aromatic, and pungent taste.

The root of Ligusticum actæifolium, *Mich.*, which is indigenous to the Southern United States, is similar in appearance and properties.

Constituents.—Lovage was analyzed by Trommsdorff (1836), Riegel (1840), and others, and found to yield a thickish volatile oil containing much stearopten, various resins, some soft, others hard, one having a bitter and pungent taste, sugar, mucilage, and other common principles.

Allied Drugs.—PIMPINELLA SAXIFRAGA, *Lin.;* Small burnet saxifrage, *E.;* Grand boucage, *Fr.;* Pimpinell, Biebernell, *G.*—Indigenous to Europe and Asia. The root resembles the preceding, but is brown-yellow, usually one-headed. not over ½ inch thick, finely annulate above and verrucose below; the bark is very thick, spongy, contains numerous resin-cells, and is radially striate, either white or yellowish, inclosing a yellow wood. The constituents are similar to those of the preceding.

LASERPITIUM LATIFOLIUM, *Lin.*—The root was formerly known as *Radix gentianæ albæ*, from its resemblance in shape to that of gentian root, but it is externally brownish-white, internally white, and contains yellow resin-cells in the thick spongy bark.

PEUCEDANUM OFFICINALE, *Lin.*—The root is externally blackish, internally brownish-yellow, with a rather thick bark containing numerous orange-colored resin-cells in radial rows, and inclosing a soft porous wood with resin-cells in the medullary rays.

Medical Action and Uses.—Levisticum belongs to the large class of plants containing an essential oil and a resin, which have always been employed as carminatives, diuretics, emmenagogues, and digestive stimulants. It has been much used in flatulent *dyspepsia*, *amenorrhœa*, and *dropsy*, especially in Germany. It is administered in decoction or infusion, in tablespoonful doses.

LIATRIS.—Liatris.

Nat. Ord.—Compositæ, Eupatorieæ.

Description.—The genus Liatris embraces principally North American perennial herbs with tuberous roots, simple and erect stems, alternate and entire leaves, and handsome rose-purple flower-heads with an oblong imbricate involucre, naked receptacle, and a pappus composed of many bristles. The flowers are usually in terminal spikes or racemes.

Liatris spicata, *Willd.*—The tuberous rhizome is known as *Button snake-root*, *Devil's bit*, and *Colic root.* It is $\frac{1}{2}$ inch or more in diameter, somewhat tuberculate from short branches, and marked with several cup-shaped stem-scars. It is slightly wrinkled and of a brown color externally, and internally of a dingy white, with streaks of brown. Its odor is somewhat balsamic, and its taste warm and bitterish.

L. squarrosa, *Willd.*, and L. scariosa, *Willd.*, are known as *Rattlesnake's master.* The rhizomes resemble the preceding, but are more elongated, irregularly ovate, and beset with a few wiry rootlets. Internally they are of a brownish color.

L. odoratissima, *Willd.* *Vanilla plant* or *Deer's tongue.*—The radical leaves are obovate-spatulate, obtuse, about 7-veined, narrowed below; the stem-leaves are oval or oblong, and clasping at the base. All the leaves are rather fleshy, pale green, and smooth, and, after drying, have a very agreeable odor.

Constituents.—The rhizomes appear to contain volatile oil and resin. The leaves of the deer's tongue were found by Procter (1859) to contain coumarin, which is frequently separated upon the surface in crystals.

Pharmaceutical Uses.—Their agreeable and persistent odor renders deer's tongue leaves serviceable in the preparation of sachet powders, etc., as suggested by Dr. A. W. Miller (1875).

Medical Action and Uses.—L. spicata is one of the numerous "snake-roots" which owe whatever virtue they possess to being diaphoretic when administered in hot decoction, in consequence of the acrid or stimulant principle they contain. These qualities also adapt them to relieve flatulent *colic.* They are also diuretic, and are used in nephritic complaints. L. odoratissima has an odor resembling that of vanilla, for which reason it is sometimes mixed with smoking tobacco, and introduced into segars. Other species, L. scariosa and L. squarrosa, are especially high in popular esteem as antidotes to the rattlesnake's bite, and are employed in *gonorrhœa*, and also to prepare gargles for *sore throat.*

LIGUSTRUM.—Privet.

Troène, Fr.; *Rainweide*, *Hartriegel*, G.

Ligustrum vulgare, *Lin.* *Nat. Ord.*—Oleaceæ.

Description.—The privet is a shrub, 8 or 10 feet high, indigenous to Southern Europe; it is cultivated for ornament and in hedges, and is naturalized in the United States. The *leaves* are opposite, elliptic-lanceolate, smooth, thickish, entire on the margin, and about 2 inches long; they have a bitterish and astringent taste. The *flowers* are in panicles, the calyx short, the corolla funnel-shaped, 4-lobed, white, and of a sweetish agreeable odor. The *berries* are globular-oval, black externally, dark-purple internally, two-celled, and contain 2 or 4 ovate-oblong acute seeds.

Constituents.—According to Stenhouse (1854) the leaves contain a principle which yields *quinone*. The bitter principle, *ligustrin*, was not completely isolated by Polex (1839) and Kromayer (1854). It appears to be insoluble in absolute alcohol and ether, and to be allied to *syringin*, the bitter principle of *lilac*, Syringa vulgaris, *Lin.* *Ligustron* is a crystalline, bitter, and fusible principle, obtained by Kromayer.

Medical Action and Uses.—The leaves and bark are strongly astringent, and were formerly used to restrain hemorrhages, and are still employed in gargles in various forms of sore mouth and throat.

LIMONIS CORTEX, *U. S.*, *Br.*—LEMON-PEEL.

Cortex fructus citri, P. G.—*Écorce (zeste) de citron, de limon*, Fr.; *Citronenschale, Limonenschale*, G.

The rind of the fruit of Citrus limonum, *Risso* (C. medica var., *B. Lin.*). Steph. and Church, Med. Bot., plate 92; Bentley and Trimen, Med. Plants, 54.

Nat. Ord.—Aurantiaceæ.

Origin.—The lemon is a native of the northwestern part of India, where it is found in the forests up to an altitude of about 4000 feet. It is extensively cultivated in the basin of the Mediterranean, and the culture has also been introduced into the southern parts of the United States, in Australia, and most tropical and subtropical countries. Several varieties have been produced from the original stock, of which, besides the lemon, the following are quite distinct:—

C. medica, Risso, *Citron* or *Cedrat.*—Its flowers are purplish externally; the fruit is large, has a rugged and thick rind, and contains an acid juice.

C. limetta, Risso, *Lime.*—Its flowers are white; the fruit is smaller than the lemon, oval or roundish, has a smoother and thin rind, and contains a very acid juice.

The *lemon-tree* is 12 to 15 feet high, irregularly branched and spiny in the leaf-axils; the leaves are oval or ovate-oblong, somewhat serrate, leathery, glossy above and articulated with the wingless or slightly winged petiole. The flowers are mostly solitary, have a small calyx, five petals, which are purplish-pink externally, and numerous stamens. The fruit varies in shape between oval and obovate, has a nipple-shaped apex, a yellow nearly smooth pericarp, and is divided into 8 to 12 cells, each with 2 or 3 seeds.

Description.—Lemon-peel forms either narrow bands or more frequently oblong and curved sections; the outer surface has a deep lemon-yellow color, and is somewhat uneven and rough from numerous oil cells imbedded in the tissue. This portion has an agreeable odor and an aromatic slightly bitter taste; it is the only part which possesses any medicinal value. The white spongy tissue underneath, which is inodorous and nearly tasteless, should be rejected.

Constituents.—The principal constituent is volatile oil (see Oleum limonis). The bitter taste is probably due to hesperidin (see page 258). The white portion is colored black by ferric salts; the principle which gives rise to this color has not yet been isolated.

Off. Prep.—Infus. aurantii comp., Infus. gentianæ comp., *Br.;* Spiritus limonis, *U. S.;* Syrupus limonis, Tinctura limonis, *Br.*

Medical Uses.—Lemon-peel is used in medicine, as in cookery, for the sake of its flavor.

LIMONIS SUCCUS, *U. S.*, *Br.*—LEMON-JUICE.

Succus citri.—*Suc de citron* (*de limon*), Fr.; *Citronensaft*, *Limonensaft*, G.

The juice of the fruit of Citrus limonum; *D. C.*

Origin.—See the preceding article. The juice is obtained by expressing the ripe fruit.

Description.—Lemon-juice is a slightly turbid yellowish liquor, which has the agreeable odor of lemon and an acid taste. Stoddart determined its usual specific gravity to be 1.044, and each fluidounce to contain 44 grains of citric acid (42.5 grains in one imperial fluidounce); its acid strength, however, is subject to variation. Lemon-juice speedily undergoes decomposition, and various methods for its preservation have been suggested, most of which, however, fail to preserve it in condition for medicinal use. It has been proposed to concentrate it by evaporation or freezing before bottling it, or to exclude the air by a stratum of fixed oil; the flavor, however, is considerably modified. A better method is to clarify the juice by adding half its volume of strong alcohol, the decanted liquid is then freed from alcohol at a very moderate heat, and the remaining liquid put into suitable bottles, which are heated to near the boiling point for about an hour, and then hermetically sealed. The juice may be preserved by the same method; but the flavor will be impaired on keeping.

Constituents.—Lemon-juice contains about 10 per cent. of citric acid and 3 to 4 per cent. of gum and sugar. By evaporation and incineration, H. M. Witt (1854) obtained between 0.2 and 0.5 of ash, the principal constituents of which were potassa 44.34, lime 7.61, and phosphoric acid 7.56 per cent. Cossa (1872).

Off. Prep.—Mistura potassii citratis, *U. S.;* Syrupus limonis, *U. S.*, *Br.*

Medical Uses.—Lemon-juice is essentially a solution of free citric acid. (See Acidum citricum.)

LINARIA.—TOAD-FLAX.

Herba linariæ, P. G.—*Linaire commune*, Fr.; *Löwenmaul*, *Marienflachs*, G.

Linaria vulgaris, *Mill.*, s. Antirrhinum linaria, *Lin.*

Nat. Ord.—Scrophulariaceæ.

Description.—The toad-flax or *ramsted*, also called *butter-and-eggs*, is a European perennial, now extensively naturalized in North America. It is one or one and a half foot high, has alternate, sessile, lance-linear, almost three-nerved, smooth and light-green leaves, one or one and a half inch long; and terminal racemes of showy yellow flowers, which have a personate corolla about two-thirds inch long, and at the base continued into a curved spur of the same length. When fresh, the herb has a slight disagreeable odor and a bitterish taste.

Constituents.—The flowers were analyzed by Riegel (1843); they contain a yellow coloring matter, mucilage, sugar, etc.

Medical Action and Uses.—The use of common toad-flax for jaundice, dropsy, and diseases of the skin, and of an ointment made with it for the cure of hemorrhoids, is now entirely obsolete.

LINI FARINA, *U. S.*, *Br.* See LINUM.

LINIMENTA.—LINIMENTS.

Embrocations, E., Fr.; *Linimente*, *Einreibungen*, G.

Liniments are liquid or semi-liquid preparations which are intended for external use, and are applied to the skin by friction. The vehicle may be oil or alcohol, or sometimes water; many are perfect solutions, others mechanical mixtures, which should be well agitated before they are used; a few are of a soft solid consistence at the ordinary temperature, but become liquid when applied to the skin.

LINIMENTUM ACONITI, *U. S.*, *Br.*—LINIMENT OF ACONITE.

Liniment d'aconite, Fr.; *Akonitliniment*, G.

Preparation.—Take of Aconite Root in fine powder eight troyounces; Glycerin a fluidounce; Alcohol a sufficient quantity. Moisten the powder with four fluidounces of alcohol, and let it macerate for twenty-four hours; then pack it in a conical percolator, and gradually pour alcohol upon it until two pints of tincture have been obtained. Distil off a pint and a half of alcohol, and evaporate the remainder until it measures seven fluidounces; to this add the glycerin, and mix them thoroughly. *U. S.*

Take of Aconite Root in coarse powder twenty ounces; Camphor one ounce; Rectified Spirit a sufficiency. Moisten the aconite with some of the spirit, and macerate in a closed vessel for three days; then transfer to a percolator, and adding more spirit percolate slowly into a receiver containing the camphor, until the product measures one pint (imperial). *Br.*

The first formula is essentially the same as that suggested by Procter in 1853. Both preparations have the strength of fluid extracts, and differ from each other mainly in the fact that the latter contains some camphor; the root, however, is not completely exhausted by the second process.

Medical Uses.—This liniment is convenient for the local use of aconite, and for addition to other anodyne applications. It is chiefly employed for the relief of *neuralgia* by saturating with it disks or pledgets of cloth which are then applied to the painful part. Mixed with an equal quantity of soap liniment it is said to effectually remove the pain of *dry gangrene.*

LINIMENTUM AMMONIÆ, *U. S.*, *Br.*—LINIMENT OF AMMONIA.

Linimentum ammoniatum, P. G.; *Linimentum volatile*, *Linimentum ammoniacale.*—*Volatile liniment*, E.; *Liniment ammoniacal* (*volatil*), *Savon ammoniacal*, Fr.; *Flüchtiges Liniment*, *Flüchtige Salbe*, G.

Preparation.—Take of Water of Ammonia a fluidounce; Olive Oil two troyounces. Mix them. *U. S.*

Take of Solution of Ammonia one fluidounce; Olive Oil three fluidounces. Mix together with agitation. *Br.*

The German Pharmacopœia directs four parts of olive oil, and the French Codex nine parts of expressed oil of almonds to one part of ammonia water.

The fixed oil is partly decomposed, with the formation of an ammonia soap, by means of which the water and oil are kept well mixed, forming a stiff opaque emulsion, which Rother (1872) renders sufficiently fluid by the addition of one-sixteenth volume of alcohol. On being kept, the liniment becomes thicker, and finally forms a stiff and even granular mass, which Rother prevents by the addition of a minute quantity of oleic acid.

Some Pharmacopœias recognize also a *Linimentum ammoniæ camphoratum*, *camphorated volatile liniment*, which is made in precisely the same manner, except that camphor liniment is substituted for the fixed oil.

Medical Uses.—This preparation represents the stimulant rather than the counter-irritant virtues of ammonia. It is used to relieve local pains of a *neuralgic* or *rheumatic* nature, and to palliate both pain and congestion in the forming stage of various inflammations, as *sore throat*, *laryngitis*, *bronchitis*, and *pleurisy*. If prevented from evaporating, it may vesicate the skin.

LINIMENTUM BELLADONNÆ, *Br.*—LINIMENT OF BELLADONNA.

Liniment de belladonne, Fr.; *Belladonna-Liniment*, G.

Preparation.—Take of Belladonna Root in coarse powder twenty ounces; Camphor one ounce; Rectified Spirit a sufficiency. Moisten the belladonna with some of the spirit, and macerate in a closed vessel for three days; then transfer to a percolator, and adding more spirit percolate slowly into a receiver containing the camphor, until the product measures one pint (imperial). *Br.*

The formula is identical with that given for aconite liniment in the same Pharmacopœia; the root is not exhausted.

Medical Uses.—Belladonna liniment is a convenient and efficient preparation for allaying the local pains which belong to neuralgia, rheumatism, sprains, etc. It is advantageously associated with aconite liniment.

LINIMENTUM CALCIS, *U. S.*, *Br.*

Lime liniment, *Liniment of lime*, E.; *Liniment calcaire*, *Savon calcaire*, Fr.; *Kalkliniment*, G.

Preparation.—Take of Solution of Lime eight fluidounces; Flaxseed Oil seven troyounces. Mix them. *U. S.*

Take of Solution of Lime, Olive Oil, of each two fluidounces. Mix together, with agitation. *Br.*

A lime soap is formed by this process, which keeps the excess of the oil emulsionized for a short time, the two separating together from the aqueous liquid.

The French Codex directs the separation of the soft saponaceous mass resulting from the agitation of nine parts of lime-water with one part of expressed oil of almonds, and its preservation for use.

Medical Uses.—This liniment is much employed in the treatment of *burns*, both those which are recent and superficial, and those which involve the skin, in their ulcerative stage. It may be used to prevent pitting in confluent *smallpox*. It is applied most efficiently on cloths, which should be kept moist.

LINIMENTUM CAMPHORÆ, *U. S.*, *Br.*—LINIMENT OF CAMPHOR.

Linimentum camphoratum, Oleum camphoratum.—Camphorated oil, E.; *Liniment camphré, Huile camphrée*, Fr.; *Kampferliniment*, G.

Preparation.—Take of Camphor three troyounces; Olive Oil twelve troyounces. Dissolve the camphor in the oil. *U. S.*

Take of Camphor one ounce; Olive Oil four fluidounces. Dissolve the camphor in the oil. *Br.*

A simple solution of camphor in olive oil, which is best obtained by employing the camphor as a fine powder, or by digesting the mixture in a closed bottle at a moderate heat.

Off. Prep.—Linimentum chloroformi, Linim. hydrargyri, Linim. terebinth. acet., *Br.*

Medical Uses.—It is used as an anodyne and discutient application to *sprains*, *bruises*, and *glandular swellings*, and for the relief of *rheumatic pains.* It is also serviceable in preventing the ill effects of pressure by surgical apparatus, and by decubitus.

LINIMENTUM CAMPHORÆ COMPOSITUM, *Br.*—COMPOUND LINIMENT OF CAMPHOR.

Liniment camphré ammoniacal, Fr.; *Ammoniak und Kampfer-Liniment*, G.

Preparation.—Take of Camphor two and a half ounces; Oil of Lavender one fluidrachm; Strong Solution of Ammonia five fluidounces; Rectified Spirit fifteen fluidounces. Dissolve the camphor and oil of lavender in the spirit; then add the solution of ammonia gradually, shaking them together until a clear solution is formed. *Br.*

Medical Uses.—The characteristic of this preparation, as distinguished from simple liniment of camphor, is, that it is rendered stimulant and even rubefacient by the strong water of ammonia it contains. It is a convenient liniment for prescription in cases of local rheumatic, neuralgic, and traumatic pains.

LINIMENTUM CANTHARIDIS, *U. S.*—LINIMENT OF CANTHARIDES.

Huile de cantharides térébenthinée, Fr.; *Spanischfliegen-Liniment*, G.

See also Liquor epispasticus.

Preparation.—Take of Cantharides in fine powder a troyounce; Oil of Turpentine half a pint. Digest the cantharides with the oil for three hours in a close vessel by means of a water-bath, and strain. *U. S.*

Cantharidin is soluble in oil of turpentine; the digestion may be effected in a bottle partly closed by a stopper.

Medical Uses.—This is a very powerful stimulant and counter-irritant preparation. Its advantages over turpentine liniment on the one hand, and over blisters upon the other, are not apparent; and unless carefully used, it may occasion troublesome irritation, and even ulcers.

LINIMENTUM CHLOROFORMI, *U. S.*, *Br.*—LINIMENT OF CHLOROFORM.

Liniment au chloroforme, Fr.; *Chloroform-Liniment*, G.

Preparation.—Take of Purified Chloroform three troyounces; Olive Oil four troyounces. Mix them. *U. S.*

Take of Chloroform, Liniment of Camphor, each two fluidounces. Mix. *Br.*

These preparations are about alike in strength as far as the chloroform is concerned; that by the second formula contains also some camphor. The liniment is readily made extemporaneously, and the camphor, if it is to be contained in it, should be previously dissolved in the chloroform, $\frac{1}{4}$ ounce of camphor being used for every ounce of olive oil.

Medical Uses.—The purpose of this preparation was probably to prolong, and at the same time mitigate, the local anæsthetic action of chloroform. But the object is better accomplished by a mixture of chloroform and soap liniment, to which tincture of aconite root may be added.

LINIMENTUM CROTONIS, *Br.*—LINIMENT OF CROTON OIL.

Liniment crotoné, Fr.; *Krotonöl-Liniment*, G.

Preparation.—Take of Croton Oil one fluidounce; Oil of Cajeput, Rectified Spirit, each $3\frac{1}{2}$ fluidounces. Mix. *Br.*

This is simply a solution of croton oil in alcohol and oil of cajeput, and has the odor of the latter.

Medical Uses.—There is an incongruity in associating a prompt but transient irritant, like oil of cajeput, with one whose operation is slow, and is scarcely active until the characteristic croton pustulation is produced. The preparation has nothing to recommend it before an extemporaneous solution of croton oil in olive oil, with or without the addition of oil of cajeput, cloves, or cassia.

LINIMENTUM HYDRARGYRI, *Br.*—LINIMENT OF MERCURY.

Linimentum mercuriale.—*Liniment mercuriel*, Fr.; *Quecksilber-Liniment*, G.

Preparation.—Take of Ointment of Mercury one ounce; Solution of Ammonia, Liniment of Camphor, of each one fluidounce. Liquefy the ointment of mercury in the liniment of camphor with a gentle heat; then add the solution of ammonia gradually, and mix with agitation. *Br.*

This may be prepared in a wide-mouthed vial, if the ointment and liniment are digested together, and frequently agitated until the lumps have disappeared, when the ammonia water should be added and well incorporated by shaking. The liniment has a gray color from the finely divided mercury.

Medical Uses.—The camphor and ammonia in this preparation are intended by their stimulant action to promote the discutient and absorbent action of the mercury. As it must be applied with friction, there is great danger of its causing salivation. It is less efficient in promoting the resolution of enlarged and indurated glands, etc., than are mercurial ointments and plasters, especially those containing the iodides of mercury.

LINIMENTUM IODI, *Br.*—LINIMENT OF IODINE.

Liniment ioduré, Fr.; *Jodliniment*, G.

Preparation.—Take of Iodine one and a quarter ounce; Iodide of Potassium half an ounce; Camphor a quarter of an ounce; Rectified Spirit ten fluidounces. Dissolve the iodine, iodide of potassium, and camphor in the spirit. *Br.*

This is much stronger than the Tinctura iodi, from which it also differs in containing enough camphor to impart to it its odor. The potassium iodide adapts the liniment for use with aqueous liquids by preventing the precipitation of the iodine.

Medical Uses.—As it is probable that a very minute proportion, if any, either of iodine or of iodide of potassium is absorbed by the sound skin, it must be concluded that this liniment will be less efficient as a local application than either the simple or compound iodine ointment, in both of which the active ingredients are kept longer in contact with the integument than they can be in a liniment.

LINIMENTUM OPII, *Br.*—LINIMENT OF OPIUM.

Anodyne liniment, E.; *Liniment opiacé*, Fr.; *Opiumliniment*, G.

Preparation.—Take of Tincture of Opium, Liniment of Soap, each two fluidounces. Mix.

The *liniment savonneux opiacé* of the French Codex is made by triturating 5 parts of powdered soap with 90 parts of expressed oil of almonds, and adding 5 parts of tincture of opium; it must be well agitated.

Medical Uses.—Being merely a mixture of laudanum and soap liniment, its fixed proportions are rather embarrassing than convenient. The quantity of laudanum used should vary with the condition of the affected part as to delicacy, degree of pain, etc.

LINIMENTUM PLUMBI SUBACETATIS, *U. S.*— LINIMENT OF SUBACETATE OF LEAD.

Liniment saturné, *Beurre de saturne*, *Baume universelle*, Fr.; *Bleiliniment*, G.

Preparation.—Take of Olive Oil three troyounces; Solution of Subacetate of Lead two troyounces. Mix them. *U. S.*

This yields a yellowish-white opaque emulsion, which does not separate on standing, but gradually stiffens. It is made extemporaneously by weighing the materials into a vial and then agitating well.

Medical Uses.—A convenient discutient liniment for *sprains*, *bruises*, *chilblains*, *inflamed glands*, and *chapped hands*.

LINIMENTUM POTASSII IODIDI CUM SAPONE, *Br.*— LINIMENT OF IODIDE OF POTASSIUM AND SOAP.

Liniment savonneux ioduré, Fr.; *Jodkalium-Seifenliniment*, G.

Preparation.—Take of Hard Soap cut small, Iodide of Potassium, each one and a half ounce; Glycerin one fluidounce; Oil of Lemon one fluidrachm;

Distilled Water ten fluidounces. Dissolve the soap in seven fluidounces of the water by the heat of a water-bath. Dissolve the iodide of potassium and glycerin in the remainder of the water, and mix the two solutions together. When the mixture is cold add the oil of lemon and mix the whole thoroughly. *Br.*

The solution of the oil is facilitated by dissolving it in an equal quantity of alcohol previous to mixing it with the aqueous liquid.

Medical Uses.—This liniment is even more objectionable than liniment of iodine, since it contains only the iodic salt and no iodine, as the latter preparation does. The clinical evidence of any real benefit being derived from it through its iodide of potassium has never been furnished. If cutaneous absorption of the iodide of potassium be desired, it will be secured much more readily by the prolonged application of compresses saturated with a strong solution of the iodide, and their protection by a water-proof covering.

LINIMENTUM SAPONIS, *U. S.*, *Br.*—SOAP LINIMENT.

Linimentum saponato-camphoratum liquidum, P. G.—*Liquid opodeldoc*, E.; *Liniment savonneux camphré*, Fr.; *Flüssiger Opodeldok*, G.

Preparation.—Take of Soap in shavings four troyounces; Camphor two troyounces; Oil of Rosemary half a fluidounce; Water six fluidounces; Alcohol two pints. Digest the soap in the water until it is dissolved; dissolve the camphor and oil in the alcohol; mix the solutions, and filter through paper. *U. S.*

Take of Hard Soap cut small two and a half ounces; Camphor one and a quarter ounce; Oil of Rosemany three fluidrachms; Rectified Spirit eighteen fluidounces; Distilled Water two fluidounces. Mix the water with the spirit, and add the oil of rosemary, the soap, and the camphor. Macerate for seven days at a temperature not exceeding 70° F. with occasional agitation, and filter. *Br.*

Both Pharmacopœias use soap made with olive oil and soda, which is more soluble in the alcohol than soap made with animal fat, but both omit to state whether or not the soap is to be dried before being weighed. The details of the first process are rapidly executed; the soap on being digested with the water in a tared vessed yields a thick and smooth, almost jelly-like solution, to which sufficient hot water should be added to compensate for the loss by evaporation; the alcoholic solution of the oil and camphor is then added, the mixture rapidly stirred, and the vessel well closed and allowed to cool. If white Castile soap is used, the liniment will have a pale-yellowish color, and is at once ready for use; but if mottled soap is employed, the preparation will be turbid, and should be filtered, when it will have a brownish color due to the iron held in solution. In very cold weather, two fluidounces of the alcohol may be replaced by the same quantity of water, to prevent a portion of the soap from separating. Barckhausen (1872) suggests the use of a potassa soap made of rape-seed oil, which has the advantage of not separating from the alcohol even at the freezing temperature.

A preparation of similar composition, but differing in consistence, is still employed to some extent and recognized by some Pharmocopœias, as

LINIMENTUM SAPONATO-CAMPHORATUM, s. BALSAMUM OPODELDOC. Opodeldoc, Steer's opodeldoc, *E.;* Baume opodeldoch, Baume de savon, *Fr.;* Opodeldok, *G.*—The French Codex prepares it as follows :—

Digest in a suitable vessel of tallow soap 30 parts, camphor 24 parts, and 90 per cent. alcohol 250 parts; when dissolved add oil of thyme 2 parts, oil of rosemary 6 parts, agitate with 10 parts of animal charcoal, add ammonia water 10 parts, filter rapidly by means of a well-covered funnel, and collect the filtrate in suitable wide-mouth vials.

The German Pharmacopœia uses about two-thirds the weight of soap, and filters before the volatile oils and ammonia have been added. The liniment is solid at the ordinary temperature, but readily liquefies at the temperature of the body, is white or yellowish, opalescent, and somewhat translucent.

SPIRITUS SAPONATUS, P. G.—Seifenspiritus, G., is a solution of one part of Castile soap in 3 parts of alcohol and 2 parts of rose-water.

Medical Uses.—An anodyne and discutient preparation, used for the same purposes as camphor liniment, but more efficient, because more stimulant, than that preparation.

LINIMENTUM SINAPIS COMPOSITUM, *Br.*—COMPOUND LINIMENT OF MUSTARD.

Liniment sinapisé composé, Fr.; *Zusammengesetztes Senfliniment*, G.

Preparation.—Take of Oil of Mustard one fluidrachm; Ethereal Extract of Mezereon forty grains; Camphor one hundred and twenty grains; Castor Oil five fluidrachms; Rectified Spirit four fluidounces. Dissolve the extract of mezereon and camphor in the spirit, and add the oil of mustard and castor oil. *Br.*

The solution is readily effected on maceration in a vial.

Medical Uses.—It was doubtless intended in this compound to provide a powerful counter-irritant and revulsive, and it is described as a useful embrocation. We should hesitate to employ it without feeling more assured than at present of its being safe. The sores made by mezereon or by mustard are very intractable. Moreover, if the oil of mustard is in such proportion as to produce its proper effect, it will do so long before the mezereon has begun to act. Hence one or the other ingredient of the liniment would seem to be superfluous.

LINIMENTUM TEREBINTHINÆ, *U. S.*, *Br.*—LINIMENT OF TURPENTINE.

Liniment térébenthiné, Fr.; *Terpentinliniment*, G.

Preparation.—Take of Resin Cerate twelve troyounces; Oil of Turpentine half a pint. Add the oil to the cerate previously melted, and mix them. *U. S.*

Take of Soft Soap two ounces; Camphor one ounce; Oil of Turpentine sixteen fluidounces. Dissolve the camphor in the oil of turpentine, then add the soap, rubbing them together until they are thoroughly mixed. *Br.*

The first formula yields what is known as *Kentish liniment;* the cerate should be melted at a low heat, and then the oil gradually added with continued stirring. The second process is a considerable modification of the former, and requires continued trituration of the soap in a mortar, with the gradual addition of the oil, in order to obtain a uniform mass.

Medical Uses.—This preparation was originally employed in the treatment of *burns* and *scalds*, which it protects from the irritating influence of the air, while it maintains a moderate stimulation which tends to prevent the ulterior effects of those injuries. It is essential for its successful use that the primary dressing should not be removed for twenty-four hours, and that the liniment should not be continued longer than is necessary to establish a healthy action in the part. This preparation is also serviceable in superficial *erysipelas*, or *erythema*, arising from traumatic causes, and in *frost-bite* without active inflammatory phenomena.

LINIMENTUM TEREBINTHINÆ ACETICUM, *Br.*—LINIMENT OF TURPENTINE AND ACETIC ACID.

Liniment térébenthiné acétique, Fr.; *Terpenthin- und Essig-Liniment*, G.

Preparation.—Take of Oil of Turpentine, Acetic Acid, Liniment of Camphor, each one fluidounce. Mix. *Br.*

Medical Uses.—This preparation is essentially "St. John Long's liniment," which name it derived from a quack who professed to cure almost every painful local disease by its application. It is particularly efficient in *neuralgia* when applied over the points of exit of the trunks, or the terminal distribution of the affected nerves. It should then be employed so as to vesicate the part superficially and over a small area. It may also be applied to relieve other local pains and inflammations, such as limited *muscular rheumatism*, and to the epigastrium to allay *vomiting* depending on inflammation of the stomach.

LINUM, *U. S.*—FLAXSEED.

Lini semina, Br.; *Semen Lini*, P. G.—*Linseed*, E.; *Semence de lin*, Fr.; *Leinsamen*, *Flachssamen*, G.

The seed of Linum usitatissimum, *Lin.* Woodv., Med. Bot., plate 3; Bentley and Trimen, Med. Plants, 39.

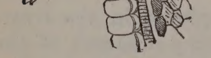
Nat. Ord.—Linaceæ.

LINI FARINA, *U. S.*, *Br.*—FLAXSEED MEAL.

Linseed meal, E.; *Farine de lin*, Fr.; *Leinsamenmehl*, G.

Origin.—Flax is probably indigenous to the Mediterranean basin, but has been cultivated for so long a period, and grows so spontaneously wherever it has been introduced, that it is difficult to determine its native country. It has an annual stem about 2 feet high, alternate linear-lanceolate leaves, and terminal flowers with 5 ovate pointed and 3-nerved sepals, and 5 fugacious blue-veined and short-clawed petals. The fruit is an ovate 5-celled and 10-seeded capsule, each cell being again imperfectly divided. As cultivated in the various tropical and temperate countries, several varieties have been observed differing in the shape and size of the seeds, and more markedly in other characters. The seeds are principally imported from Russia and Germany.

Fig. 99.



Flaxseed.—*a.* Entire. *b.* Section through the epithelium, testa, and tegmen to the albumen.

Description.—Flaxseed is about $\frac{1}{6}$ inch long, oblong-ovate, considerably flattened, rounded below, and oblique at the apex, beneath which the hilum is located in a slight depression. The testa is of a brown color, glossy, and covered with a transparent epithelium, which swells very considerably in water; the kernel consists of a very thin endosperm and two large plano-convex oily cotyledons having the shape of the seed, with the radicle projecting into the pointed end. The seed is inodorous, and has a mucilaginous, bitterish, and oily taste.

Lini farina, U. S., is the meal obtained from flaxseed, containing the oil. The British Pharmacopœia recognizes by the same name the meal which has been deprived of the oil by pressure.

Constituents.—The most important constituents of flaxseed are the *mucilage* and *fixed oil*, the latter (see Oleum lini), according to Chevallier (1844), being contained in the embryo to the extent of about 30 to 39 per cent., the former in the epithelium to the extent of about 15 per cent. The mucilage is $C_{12}H_{20}O_{10}$, and by nitric acid is converted into mucic acid. Besides the above, Leo Meyer (1826) found protein compounds, a small portion of wax, resin, sugar, malates, acetates, and other salts, which are dissolved with the mucilage. The ash amounts to about 3 per cent., and consists of phosphates with some sulphates and chlorides of potassium, calcium, and magnesium.

Off. Prep.—1. Of flaxseed: Farina lini, Infus. lini comp. (lini), *U. S.*, *Br.* 2. Of flaxseed meal: All cataplasms, except Catapl. fermenti, *Br.*

Medical Action and Uses.—The union of oil and mucilage in flaxseed adapts it for external application in the many cases in which an emollient is required; and the ready absorption of its infusion has led to its internal use as a diluent and diuretic. Flaxseed tea is universally employed in *inflammations* of mucous membranes of the respiratory, digestive, and urinary organs. It serves as the basis of numerous ptisans, and is injected into the rectum, vagina, and bladder, in irritations of those organs. It forms an ordinary drink in *renal* and *vesical* irritations. The tea is made with half an ounce of flaxseed to a pint of boiling water, macerated for two hours, and strained. It may be taken in any convenient quantity. The compound infusion, which is officinal, contains liquorice, which adapts it to bronchial affections. Flaxseed mucilage is prepared by boiling the seed. It is commonly used to cover *erysipelatous* and other inflammations of the skin, *burns*, etc., but is objectionable if allowed to get dry, by rendering the skin stiff; it is also apt to become sour and irritating. For the purposes last mentioned the acetate of lead is sometimes dissolved in it. It precipitates the solution of subacetate of lead.

The flaxseed poultice is prepared by gradually pouring boiling water upon flaxseed meal, and stirring the mixture until it acquires the proper consistence. As it tends to render the skin white, wrinkled, and sodden, and to excite a pustular eruption, the part to which it is applied should first be covered with sweet oil, fresh lard, or glycerine; or as directed officinally (British Pharmacopœia), olive oil should be mixed with the meal of which the poultice is made.

LINTEUM.—Lint.

Linteum carptum.—*Charpie*, Fr. G.

Preparation and Description.—Lint was originally made from bleached linen cloth by scraping it until it became soft and woolly. At the present time it is almost exclusively prepared by means of machinery from a fabric woven for this purpose, and is known as *patent lint*, in distinction to the hand-made lint. It is in rather thick, but very soft and fleecy sheets, and, when viewed under the microscope, shows the bast cells of flax as long cylindrical tubes, which are slightly thickened in a few places, and somewhat pointed towards both ends. The cell-walls are very thick by concentric deposits, leaving only a small central cavity. Immersed in an ammoniacal solution of copper, they swell considerably, and are ultimately dissolved without leaving any residue. These cells resemble the bast fibres of hemp, but the latter are thinner, blunt at the ends, with a still smaller cavity in the centre, and adhere more firmly together, hence the coarser appearance of hemp fabrics.

Cotton is now often more or less substituted for linen, and lint made in this way is known as *cotton lint*. The fibre of cotton is described on page 679, and may be readily distinguished from linen fibre by the microscope.

Tests for Linen and Cotton.—Boiled with a concentrated solution of potassa, the linen fibre turns bright yellow within two minutes, while cotton fibre remains white or becomes pale yellowish. Dipped in a solution of *rosolic acid*, which is known in commerce as aurin or yellow corallin, and afterwards in a concentrated solution of sodium carbonate, linen fibre is dyed rose-red, while cotton fibre remains white. When immersed in a tincture of *madder*, linen fibre acquires a yellowish-red, but cotton fibre a light yellow color. Cold concentrated *sulphuric acid* does not materially alter linen fibre within one or two minutes, while cotton fibre is destroyed in the same time. When rubbed with a *fixed oil*, linen fabric remains white and opaque, but cotton becomes translucent.

Surgical Action and Uses.—The purpose of lint is to provide a soft, unirritating covering for wounds; to protect them from the air and the foreign particles floating in it; to moderate and graduate the pressure of bandages and other surgical apparatus; to absorb the more liquid discharges; and to be introduced into wounds which are not intended to heal immediately. Of the different forms of lint, that which is made of old linen by picking apart its threads is the most elastic and absorbent, and by far the most comfortable to the patient; that which is made by scraping old linen is very suitable for small wounds and abrasions; and the so-called patent lint is the least eligible unless its threads are unravelled so as to form a soft mass. But the last mentioned lint, when made of cotton, as it usually is, does not absorb discharges nearly as well as that derived from linen, chiefly on account of the oil which adheres to it. Of late years cotton has been prepared entirely free from oil, and therefore possessing a greater absorbent power, and is at the same time impregnated with carbolic acid so as to render it disinfectant. But a defect of all cotton lint is that as soon as it becomes saturated with liquids it entirely loses its elasticity, which is not the case with old linen lint, or charpie. A substance analogous to charpie is oakum, which consists of tarred ropes picked into shreds, and whose value derived from the tar impregnating it is counterbalanced by the harshness of the material.

LIQUIDAMBAR.—Sweet Gum.

A balsamic exudation from Liquidambar styraciflua, *Lin.*

Nat. Ord.—Hamamelaceæ, Balsamifluæ.

Origin.—The sweet gum tree is a large and handsome North American tree, growing from Connecticut and Illinois southward and westward to Mexico. It has a thick gray deeply furrowed astringent bark, that of the branches being usually furnished with thick, wing-like ridges of cork. The leaves are dark green, round in outline, palmately five to seven-lobed, and the lobes serrate. The fruit is capsular, beaked, aggregated in globular heads, together with the indurated scales. The leaves, fruit and bark when bruised have an agreeable odor; the taste of the bark is balsamic and astringent, and that of the other parts mentioned aromatic and acidulous. In its southern locations the tree yields a balsamic exudation from incisions made in the bark.

Description.—Sweet gum, also called *gum wax*, exudes in the form of a thick liquid, having the density of syrup, and a yellowish color. On standing it thickens, becomes darker in color, and finally hard at the ordinary temperature, and breaks with a resinous fracture, which is of a variegated appearance, the color being brown, with lighter and even white spots and streaks. It softens somewhat by the warmth of the hand, and when heated fuses to a yellowish-brown liquid. It has a very pleasant balsamic odor and taste, the latter being followed by pungency. It dissolves completely, fragments of bark excepted, in alcohol, ether, and chloroform; the alcoholic solution having a slight acid reaction.

Constituents.—A pretty complete analysis of sweet gum was made by Wm. L. Harrison (1874). He obtained, by distillation with a solution of sodium carbonate in water, $3\frac{1}{2}$ per cent. of an aromatic oily hydrocarbon, having the properties of *styrol*, and the aqueous liquid in the retort, on being supersaturated with acid, yielded $5\frac{1}{2}$ per cent. of *cinnamic acid*. The portion insoluble in the alkaline liquor was partly dissolved in hot petroleum-benzin, the solution yielding *styracin* on cooling, and finally left a dark brown nearly colorless and inodorous resin. The sweet gum examined contained 9 per cent. of impurities. On treating sweet gum with warm petroleum-benzin, cinnamic acid and styracin are taken up, and crystallize together on cooling; they may then be separated with weak ammonia, which dissolves the cinnamic acid only. Harrison observed also that by heating sweet gum with a small quantity of water, and stirring frequently, a gray-colored mixture is obtained resembling storax. The presence of cinnamic acid in sweet gum was previously proved by Hanbury (1857) and Procter (1866). It will be observed that sweet gum agrees in composition with storax, which, in addition, contains water mechanically mixed with it.

Pharmaceutical Uses.—A *syrup of sweet gum* is made by the officinal process for syrup of tolu, and is much employed in some parts of the Southern States. A *syrup of sweet gum bark* is likewise used and prepared by the officinal process for syrup of wild cherry (Dr. C. W. Wright, 1856). According to L. Hughes (1876), an ethereal solution of sweet gum is very serviceable for extinguishing the mercury in preparing mercurial ointment.

Medical Action and Uses.—These appear to be identical with those of storax; and indeed the latter is defined by the United States Pharmacopœia to be "a balsam prepared from the bark of Liquidambar orientale." Its action is that of an aromatic resin, operating particularly upon the respiratory and urinary mucous membranes. It is employed in the treatment of chronic profluvia of these parts, such as *bronchitis*, *cystitis*, *pyelitis*, and *gleet*. Externally it was used formerly in an ointment for the treatment of *scabies*, and for various purposes to which resin cerate is now applied, including frost-bite, indolent *ulcers*, and *burns*.

LIQUORES.—SOLUTIONS.

Solutés, Fr.; *Lösungen*, G.

With the exception of infusions, decoctions, and syrups, and of those aqueous liquids containing volatile oils or gases, all aqueous solutions are, by the U. S. Pharmacopœia, designated *Liquores;* the British and some other Pharmacopœias embrace under the same head also aqueous solutions of gases. The German Pharmacopœia is inconsistent in its designation; lime-water, chlorine water, and some lotions being placed among *Aquæ*, while ammonia water is regarded as a *liquor*. Gutta-percha solution and blistering liquid alone have a menstruum other than water.

LIQUOR AMMONIÆ, *Br.* See AQUA AMMONIÆ.

LIQUOR AMMONII ACETATIS, *U. S.*—SOLUTION OF ACETATE OF AMMONIUM.

Liquor ammoniæ acetatis, Br.; *Liquor ammonii acetici*, P. G.; *Acetas ammonicus liquidus*, *Spiritus Mindereri.—Spirit of Mindererus*, E.; *Acetate d'ammoniaque liquide*, *Esprit de Mindererus*, Fr.; *Essigsaure Ammonium-Flüssigkeit*, G.

Preparation.—Take of Diluted Acetic Acid two pints; Carbonate of Ammonium a sufficient quantity. Add the carbonate gradually to the acid until the latter is neutralized, and filter. This preparation, when dispensed, should be freshly made.

Solution of acetate of ammonium may also be prepared by mixing together the following solutions :—

Take of Carbonate of Ammonium six hundred and forty grains; Distilled Water a sufficient quantity. Dissolve the carbonate of ammonium in twelve fluidounces of distilled water, and filter through paper, adding a sufficient quantity of distilled water, through the filter, to make the solution measure a pint.

Take of Acetic Acid four fluidounces; Distilled Water twelve fluidounces. Mix them.

These solutions must be kept in well-stopped bottles, and mixed in equal quantities when dispensed. *U. S.*

Take of Acetic Acid ten fluidounces; Carbonate of Ammonia three and a quarter ounces or a sufficiency; Distilled Water two and a half pints. Reduce the carbonate of ammonia to powder, and add it gradually to the acetic acid, until a neutral solution is formed, then add the water. *Br.*

The directions of the U. S. Pharmacopœia indicate that the solution is to contain some carbonic acid. The first formula directs the *neutralization* of the acetic acid, which, however, cannot be ascertained by litmus paper, owing to the carbonic acid remaining in solution. Turmeric paper is preferable, in so far as it more readily indicates even a slight excess of ammonium carbonate by the brown color produced; but the exact point of neutralization cannot be ascertained. Under the circumstances the taste is as reliable as test-paper. After the pricking sensation upon the tongue caused by the carbonic acid has disappeared, the taste should be saline, and free from alkalinity. This result is accomplished by the second process, provided that translucent ammonium carbonate is used in making one of the solutions. The correct measures of the alkaline and acid solutions having been taken, they are mixed in a graduate, and after the violent effervescence has subsided the liquid is poured into the vial.

The British Pharmacopœia directs the preparation of a neutral solution which is somewhat stronger; the undiluted acetic acid being used, less carbonic acid is retained by the liquid, and may be expelled by trituration or stirring at first, and towards the close of the reaction by warming the liquid until it has no effect upon test-paper, after which it is to be properly diluted. In place of ammonium carbonate ammonia water may be used to effect the neutralization, as directed by the German Pharmacopœia.

Acetic acid decomposes ammonium carbonate, carbonic acid gas being given off, and ammonium acetate remaining in solution; $4HC_2H_3O_2 + N_4H_{16}C_3O_8$ yields $3CO_2 + 4NH_4C_2H_3O_2 + 2H_2O$. When long kept in contact with air, the solution acquires an alkaline reaction.

Physiological Action.—Experiments upon animals show that this preparation, in large doses, affects them energetically; in rabbits causing fatal tetanic spasms and dissolution of the gastric mucous membrane. Given to healthy men it does not appear to occasion any decided symptoms—only a little warmth of the skin and in the abdomen, headache, and loss of appetite. Upon the skin it acts as an irritant, and may even vesicate it. Judged by its apparent effects in disease, it seems to be diaphoretic, diuretic, and expectorant, sometimes causing transient giddiness and exhilaration.

Medical Uses.—It is generally held to be efficient in the forming stage of *catarrh*, *sore throat*, and *muscular rheumatism*, and in the *eruptive fevers* when the eruption is slow to appear. It is the best diaphoretic in epidemic catarrh or *influenza*. In low forms of *fever* it is often of signal advantage, helping to sustain the powers of life until the crisis is past. In this way it is peculiarly valuable in *typhus*, in which, like other appropriate stimulants, it lowers the pulse and temperature, moistens the dry tongue, and moderates the delirium.

It is reported to have been peculiarly efficacious in the treatment of epidemic *pseudo-membranous bronchitis.*

In *sick headache* few remedies are so successful as a teaspoonful or two of this solution repeated every hour. In *alcoholic intoxication* it frequently dissipates at once the signs of drunkenness. It is reported to be an efficient remedy in *dysmenorrhœa* and *menorrhagia.* It is an adjuvant in the treatment of scarlatinous *dropsy*, and is, perhaps, not without advantage in chronic *eruptions of the skin.*

Externally it is a valuable discutient in *contusions, glandular swellings, mammary engorgements, commencing abscesses, hydrarthrosis*, and even acute *hydrocele.* It has been found beneficial in *impetigo capitis.*

The *dose* of the officinal solution is from half a fluidounce to a fluidounce and a half, diluted with sweetened water.

LIQUOR AMMONIÆ CITRATIS, *Br.*—SOLUTION OF CITRATE OF AMMONIA.

Citrate d'ammoniaque liquide, Fr.; *Citronensaure Ammoniak-Flüssigkeit*, G.

Preparation.—Take of Citric Acid three ounces; Strong Solution of Ammonia two and three-quarter fluidounces or a sufficiency; Distilled Water one pint. Dissolve the citric acid in the water, and add the solution of ammonia until the liquid is neutral to test-papers. *Br.*

Citric acid $H_3C_6H_5O_7$ unites with ammonia $3HNH_4O$ to form ammonium citrate $(NH_4)_3C_6H_5O_7$ and water $3H_2O$. The point of neutralization is ascertained by blue litmus paper, which should not be reddened, and by turmeric paper, which should not acquire a brownish tint. The solution is clear and colorless, and has a saline taste.

Medical Action and Uses.—This solution is perhaps more palatable than solution of acetate of ammonia, but its medicinal effects are in no wise different. *Dose*, from two to four fluidrachms.

LIQUOR ANTIMONII CHLORIDI, *Br.*—SOLUTION OF CHLORIDE OF ANTIMONY.

Liquor Stibii chlorati, P. G.; *Antimonium muriaticum liquidum, Butyrum antimonii (s. stibii), Chloridum (s. Chloruretum) stibicum.—Liquid butter of antimony*, E.; *Chlorure (Beurre) d'antimoine liquide, Huile d'antimoine*, Fr.; *Spiessglanzbutter*, G.

Preparation.—Take of Black Antimony one pound; Hydrochloric Acid four pints. Place the black antimony in a porcelain vessel, pour upon it the hydrochloric acid, and constantly stirring, apply to the mixture, beneath a flue with a good draught, a gentle heat, which must be gradually augmented as the evolution of gas begins to slacken, until the liquid boils. Maintain it at this temperature for fifteen minutes; then remove the vessel from the fire, and filter the liquid through calico into another vessel, returning what passes through first, that a perfectly clear solution may be obtained. Boil this down to the bulk of two pints (imperial), and preserve it in a stoppered bottle. *Br.*

Hydrochloric acid decomposes sulphide of antimony with the production of antimonious chloride which dissolves in the acid liquid, and hydrogen sulphide which escapes; $Sb_2S_3 + 6HCl$ yields $2SbCl_3 + 3H_2S$. Provision must be made to carry off the offensive gas either through a flue or by working in the open air. The powdered sulphide and the acid may be left in contact for several hours, during which time the reaction will partly take place; the mixture should afterwards be slowly heated until the boiling point is reached, and the disengagement of sulphuretted hydrogen ceases. The insoluble mineral impurities are then filtered off, either through calico, or preferably through a material which is not corroded by the acid liquid, such as gun-cotton, asbestos, or glasswool. The arsenic naturally contained in the antimony is partly evolved, and the remainder is removed as arsenious chloride by boiling the filtered liquid and concentrating it as directed, this arsenic compound being much more volatile than the antimonious chloride.

Properties.—It is a yellowish or yellowish-red liquid, having the spec. gr. 1.47, and yielding with water a white precipitate of antimonious oxychloride (*powder of Algaroth*), $(SbCl_3)_2 5Sb_2O_3$. This precipitate is completely soluble in an aqueous solution of tartaric acid, and the solution, when treated with hydrogen sulphide, yields an orange-brown precipitate of sulphide of antimony, which, after drying, should weigh not less than 22 grains for every fluidrachm of the officinal solution. When free from other metals the solution is colorless; as prepared from the crude sulphide, however, it always contains ferric chloride.

Impurities.—*Lead*, if present, will mostly crystallize from the cold liquid; what remains dissolved may be recognized by a drop of dilute sulphuric acid, which will cause a white precipitate. *Copper* is recognized by the blue color obtained on treating the liquid with an excess of ammonia. *Arsenic* is detected by rendering the liquid strongly alkaline with potassa, adding a little pure zinc, and heating to boiling. The vapors on coming in contact with filtering paper, moistened with a drop of solution of silver nitrate, will then color the latter black.

Pharmaceutical Uses.—In the preparation of Antimonii oxidum, *Br.*

Surgical Action and Uses.—Butter of antimony is one of the most powerful caustics used in surgery, and, from its readily penetrating into *wounds*, it has been used to cauterize those inflicted by rabid animals and venomous serpents. It has also been applied to *malignant pustule*, *warts*, *condylomata*, and *chancres*. "Pure chloride of antimony has been used as an application to staphyloma by some German surgeons; a camel's-hair pencil or a point of lint is dipped in the deliquescent salt and applied to the tumor until a whitish crust is perceived, when the whole is washed away by means of a large camel's-hair pencil dipped first in milk and afterwards into milk and water." (Neligan.)

Several instances of poisoning by this preparation are on record in which, besides abrasions of the mouth and throat, or even a charred appearance of these parts, there was more or less complete general collapse. In one case recovery took place after four or five drachms, and in another after an ounce, had been taken. In a fatal case the dose was three ounces, and on inspection after death the interior of the alimentary canal from the mouth downwards to the jejunum presented a black appearance, as if the parts had been charred. (Taylor.)

The proper antidotes for poisoning by chloride of antimony are chalk, and magnesia or its carbonates, combined with demulcent drinks. Tannic acid and the substances containing it are also recommended.

LIQUOR ARSENICALIS, *Br.* See LIQUOR POTASSII ARSENITIS.

LIQUOR ARSENICI CHLORIDI, *U. S.*—SOLUTION OF CHLORIDE OF ARSENIC.

Liquor arsenici hydrochloricus, Br.—*Hydrochloric solution of arsenic*, E.; *Liqueur arsenicale hydrochlorique*, Fr.; *Chlorarsenik-Lösung*, G.

Preparation.—Take of Arsenious Acid in small pieces sixty-four grains; Muriatic Acid two fluidrachms; Distilled Water a sufficient quantity. Boil the arsenious acid with the muriatic acid and four fluidounces of distilled water, until the arsenious acid is entirely dissolved, and, when the solution is cold, add enough distilled water to make it measure a pint. *U. S.*

Take of Arsenious Acid in powder eighty grains; Hydrochloric Acid two fluidrachms; Distilled Water a sufficiency. Boil the arsenious acid with the hydrochloric acid and four ounces of the water until it is dissolved; then add distilled water to make the bulk up to one pint (imperial). *Br.*

Arsenious and hydrochloric acids, when heated together, and then distilled, unite to form volatile *arsenious chloride*, As_2Cl_6, which, on being dissolved in water, is decomposed again into the compounds from which it was prepared. The officinal solutions, therefore, contain simply the two acids.

Properties.—The solution is colorless, has an acid reaction, and the spec. grav. 1.009. Sulphuretted hydrogen yields at once a bright yellow precipitate of sulphide of arsenic. In arsenic strength it corresponds with Fowler's solution, containing 4 grains to the fluidounce; De Valangin's solution contained $1\frac{3}{4}$ grains. The British Pharmacopœia gives the following directions for determining its strength. One fluidounce boiled for five minutes with twenty grains of bicarbonate of soda, and then diluted with six fluidounces of distilled water, to which a little mucilage of starch has been added, does not give with the volumetric solution of iodine a permanent blue color until 808 grain-measures have been added.

Medical Uses.—The advantages of this preparation, which is known as Valangin's solution, over Fowler's solution, are far from being apparent. Indeed, its action has been pronounced very uncertain. Its medicinal uses and its *dose* are the same as those of the latter preparation.

LIQUOR ARSENICI ET HYDRARGYRI IODIDI, *U. S.* —SOLUTION OF IODIDE OF ARSENIC AND MERCURY.

Solutio Donovani.—Donovan's solution, E.; *Soluté d'iodo-arsénite de mercure, Liqueur de Donovan*, F.; *Jodquecksilber-Arsenik-Lösung, Donovansche Tropfen*, G.

Preparation.—Take of Iodide of Arsenic, Red Iodide of Mercury, each thirty-five grains; Distilled Water half a pint. Rub the iodides with half a fluidounce of the water, and, when they are dissolved, add the remainder of the water, and filter through paper. *U. S.*

This is a solution of the two iodides in very nearly the proportion of their molecular weights, and containing them mixed, but not chemically combined.

Properties.—It is of a light yellow color, has a metallic taste, and gives precipitates with solutions of silver, alkalies, and salts of the alkaloids. The 8 fluidounces represent very nearly 6 grains of metallic arsenic, and 15.5 grains of mercury.

Medical Uses.—The combination of arsenic and mercury in this preparation was made for the treatment of *syphilitic* diseases of the skin, and is especially useful in those of the squamous form, although mercury alone is apt to aggravate them. Many consider that in these cases the mercury is more injurious than useful. Its efficacy is shown in other cutaneous affections apparently free from syphilitic taint, when they have become chronic, and have resisted arsenic alone. Among these may be mentioned *impetigo* and *sycosis;* in the latter it should be associated with epilation. The best authorities deny that it has any curative influence in *lupus*. The *dose* is five drops, gradually increased, and should be taken after meals, well diluted.

LIQUOR ATROPIÆ, *Br.*—SOLUTION OF ATROPIA.

Soluté d'atropine, Fr.; *Atropin-Lösung*, G.

Preparation.—Take of Atropia four grains; Rectified Spirit one fluidrachm; Distilled Water seven fluidrachms. Dissolve the atropia in the spirit, and add this gradually to the water, shaking them together. *Br.*

Medical Uses.—This solution contains in each minim the one hundred and twentieth of a grain of atropia. It may be used hypodermically in the dose of one minim, and cautiously increased. It is used for dilating the pupil by instilling it into the eye, care being taken, by pressure on the puncta lachrymalia, to prevent its passage into the nostril.

LIQUOR ATROPIÆ SULPHATIS, *Br.*—SOLUTION OF SULPHATE OF ATROPIA.

Soluté de sulfate d'atropine, F.; *Schwefelsaure Atropinlösung*, G.

Preparation.—Take of Sulphate of Atropia four grains; Distilled Water one fluidounce. Dissolve. *Br.*

The two preceding solutions are best prepared in small quantity only, that decomposition, which is likely to result from long keeping, may be prevented.

Medical Uses.—This preparation is identical with solution of atropia in its strength, action, uses, dose, and mode of application. For acting upon the iris, disks of paper or gelatin impregnated with either solution may be introduced between the eyelid and the eyeball.

LIQUOR BARII CHLORIDI, *U. S.*—SOLUTION OF CHLORIDE OF BARIUM.

Soluté de chlorure de baryum, Fr.; *Chlorbaryum-Lösung*, G.

Preparation.—Take of Chloride of Barium a troyounce; Distilled Water three fluidounces. Dissolve the chloride in the distilled water and filter through paper. *U. S.*

Properties.—A colorless solution having the disagreeable taste of barium salts. It is precipitated by solutions of sulphates and carbonates, and of most salts of organic acids, except the acetates.

Medical Uses.—It is difficult to understand why a preparation in favor of whose therapeutic virtues so little can be said, should continue to be employed in medicine, and distinguished by an officinal rank. Under Barium will be found a more detailed account of it.

LIQUOR BISMUTHI ET AMMONIÆ CITRATIS, *Br.*—SOLUTION OF CITRATE OF BISMUTH AND AMMONIA.

Liquor bismuthi.—Solution of ammonio-citrate of bismuth, E.; *Soluté de citrate de bismuth ammoniacal*, Fr.; *Citronensaure Wismuth-Ammoniak-Lösung*, G.

Preparation.—Take of Purified Bismuth four hundred and thirty grains; Nitric Acid two fluidounces; Citric Acid two ounces; Solution of Ammonia, Distilled Water, each a sufficiency. Mix the nitric acid with an ounce of distilled water, and add the bismuth in successive portions. When effervescence has ceased, apply for ten minutes a heat approaching that of ebullition, and decant the solution from any insoluble matter that may be present. Evaporate the solution until it is reduced to two fluidounces, then add the citric acid previously dissolved in four ounces of distilled water, and afterwards the solution of ammonia in small quantities at a time until the precipitate formed is redissolved, and the solution is neutral or slightly alkaline to test-paper. Dilute with distilled water to the volume of one pint (imperial). *Br.*

A strong solution of bismuthous nitrate is first produced by dissolving the metal in nitric acid and concentrating by evaporation. Twice the weight of citric acid is then added, or enough to convert the whole of the bismuth into bismuthous citrate, and to leave an equal weight in excess. On adding ammonia to the acid liquid, ammonium citrate is formed, and this reacting with the bismuth salt, bismuthous citrate is thrown down: $(NH_4)_3C_6H_5O_7 + Bi3NO_3$ yields $BiC_6H_5O_7 + 3NH_4NO_3$. Without filtering, more ammonia is supplied to produce an additional quantity of ammonium citrate, which is supposed to unite with the bismuthous citrate to form the double salt, the citrate of bismuth and ammonium, $BiC_6H_5O_7.(NH_4)_3C_6H_5O_7$, in addition to which the solution contains ammonium nitrate. N. G. Bartlett (1865), however, showed, and his observations were corroborated by Méhu (1873), that the neutral bismuthous citrate dissolves in ammonia, and that on evaporation, a dry salt is obtained which is again soluble in water, and for which Rother (1876) gives the formula $(NH_4)_3C_6H_5O_7.Bi3HO$. These observations have led to several modifications of the above formula, by which contamination with ammonium nitrate is at the same time avoided. These modifications are based upon the preparation of *bismuth citrate;* 1, by double decomposition between bismuth nitrate and potassium or sodium citrate; or 2, by first preparing bismuthous hydrate or subcarbonate, and treating this with the equivalent quantity of citric acid; or 3, as suggested by Rother, by boiling for a short period equivalent quantities of (10 parts) bismuth subnitrate and (7 parts) citric acid with some water, washing the precipitate, and dissolving in ammonia.

Properties.—The solution of the British Pharmacopœia is colorless, has a saline slightly styptic taste, and the specific gravity 1.122. It is neutral or slightly alkaline to test-paper, and mixes with water without change. Potassa yields a precipitate of bismuth hydrate, and liberates ammonia; muriatic acid produces a precipitate of basic salt which is redissolved by an excess of acid. Three fluidrachms of the officinal solution, treated with sulphuretted hydrogen, yield a black precipitate, which, after drying, weighs 9.92 grains. Each fluidrachm represents 3 grains of bismuthous oxide.

BISMUTHI ET AMMONII CITRAS.—Ammonio-citrate of bismuth, *E.;* Citrate de bismuth ammoniacal, *Fr.;* Citronsaures Wismuthammoniak, *G.*

As stated above, the officinal solution contains ammonium nitrate and an excess of ammonium citrate. It is, therefore, not adapted to the preparation of the dry salt. But if the *bismuth citrate* prepared by either of the above processes is dissolved in ammonia, the solution carefully concentrated and dried, the salt is obtained in white, transparent shining scales, which are freely soluble in water, slightly so in alcohol, and insoluble in ether, and have a slightly acid and metallic taste. Exposed to air, it loses ammonia, becomes opaque, and then dissolves in water only after the addition of a little ammonia. According to Rother, it is anhydrous, and should therefore yield 46.4 per cent. of bismuthous oxide.

Medical Uses.—If, as we have endeavored to show elsewhere, the action of bismuth is entirely local and depends upon its insolubility, the use of its soluble salts is irrational. Yet the solubility of this preparation is set forth as a ground of its superiority over the oxide and the subnitrate! The officinal *dose* is stated to be from thirty minims to one fluidrachm.

LIQUOR CALCII CHLORIDI, *U. S.*—SOLUTION OF CHLORIDE OF CALCIUM.

Soluté de chlorure de calcium, Fr.; *Chlorcalcium-Lösung*, G.

Preparation.—Take of Marble in small pieces six troyounces; Muriatic Acid twelve troyounces; Distilled Water a sufficient quantity. Mix the acid with half a pint of distilled water, and gradually add the marble. Towards the close of the effervescence apply a gentle heat, and, when the action has ceased, pour off the clear liquid, and evaporate to dryness. Dissolve the residue in one and a half times its weight of distilled water, and filter through paper. *U. S.*

The preparation of calcium chloride and its purification from iron have been explained (see Calcii chloridum, p. 317). In the above process the solution is directed to be evaporated to dryness; if the temperature does not exceed 150° C. (302° F.) the residue is a hydrate of the formula $CaCl_2.2H_2O$, and molecular weight 147. This is dissolved in 1½ times its weight of distilled water, so that 10 parts of the solution contain 4 parts of the salt mentioned, or 3 parts of the anhydrous calcium chloride. (For properties and tests see page 317.)

Pharmaceutical Uses.—In the preparation of Calcii carbonas præcip., *U. S.*

Medical Action and Uses.—This solution is an active irritant, and may readily become poisonous. It was formerly used in *scrofula*, *goitre*, and *cutaneous eruptions*, but is now deservedly abandoned. The *dose* is said to be thirty or more minims, and should be given in milk or sweetened water.

LIQUOR CALCIS, *U. S.*, *Br.*

Aqua calcariæ, P. G.; *Aqua calcariæ ustæ*, *Aqua calcis*, *Calcaria soluta*, *Oxydum calcicum aqua solutum.*—*Solution of lime*, *Lime water*, E.; *Eau (Liqueur) de chaux*, Fr.; *Kalkwasser*, G.

Preparation.—Take of Lime four troyounces; Distilled Water eight pints. Upon the lime, first slaked with a little of the distilled water, pour the remainder of the water, and stir them together. Then immediately cover the vessel, and set it aside for three hours. Keep the solution, together with the undissolved lime, in a well-stopped bottle, and pour off the clear liquid when wanted.

Water free from saline or other obvious impurity, though not distilled, may be employed in this process. *U. S.*

Take of Slaked Lime two ounces; Distilled Water one gallon. Put the lime into a stoppered bottle containing the water, and shake well for two or three minutes. After twelve hours the excess of lime will have subsided, and the clear solution may be drawn off with a siphon as it is required for use, or transferred to a green glass bottle furnished with a well-ground stopper. *Br.*

When water is added to burned lime or calcium oxide, it is converted into *calcium hydrate* Ca2HO, molec. weight 74, which dissolves in the excess of water. If used for this purpose the lime should be prepared from marble, when it will be nearly pure; but if made from ordinary limestone, it usually contains alkalies which are readily soluble in water; hence it should be treated with a portion of the water, and this rejected to remove the impurities mentioned. The water should be kept upon the lime to retain the solution saturated, and this should be drawn off as needed. Since at the ordinary temperature lime requires about 750 parts of water for solution, one fluidounce (U. S. measure) of lime-water contains 0.6 grain of lime, or 0.8 grain of calcium hydrate.

Properties.—Lime-water is a clear, colorless solution, of a slight alkaline disagreeable taste, but a strong alkaline reaction to test-paper. When exposed to air, it becomes covered with a pellicle of calcium carbonate; the same compound is formed with the loss of the alkaline reaction if carbonic acid gas is passed through the solution, and the solution heated to expel the excess of the gas. If lime-water is heated to boiling, it becomes turbid from the separation of some calcium hydrate, which dissolves again on cooling. (For the chemical behavior of lime, see Calx, page 325.)

The British Pharmacopœia gives the following test for ascertaining the strength of lime-water: Ten ounces require for neutralization at least 200 grain-measures of the volumetric solution of oxalic acid, which corresponds to 5.6 grains of calcium oxide (CaO).

Pharmaceutical Uses.—In preparing Argenti oxidum, Lotio hydrargyri flava, Lotio hydrargyri nigra, *Br.*, and Linimentum calcis, *U. S.*, *Br.*

Medical Action and Uses.—Lime-water is without caustic qualities, but is astringent and styptic, diminishing more or less the secretion of parts to which it is directly applied, and of the mucous membranes and glands when taken internally. It is a valuable lotion in various diseases of the skin, especially *eczema capitis* and *ulcers.* In the former, the affected part should be thoroughly cleansed with warm water and soap before the lime-water is applied. In all cases of chronic *mucous* or *purulent discharges* from the nostrils, fauces, auditory canals, vagina, urethra, or rectum, it is one of the simplest and best washes. It is said to destroy *ascarides of the rectum.* With flaxseed oil or sweet oil it forms the officinal liniment so useful in the treatment of *burns.*

Internally, as already indicated, it appears to escape the neutralizing influence of the gastric acids, for it has long been used to diminish the mucous secretion in *chronic bronchitis*, and to modify the urine and the lining membrane of the urinary passages in *calculous* and other disorders of urino-genital organs. In vesical diseases lime-water is sometimes injected into the bladder through a catheter, after properly cleansing the organ. It would seem, whether employed in the one or the other manner, to act by diminishing the irritability of the vesical mucous membrane. The constipation that results from the internal use of lime-water, as well as its beneficial operation in chronic bronchitis, prove that it is not fully acidified in the stomach. In *diarrhœa* attended with acid stools and the associated colic and tympanites belonging to acid gastro-intestinal fermentation, and which is so prevalent during hot seasons, especially among infants, lime-water, added to their milk in the proportion of from one-fourth to one-half, is a very efficient remedy. The *aphthous* condition of the mouth and fauces, and the *thrush* that forms there under these circumstances, are often removable by lime-water. In *chronic diarrhœa*, dependent on whatever cause, this solution given with milk as the almost exclusive food, will usually mitigate, and in appropriate cases cure, the disease. The most signal triumphs of this simple method are achieved in *chronic dysentery*, and in cases of *typhoid fever* protracted by the persistence of the intestinal ulcers. Even in tubercular *phthisis* it sometimes suspends the discharges for a considerable time. In all these affections it diminishes *tympanites*, and in certain cases in which that symptom appears to be the result of intestinal fermentation only, lime-water is one of the best remedies. This preparation has been extolled as a remedy for *diabetes*, and the highest testimony in its favor exists, so far as relates to its power of lessening the secretion of sugar. It in like proportion diminishes thirst and voracious appetite. It should be given with milk, or, if that is contra-idicated, with cream, and in quantity not less than one or two pints daily. In *hydruria*, or diabetes insipidus, it is more efficacious still. It has been recommended in *rachitis* and *osteo-malacia;* and is very useful in gouty (acid) *dyspepsia*, especially when taken during the first stages of digestion. The *cutaneous eruptions* so often associated with gouty disorders are usefully treated by the internal use of lime-water.

The demonstration that false membranes are soluble in lime-water led to the use of gargles and the spray of this liquid and the vapors of slaked lime in *pseudo-membranous pharyngitis* (diphtheria), and in *laryngitis* and *bronchitis* of the same type. The result has been the cure of a large number of cases in which the nature of the disease was abundantly demonstrated by inspection, or by the rejection of false membranes. To be successful, the inhalation should be almost uninterrupted. As often as possible the patient should be confined in a dense vapor of slaking lime, and with this the use of atomized lime-water should be alternated, while the room is kept filled with the vapor. Other treatment, except stimulants, is of little use. It may, perhaps, be questioned whether the good results of this method are due to the solvent action of the lime, or to the softening influence of the watery vapor which holds it in solution. Probably both influences contribute to the result.

Lime-water is an appropriate antidote to *arsenious acid*, with which it forms an innocuous compound.

The *dose* of lime-water is from half an ounce to six ounces, given from one to four times a day, with an equal quantity of milk or weak animal broth.

LIQUOR CALCIS CHLORATÆ, *Br.*—SOLUTION OF CHLORINATED LIME.

Chlorure de chaux liquide, Fr.; *Chlorkalk-Flüssigkeit*, G.

Preparation.—Take of Chlorinated Lime one pound; Distilled Water one gallon. Mix well the water and the chlorinated lime by trituration in a large mortar, and, having transferred the mixture to a stopped bottle, let it be well shaken several times for the space of three hours. Pour out now the contents of the bottle on a calico filter, and let the solution which passes through be preserved in a stoppered bottle. *Br.*

The solution has the odor, taste, and general properties of chlorinated lime (see page 326). The British Pharmacopœia requires each fluidounce to contain thirteen grains of available chlorine, which is ascertained by the following test: sixty grains by weight mixed with twenty grains of iodide of potassium dissolved in four fluidounces of water, when acidulated with two fluidrachms of hydrochloric acid, gives a red solution, which requires for the discharge of its color five hundred grain-measures of the volumetric solution of hyposulphite of soda.

Medical Action and Uses.—They are the same as those of chlorinated lime. The solution is convenient as a *deodorizer* of decomposing organic matter, as an *excitant* of the skin in low fevers, and as a stimulant of chronic *cutaneous eruptions.*

LIQUOR CALCIS SACCHARATUS, *Br.*—SACCHARATED SOLUTION OF LIME.

Saccharate (*Sucrate*) *de chaux liquide*, Fr.; *Kalksaccharat-Lösung*, G.

Preparation.—Take of Slaked Lime one ounce; Refined Sugar in powder two ounces; Distilled Water one pint. Mix the lime and the sugar by trituration in a mortar. Transfer the mixture to a bottle containing the water, and having closed this with a cork shake it occasionally for a few hours. Finally separate the clear solution with the siphon, and keep it in a stoppered bottle. *Br.*

Water containing sugar dissolves a larger quantity of lime than pure water. Peligot has ascertained the solubility for 100 parts of sugar in solutions of 40 per cent. to be 26.57 parts; of 20 per cent. only 23.15 parts; and in solutions of 5 per cent. only 18.06 parts of lime. The stronger solution, which has a thin syrupy consistence, has sometimes been used under the name of *Syrupus* *calcis*, *Syrup* or *Saccharate* of lime. Prepared according to the British Pharmacopœia, the solution has the general properties of lime-water, and the specific gravity 1.052. 460.2 grains by weight (1 fluidounce), require for neutralization 254 grain-measures of volumetric solution of oxalic acid, which corresponds to 7.11 grains of lime in one fluidounce.

Medical Action and Uses.—It has been supposed that this solution excelled ordinary lime-water, because it contains more lime. It is probably, however, unsuitable for continued use, since the excess of lime tends to accumulate in the bowels, and irritate and even obstruct them. *Dose*, from fifteen minims to a fluidrachm in water or milk. It has sometimes been employed as an antidote to hydrosulphuric acid and its compounds, in which case it should be freely administered.

LIQUOR CHLORI, *Br.* See AQUA CHLORINII.

LIQUOR EPISPASTICUS, *Br.*—BLISTERING LIQUID.

Linimentum cantharidis, Br., 1864.—*Liqueur vésicant*, Fr.; *Blasenziehende Flüssigkeit*, G.

Preparation.—Take of Cantharides in powder eight ounces; Acetic Acid four fluidounces; Ether a sufficiency. Mix the cantharides and acetic acid; pack them in a percolator, and at the expiration of twenty-four hours pour ether over the contents of the percolator, and allow it to pass slowly through till twenty fluidounces are obtained. Keep it in a stoppered bottle. *Br.*

Cantharidin being soluble both in acetic acid and ether, the preparation should contain the entire amount of that principle in solution. Tichborne preferred to substitute the acetic acid by an equivalent amount of glacial acetic acid, as thereby less water is introduced into the powder. Brady has shown that, when spontaneously evaporated from the skin, the film left is not uniform, but thickest at the circumference. Deane (1876) recommends the discarding of the officinal solvents, and the substitution of acetic ether, which dries more uniformly, and takes up a larger amount of cantharidin.

Medical Action and Uses.—This liquid is intended to produce a rapid vesication, which is effected chiefly by the acetic acid, although the irritation is maintained by the cantharides. It should be well rubbed into the skin with a small mop or piece of sponge attached to a handle, until redness is produced, and should be used only on limited portions of the skin.

LIQUOR FERRI CHLORIDI, *U. S.*—SOLUTION OF CHLORIDE OF IRON.

Liquor ferri perchloridi fortior, Br.; *Liquor ferri sesquichlorati*, P. G.; *Liquor ferri muriatici oxydati*, *Ferrum sesquichloratum solutum.*—*Solution of ferric chloride*, *Strong solution of perchloride of iron*, E.; *Solution de perchlorure de fer*, *Chlorure ferrique liquide*, Fr.; *Flüssiges Eisenchlorid*, G.

The specific gravities of the officinal solutions of ferric chloride are: 1.480 to 1.484 *P. G.*, 1.44 *Br.*, 1.355 *U. S.*, 1.26 *F. P.*

Preparation.—Take of Iron in the form of wire and cut in small pieces three troyounces; Muriatic Acid seventeen troyounces and a half; Nitric Acid, Distilled Water, each a sufficient quantity. Put the iron into a flask measuring two pints, pour upon it eleven troyounces of the muriatic acid, and let the mixture stand until effervescence ceases; then heat to the boiling point, decant the liquid, filter through paper, and, having rinsed the flask with a little distilled water, boiling hot, pour the washings upon the filter. Put the filtered liquid into a porcelain capsule measuring four pints, mix with it the residuary muriatic acid, and, having heated the mixture nearly to the boiling point, add a troyounce and a half of nitric acid. Upon the cessation of effervescence, drop in nitric acid until it no longer occasions effervescence; and, when the liquid becomes cool, add sufficient distilled water to make it measure a pint. *U. S.*

Take of Iron Wire two ounces; Hydrochloric Acid twelve fluidounces; Nitric Acid nine fluidrachms; Distilled Water eight fluidounces. Mix eight fluidounces of the hydrochloric acid with the distilled water, and in this dissolve the iron at a gentle heat. Filter the solution, add to it the remainder of the hydrochloric acid and the nitric acid, heat the mixture briskly until on the sudden evolution of red fumes the liquid becomes of an orange-brown color, then evaporate by the heat of a water-bath until it is reduced to ten fluidounces. *Br.*

The reactions which take place in the preparation of ferric chloride, and the proper manipulations to insure success, have been described. (See Ferri chloridum, page 613.) The solution of the U. S. Pharmacopœia differs from the similar solutions of the other pharmacopœias in containing an excess of one troyounce of muriatic acid to the pint; the difference in density has been stated above.

Properties and Tests.—Solution of ferric chloride is a reddish-brown liquid, which has a strong styptic taste and may be mixed with water and alcohol in all proportions without producing a precipitate. Diluted with water, it is not precipitated by barium chloride or potassium ferridcyanide (absence of sulphate and ferrous salt), but yields a white precipitate with silver nitrate (chloride), and a dark blue precipitate of Prussian blue with potassium ferrocyanide. The absence of nitric acid is proven by adding a crystal of ferrous sulphate to a little of the solution and afterwards a few drops of strong sulphuric acid, when a black color should not be produced near the crystal. Two fluidrachms of the solution, diluted with water and mixed with an excess of ammonia water, yield a reddish-brown precipitate which, when washed and ignited, weighs 28.25 grains U. S. P., 31.24 grains Br. P.

Pharmaceutical Uses.—*Martin's hemostatic*, which is used in France, consists of selected pieces of spunk, which are saturated with ferric chloride.

Adrian's hemostatic is made by dissolving 15 grams of sodium chloride in 60 grams of water, and adding 25 grams of solution of ferric chloride specific gravity 1.26.

FERRUM ALBUMINATUM is a compound of ferric chloride and albumen, which has been recently introduced in Europe, and for which J. Biel (1878) has given the following process: 10 grams of dry soluble egg-albumen are dissolved in 100 grams of distilled water; the clear solution is mixed with 2.4 grams of solution of ferric chloride, *P. G.* (or 1.75 grams of crystallized ferric chloride, see page 613), previously diluted with 24 grams of distilled water; 20 grams of 90 per cent. alcohol are now added, and sufficient water to make 200 grams. This concentrated solution will keep in the dark without alteration; for dispensing, to obtain the *Liquor ferri albuminati*, one part of it is diluted with 4 parts of distilled water, and then contains 0.033 per cent. of metallic iron, the strength generally adopted in Europe. It is more convenient, however, to evaporate the concentrated solution at a temperature not exceeding 40° C. (104° F.), when the compound is obtained in golden-yellow transparent scales containing 3.34 per cent. iron, and yield the solution, by dissolving them in 100 times their weight of distilled water.

Off. Prep.—Liquor ferri perchloridi, *Br.;* Tinct. ferri chloridi (perchloridi), *U. S.*, *Br.*

Medical Action and Uses.—Solution of chloride of iron is used chiefly for the styptic and astringent qualities which it possesses in a high degree.

Its efficiency as an internal medicine is displayed in various *passive hemorrhages*, particularly of the stomach, bowels, uterus, and urinary passages. It is useful in several profluvia, as *leucorrhœa*, *hydruria*, nocturnal *incontinence of urine*, and *vesical catarrh*. It is reported to control *seminal emissions* due to irritability of the urethra or spermatic ducts. In chronic *dysentery* it is one of the best of the astringent medicines appropriate to that affection; it may be prescribed internally and by enema. This preparation is more frequently employed locally as a styptic and astringent in *epistaxis*, hemorrhage from *leech bites*, from the jaw after the *extraction of teeth*, from the *tonsils*, from *cancer of the uterus*, from the *umbilical* cord, from the rectum in *hemorrhoids*, from the uterus after *abortion*, and from *vascular growths* in the cavity of that organ. One of its most valuable applications is to the arrest of *post-partum hemorrhage* caused by uterine inertia. Dr. Barnes, who first employed it, made use of a mixture of half a pint of the stronger solution of the chloride (B. P.) with a pint and a half of water. He directed that a tube about nine inches long should be carried by the hand to the fundus of the uterus previously freed from coagula, and that the liquid should be very slowly injected, care being taken that no air accompanied it. It is stated never to fail, and in no case to do any harm. Numerous confirmatory cases have been published. In *pulmonary hemorrhage* a weak solution of the chloride has been successfully used in the form of atomized spray. It may be employed to check *gastric hemorrhage* in any of the various conditions in which that accident occurs. This powerful styptic has been used to cure *aneurisms*, varicose, sacculated, and others; but although the operation is successful in coagulating the blood in the tumor, it has so often happened either that the tumor suppurated, or that purulent infiltration took place around it, or that fatal embolism occurred, that the operation is no longer considered warrantable. It has been most successful in erectile tumors of the scalp; and safest when the tumors, previously blistered or not, have been covered with compresses wet with the astringent solution. *Varicose veins* have been treated by injections of this preparation, pressure being maintained immediately above the point operated upon. In chronic *ophthalmia* with varicose enlargement of the bloodvessels, it affords, probably, the best chance of cure. As a local application in *diphtheria* it appears to excel all other stimulants and caustics. In the same manner it cures *chilblains*, and is advantageous in *zona*. It is useful in repressing fungous granulations everywhere, but especially in cases of *in-grown toe nail*, and in ulceration of the *gums*. It also forms one of the best dressings for *hospital gangrene*, hardening the tissues and correcting the fetor. In *prolapsus of the rectum* it has been efficiently employed, the projecting bowel being well painted with the solution and then reduced; after which it is retained by means of a tampon moistened with a diluted solution of the medicine. *Dose*, from one to ten minims mixed with syrup, and largely diluted. The teeth should be carefully guarded against its action, by administering the liquid through a glass tube, and by thoroughly washing the mouth after its use.

LIQUOR FERRI PERCHLORIDI, *Br.*—SOLUTION OF PERCHLORIDE OF IRON.

Solution de chlorure ferrique diluée, Fr.; *Verdünnte Eisenchlorid-Lösung*, G.

Preparation.—Take of Strong Solution of Perchloride of Iron five fluidounces; Distilled Water fifteen fluidounces. Mix. *Br.*

This preparation is intended to take the place of the tincture of ferric chloride, as it retains the iron salt in an unchanged condition.

See Liq. ferri chloridi.

LIQUOR FERRI CITRATIS, *U. S.*—SOLUTION OF CITRATE OF IRON.

Liquor ferri citrici, Citras ferricus liquidus.—Citrate de fer liquide, Fr.; *Flüssiges Eisencitrat*, G.

Preparation.—Take of Citric Acid in coarse powder five troyounces and three hundred and sixty grains; Solution of Tersulphate of Iron a pint; Water of Ammonia twenty fluidounces; Distilled Water a sufficient quantity. To the water of ammonia, mixed with two pints of distilled water, add the solution of tersulphate of iron, previously mixed with two pints of distilled water, stirring constantly; transfer the precipitate formed to a muslin strainer, and wash it with water until the washings are nearly tasteless. After the precipitate has been drained, put half of it into a porcelain capsule, on a water-bath heated to 140° F., add the citric acid, and stir the mixture until the precipitate is nearly dissolved. Then add so much of the reserved precipitate as may be necessary fully to saturate the acid. Lastly, filter the liquid, and evaporate it, at a temperature not above 140° F., until it is reduced to the measure of a pint. *U. S.*

The first part of the process consists in preparing ferric hydrate; the reaction has been explained (see page 625). The hydrate retains a considerable quantity of water, so that on the addition of citric acid the mixture becomes liquid as the acid is dissolved and ferric citrate formed. The solution is aided by the application of heat which should never exceed 66° C. (151° F.), but is best kept at 60° C. (140° F.) to prevent decomposition. The digestion must be continued for several hours until the acid has taken up as much iron as can combine with it, when it is filtered and evaporated as directed.

Properties.—The solution has a dark brown color and a slightly ferruginous taste; when evaporated spontaneously or at a moderate heat, in thin layers, it forms transparent, garnet-red scales, which are readily detached from the glass or porcelain plate. A fluidrachm should yield 30 grains of scales.

Pharmaceutical Uses.—In preparing Ferri citras, Ferri et ammonii citras, and Ferri et quiniæ citras, *U. S.*

Medical Uses.—This solution forms a convenient mode of dispensing citrate of iron. *Dose*, ten minims, or about five grains of the salt.

LIQUOR FERRI NITRATIS, *U. S.*—SOLUTION OF NITRATE OF IRON.

Liquor ferri pernitratis, Br.—*Solution of pernitrate of iron*, E.; *Azotate (pernitrate) de fer liquide*, Fr.; *Salpetersaure Eisenoxyd-Lösung*, G.

Preparation.—Take of Iron in the form of wire and cut in pieces two troyounces and a half; Nitric Acid five troyounces; Distilled Water a sufficient quantity. Mix the iron with twelve fluidounces of distilled water in a wide-mouthed bottle, and add to the mixture, in small portions at a time, with frequent agitation, three troyounces of the nitric acid, previously mixed with six fluidounces of distilled water, moderating the reaction by setting the vessel in cold water, in order to prevent the occurrence of red fumes. When the effervescence has nearly ceased, agitate the solution with the undissolved iron until a portion of the liquid, on being filtered, exhibits a pale green color. Then filter the liquid, and, having poured it into a capacious porcelain capsule, heat it to the temperature of 130° F., and add the remainder of the nitric acid. When the effervescence has ceased, continue the heat until no more gas escapes, and then add enough distilled water to make the liquid measure thirty-six fluidounces. *U. S.*

Take of fine Iron Wire free from rust one ounce; Nitric Acid four and a half fluidounces; Distilled Water a sufficiency. Dilute the nitric acid with sixteen ounces of the water, introduce the iron wire into the mixture, and leave them in contact until the metal is dissolved, taking care to moderate the action, should it become too violent, by the addition of a little more distilled water. Filter the solution, and add to it as much distilled water as will make its bulk one pint and a half (30 fluidounces). *Br.*

Both formulas aim at the production of ferric nitrate, $Fe_2 6NO_3$. If the directions of the British Pharmacopœia are followed, the iron is taken up with the evolution of red vapors, the reaction being as follows: Fe_2+8HNO_3 yields $Fe_2 6NO_3+2NO+4H_2O$. Considerable heat is produced, and may rise to such a degree that nitric acid is vaporized; the reaction must therefore be closely watched, and, if it should become too violent, moderated by the addition of some cold water.

This difficulty is sought to be avoided in the process of the United States Pharmacopœia by first forming ferrous nitrate and converting this into the ferric salt. Berzelius observed that, besides ferrous nitrate, ammonium nitrate is also formed, and no gas evolved, if a mixture of iron, water, and nitric acid is kept below the temperature of 50° C. (122° F.), when $2Fe_2+10HNO_3$ yields $4(Fe2NO_3)+NH_4NO_3+3H_2O$. The formation of ammonia is a secondary reaction, and depends upon the action of the nascent hydrogen upon the excess of nitric acid; it is lessened, but not entirely prevented, by a stronger acid and at a higher temperature, and augmented as the temperature and the acid strength are decreased, sometimes to such a degree that ferrous hydrate is separated. It follows from this that the solutions, as obtained by both formulas, are apt to vary in their composition.

Ordway (1865) found that weak solutions of *ferrous nitrate*, which are free from excess of acid, may be concentrated at 60° C. (140° F.), but must then be evaporated at a lower temperature to prevent oxidation. The green crystals obtained in the cold cannot be dried without decomposition. *Ferric nitrate* has been obtained in colorless or purplish crystals, which are cubes when containing $12H_2O$, or prisms with $18H_2O$.

Properties and Tests.—The solution has a reddish-brown, or, if the acid is somewhat in excess, a pale amber color, which becomes darker on heating, and lighter again on cooling. When mixed with a solution of ferrous sulphate, and then with strong sulphuric acid, it assumes a blackish-brown color. Ferridcyanide of potassium, nitrate of silver, and nitrate of barium do not disturb the solution, proving the absence of ferrous salt, chloride, and sulphate. The specific gravity is 1.060 to 1.070, U. S. P.; 1.107, Br. P.

The ferric oxide obtained from a fluidounce of the solution by precipitating with ammonia, washing, and igniting, is required to weigh between 8 and 10 grains, U. S. P.; 20.6 grains, Br. P.

Medical Action and Uses.—This preparation differs in its properties from the other acid compounds of iron. It is much more astringent than the vegetable acid salts or than the iodide of iron, and less harsh than the sulphuric and muriatic acid compounds. It is used chiefly in chronic *diarrhœa* dependent upon debility of the system, or following dysentery, when no febrile complication exists. It is also profitably employed in *leucorrhœa* affecting feeble and lymphatic females, both internally and locally; and in *menorrhagia* occurring under similar conditions. The *dose* is about ten drops, largely diluted. As an injection, from ten to thirty drops in an ounce of water may be employed.

LIQUOR FERRI PERCHLORIDI. See LIQ. FERRI CHLORIDI.

LIQUOR FERRI SUBSULPHATIS, *U. S.*—SOLUTION OF SUBSULPHATE OF IRON.

Solution of persulphate of iron, Monsel's solution, E.; *Liqueur hémostatique de Monsel*, Fr.; *Basisch-schwefelsaure Eisenoxyd-Lösung, Monsel's Eisenlösung*, G.

Preparation.—Take of Sulphate of Iron in coarse powder twelve troyounces; Sulphuric Acid a troyounce and thirty grains; Nitric Acid a troyounce and three hundred grains; Distilled Water a sufficient quantity. Mix the acids with half a pint of distilled water in a capacious porcelain capsule, and, having heated the mixture to the boiling point, add the sulphate of iron, one-fourth at a time, stirring after each addition until effervescence ceases. Then keep the solution in brisk ebullition until nitrous vapors are no longer perceptible, and the color assumes a deep ruby-red tint. Lastly, when the liquid is nearly cold, add enough distilled water to make it measure twelve fluidounces. *U. S.*

This process is a slight modification of that proposed by D. Squibb (1860). On introducing the ferrous sulphate in small portions into the heated acids, a black color is produced from the union of nitric oxide with ferrous sulphate, which disappears with the copious evolution of red nitrous vapors as fast as the sulphate dissolves in the hot liquid. The mixture foams most towards the end of the process, and after the liquid has again subsided a little of it should be tested with nitric acid to insure its complete oxidation. The amount of sulphuric acid used is insufficient for forming the so-called neutral ferric sulphate. A basic or oxysulphate is the result, which has the composition $2Fe_2O.5SO_3 + Aq$, or $5(Fe_2 3SO_4).Fe_2 6HO$. The mineral *copiapite* is a crystallized hydrate of the same combination. Other more basic ferric sulphates are known, some being soluble, others insoluble in water.

Properties and Tests.—Monsel's solution is a deep brown-red liquid, being nearly of a syrupy consistence, and of the spec. grav. 1.552. It has a very astringent, but not caustic taste, and mixes with water and alcohol in all proportions without decomposition. On dropping sulphuric acid into it, the color becomes lighter, and with a larger quantity of the acid, a separation of whitish ferric sulphate takes place. Diluted with distilled water, it yields precipitates with ammonia water and barium nitrate, but none with nitrate of silver; or with ferridcyanide of potassium. When a crystal of ferrous sulphate is added to a little of the solution, and afterwards some strong sulphuric acid, a blackish color is not produced. When evaporated at a moderate heat upon a glass or porcelain plate, it yields transparent, deliquescent scales, and at a somewhat higher temperature is converted into a yellowish powder, which is less deliquescent.

Medical Uses.—This preparation is chiefly used as a local styptic in cases of *hemorrhage* from parts not readily subjected to pressure, as the nasal cavities, the sockets from which teeth have been extracted, the uterus, vagina, rectum, etc. It has the advantage of being less irritating than other acid salts of iron. It is generally applied by means of a wooden or glass brush, or a fragment of compact sponge. Where pressure can also be made, it should not be omitted. An atomized solution of it has been found successful in some cases of *hæmoptysis*. For this purpose from one to ten grains should be dissolved in an ounce of distilled water. Internally it may be prescribed in the *dose* of from five to fifteen grains properly diluted.

LIQUOR FERRI TERSULPHATIS, *U. S.*—SOLUTION OF TERSULPHATE OF IRON.

Liquor ferri persulphatis, Br.; *Liquor ferri sulfurici oxydati*, P. G.—*Solution of persulphate of iron*, E.; *Persulfate de fer liquide*, Fr.; *Flüssiges schwefelsaures Eisenoxyd*, G.

Preparation.—Take of Sulphate of Iron in coarse powder twelve troyounces; Sulphuric Acid two troyounces and sixty grains; Nitric Acid a troyounce and three hundred and sixty grains; Water a sufficient quantity. Mix the acids with half a pint of water in a capacious porcelain capsule, and, having heated the mixture to the boiling point, add the sulphate of iron, one-fourth at a time, stirring after each addition until effervescence ceases. Then continue the heat until the solution acquires a reddish-brown color, and is free from nitrous odor. Lastly, when the liquid is nearly cold, add enough water to make it measure a pint and a half. *U. S.*

Take of Sulphate of Iron eight ounces; Sulphuric Acid, Nitric Acid, of each six fluidrachms; Distilled Water twelve fluidounces, or a sufficiency. Add the sulphuric acid to ten ounces of the water, and dissolve the sulphate of iron in the mixture with the aid of heat. Mix the nitric acid with the remaining two ounces of the water, and add the dilute acid to the solution of sulphate of iron. Concentrate the whole by boiling, until, by the sudden disengagement of ruddy vapors, the liquid ceases to be black, and acquires a red color. A drop of the solution is now to be tested with red prussiate of potash, and if a blue precipitate forms, a few additional drops of nitric acid should be added, and the boiling renewed, in order that the whole of the sulphate may be converted into persulphate of iron. When the solution is cold, make the quantity eleven fluidounces by the addition, if necessary, of distilled water. *Br.*

The reaction which takes place in these processes is precisely the same as in making the subsulphate of iron, the only difference being that the sulphuric acid is used in sufficient quantity to form ferric sulphate, $Fe_2 3SO_4$. The reaction is explained by the equation $6FeSO_4 + 3H_2SO_4 + 2HNO_3 = 3(Fe_2 3SO_4) + 2NO + 4H_2O$.

Properties.—Solution of ferric sulphate is a dark, reddish-brown liquid, having no odor, and a very astringent, and at the same time acid taste. It is miscible in all proportions with alcohol and water without causing decomposition. Its behavior to reagents is the same as that of the subsulphate. It has the spec. grav. 1.320 U. S. P., 1.441 Br. P. One fluidounce of the solution, diluted with water and mixed with an excess of ammonia water, yields a precipitate which, when washed and ignited, weighs 69 grs. U. S. P., 91.5 grs. Br. P.

Pharmaceutical Uses.—In preparing magnetic oxide of iron, and ferric oxide as an antidote to arsenic, or for preparing the various tartrates and citrates containing iron; also in preparing, by double decomposition, ferri ferrocyanidum, ferri pyrophosphas, *U. S.*, and tinct. ferri acetatis, *Br.*, and in forming the double salt ferri et ammonii sulphas, *U. S.*

Medical Uses.—It may be used for the same purposes as the subsulphate, but is not so eligible, because it is more irritant and less astringent.

LIQUOR GUTTA-PERCHÆ, *U. S.*, *Br. Add.*—SOLUTION OF GUTTA-PERCHA.

Liqueur de gutta-percha, Fr.; *Guttapercha-Lösung*, G.

Preparation.—Take of Gutta-percha in thin slices a troyounce and a half; Purified Chloroform seventeen troyounces; Carbonate of Lead in fine powder two troyounces. To twelve troyounces of the chloroform, contained in a bottle, add the gutta-percha, and shake occasionally until it is dissolved. Then add the carbonate of lead, previously mixed with the remainder of the chloroform, and, having several times shaken the whole together, at intervals of half an hour, set the mixture aside, and let it stand for ten days, or until the insoluble matter has subsided, and the solution become limpid, and either colorless or of a pale straw-color. Lastly, decant the liquid, and keep it in a well-stopped bottle. *U. S.*

Take of Gutta-percha in thin slices one ounce; Chloroform eight fluidounces; Carbonate of Lead in fine powder one ounce. Add the gutta-percha to six fluidounces of the chloroform in a stoppered bottle, and shake them together frequently until solution has been effected. Then add the carbonate of lead, previously mixed with the remainder of the chloroform, and, having several times shaken the whole together, set the mixture aside, and let it remain at rest until the insoluble matter has subsided. Lastly, decant the clear liquid, and keep it in a well-stoppered bottle. *Br.*

Crude gutta-percha does not yield a clear solution with chloroform, but on standing the impurities will rise to the surface, more rapidly if, according to Maschke (1857), the solution is agitated with 1 or 1½ per cent. of water. Hodgson (1861) proposed carbonate of lead with the same object in view, the impurities subsiding with the lead compound. Other heavy and insoluble compounds may be used with the same result of rendering the solution clear and almost or entirely colorless.

Off. Prep.—Charta sinapis, *U. S.*, *Br.*

Medical Uses.—The various applications of this solution are enumerated under Gutta-percha. They consist, briefly, in the adhesive and protective qualities of the film formed by the evaporation of the solvent.

LIQUOR HYDRARGYRI NITRATIS, *U. S.*—SOLUTION OF NITRATE OF MERCURY.

Liquor hydrargyri nitratis acidus, Br.; *Liquor hydrargyri nitrici oxydati*, *Hydrargyrum oxydatum nitricum solutum.*—*Acid solution of nitrate of mercury*, *Solution of pernitrate of mercury*, E.; *Deutoazotate* (*Pernitrate*) *de mercure liquide*, Fr.; *Flüssiges salpetersaures Quecksilberoxyd*, G.

Preparation.—Take of Mercury three troyounces; Nitric Acid five troyounces; Distilled Water six fluidrachms. Dissolve the mercury, with the aid of a gentle heat, in the acid previously mixed with the distilled water. When reddish vapors cease to arise, evaporate the liquid to seven troyounces and a half, and keep it in a well-stopped bottle.

Solution of Nitrate of Mercury may also be prepared as follows: Take of Red Oxide of Mercury three troyounces and one hundred and twenty grains; Nitric Acid three troyounces and three hundred grains; Distilled Water six fluidrachms. Mix the acid with the water, dissolve the oxide of mercury in the mixture, and evaporate to seven troyounces and a half. *U. S.*

Take of Mercury four ounces; Nitric Acid five fluidounces; Distilled Water one and a half fluidounce. Mix the nitric acid with water in a flask, and dissolve the mercury in the mixture without the application of heat. Boil gently for fifteen minutes, cool, and preserve the solution in a stoppered bottle. *Br.*

The mercury is dissolved in the first and last processes by the action of nitric acid, with the extrication of red nitrous vapors to form mercuric nitrate; $3Hg_2 + 16HNO_3$ yields $6(Hg2NO_3) + 4NO + 8H_2O$. It is necessary to apply some heat, particularly at the close of the reaction, to convert into mercuric any mercurous salt which may be present. The second United States process yields the same solution more rapidly, and involves simply a combination of the mercuric oxide with nitric acid, water being liberated; $HgO + 2HNO_3$ yields $HgNO_3 + H_2O$.

Properties and Tests.—The solution is colorless, and has a strong acid reaction and a caustic and metallic taste. Its specific gravity is 2.165 U. S. P.; 2.240 Br. P. A crystal of ferrous sulphate dropped into it soon becomes surrounded with a dark-colored liquid (presence of nitrate). Dropped upon copper, a deposit of mercury is at once produced, and if dropped into very dilute muriatic acid, a white precipitate of mercurous chloride is not formed. The absence of mercurous nitrate is also proven by the yellow (not black) precipitate with soda or potassa solution, and by the scarlet red (not yellow or green) precipitate with potassium iodide; this latter precipitate is soluble in an excess of the precipitant.

If the solution is kept over sulphuric acid, until crystals have been separated, the syrupy liquid will have the composition $Hg2NO_3.2H_2O$; and the crystals contain less water, their composition being $2(Hg2NO_3).H_2O$. If the liquid is further concentrated by heat, nitric acid is given off and the solution contains then basic nitrates which are crystallizable, but when largely diluted with water are converted into more basic insoluble white or yellowish compounds.

The German Pharmacopœia recognizes a *Liquor hydrargyri nitrici oxydulati* (*s. Hydrargyrum oxydulatum solutum, s. Liquor Bellostii*), which is made by dissolving, without heat, 100 parts of powdered crystallized mercurous nitrate in 15 parts of nitric acid to which 885 parts of distilled water are gradually added.

Medical Action and Uses.—It is not used internally. Locally its action is powerfully caustic, destroying the life of the tissue to which it is directly applied, and inflaming the surrounding parts. The slough separates as a yellowish scab. When swallowed by mistake it produces the effects of a powerful corrosive poison, including intense pain, vomiting, purging, collapse, and speedy death, after which the fauces have been found vesicated and discolored, and the stomach presenting brown eschars. Applied to an ulcerated surface, even of small extent, it has caused salivation; and a weak solution of it used in the treatment of itch has occasioned fatal poisoning, with symptoms of corrosion and salivation also.

This preparation is employed to stimulate sluggish restorative processes and to remove indurated tissues. It is a valuable application in chronic and indurated *ulcers* of the neck of the uterus, of whatever nature, but most so, of course, in simple ulcers. Tubercles and ulcers of the skin belonging to *lupus* have sometimes been treated advantageously by this caustic, while appropriate internal medicines were also given. It is advised that it should by applied daily. It is an efficient remedy for *acne* by destroying the diseased sebaceous follicles. It has been recommended as the most successful of local applications for all forms of *syphilitic* sores, of the skin, tongue, throat, etc. The strength of the solution employed must vary with the object in view. In lupus and acne the pure liquid must be used, and applied by means of a pointed glass rod or brush, or a wooden splinter, so as accurately to limit the caustic action to the diseased tissue. When ulcers of the throat are to be treated, one or two minims of the acid to an ounce of water may be used as a gargle, or with an atomizer, care being taken not to inhale the spray; or by means of a sponge mop a mixture of a fluidrachm of the solution with an ounce of water may be applied. For cutaneous ulcers a lotion may be made with thirty minims of the solution and an ounce of water.

LIQUOR HYDRARGYRI PERCHLORIDI, *Br.*—SOLUTION OF PERCHLORIDE OF MERCURY.

Liquor hydrargyri bichloridi.—Solution of corrosive sublimate, E.; *Chlorure de mercure et d'ammoniaque liquide*, *Soluté de sel alembroth*, Fr.; *Sublimat-Lösung*, G.

Preparation.—Take of Perchloride of Mercury, Chloride of Ammonium, each ten grains; Distilled Water one pint. Dissolve. *Br.*

This is a colorless solution of the sal alembroth of the alchymists, having the saline and metallic taste of the salts from which it is made. It yields white precipitates with alkalies and their carbonates, and is decomposed by vegetable juices and the medicinal extracts. It contains one-half grain of corrosive sublimate to the (imperial) fluidounce, and is of one-half the strength of the similar solution which was formerly recognized by the Prussian and other European Pharmacopœias.

Medical Action and Uses.—The object of this preparation appears to be to render the solution of corrosive sublimate more perfect than that in water alone. The average *dose* is one fluidrachm, containing one-sixteenth of a grain of corrosive sublimate.

LIQUOR IODINII COMPOSITUS, *U. S.*—COMPOUND SOLUTION OF IODINE.

Liquor iodi, Br.—*Solution of iodine*, E.; *Soluté ioduré de Lugol*, Fr.; *Lugol'sche Jodlösung*, G.

Preparation.—Take of Iodine three hundred and sixty grains; Iodide of Potassium a troyounce and a half; Distilled Water a pint. Dissolve the iodine and iodide of potassium in the distilled water. *U. S.*

Take of Iodine twenty grains; Iodide of Potassium thirty grains; Distilled Water one fluidounce. Dissolve. *Br.*

Solutions of potassium iodide dissolve iodine in different proportions, weak solutions taking up 1 atom of I for each molecule of KI, or 76.5 parts for 100 parts of the salt. The dissolved portion, therefore, has the composition KI_2. The proportion of iodine to potassium iodide in the second formula approaches the composition given; but the formula of the United States Pharmacopœia directs a larger amount of the salt. The iodine strength of both solutions, however, is nearly alike. Viewed as free iodine held in solution by potassium iodide, one part of the former is represented by 23.3 parts (United States Pharmacopœia) and 24.4 parts (British Pharmacopœia) of the solution.

Properties.—The solution is of a dark brown-red color, having the caustic taste of iodine, and imparting to starch paste a dark blue color. When boiled iodine is given off, but the whole of it does not volatilize until the liquid is evaporated to dryness, and the residuary mass heated nearly to redness. When agitated with chloroform, ether, or bisulphide of carbon, the solution is decolorized.

Medical Action and Uses.—This preparation is considerably stronger in the proportion of its active ingredients than the compound *tincture* of iodine, and is thought to be more efficient, although there is no satisfactory evidence in favor of that opinion. Twenty-four drops of it contain about one grain of iodine. The average *dose* is six drops. It should be administered in a large portion of water.

LIQUOR LITHIÆ EFFERVESCENS, *Br.*—EFFERVESCING SOLUTION OF LITHIA.

Aqua lithiæ effervescens.—Lithia water, E.; *Eau de lithine*, Fr.; *Lithionwasser*, G.

Preparation.—Take of Carbonate of Lithia ten grains; Water one pint. Mix in a suitable apparatus, and pass into it as much pure washed carbonic acid gas, obtained by the action of sulphuric acid on chalk, as can be introduced with a pressure of seven atmospheres. Keep the solution in bottles securely closed, to prevent the escape of the compressed gas. *Br.*

This is a solution of lithium carbonate in water rendered more agreeable by the carbonic acid gas. Each fluidounce contains half a grain of the carbonate, the amount of which is best ascertained by evaporating a known measure of it. The residue should answer to the tests for lithium carbonate.

Medical Uses.—This is merely an agreeable form of administration for lithia, and may be given in the *dose* of from four to twelve fluidounces.

LIQUOR MAGNESIÆ CARBONATIS, *Br.*—SOLUTION OF CARBONATE OF MAGNESIA.

Aqua magnesio-effervescens.—Fluid magnesia, E.; *Eau magnésienne, Magnésie liquide*, Fr.; *Kohlensaure Magnesialösung*, G.

Preparation.—Take of Sulphate of Magnesia two ounces; Carbonate of Soda two and a half ounces; Distilled Water a sufficiency. Dissolve the two salts separately, each in half a pint of water. Heat the solution of sulphate of magnesia to the boiling point, then add to it the solution of carbonate of soda, and boil them together until carbonic acid ceases to be evolved. Collect the precipitated carbonate of magnesia on a calico filter, and wash it with distilled water until what passes ceases to give a precipitate with chloride of barium. Mix the washed precipitate with a pint of distilled water, and, putting them into a suitable apparatus, pass into it pure washed carbonic acid gas, obtained by the action of sulphuric acid on chalk. Let the mixture remain in contact with excess of carbonic acid, retained there under pressure for about twenty-four hours; then filter the liquid to remove any undissolved carbonate of magnesia, and again pass carbonic acid gas into the filtered solution. Finally, keep the solution in a bottle securely closed, to prevent the escape of carbonic acid.

The solution contains about thirteen grains of carbonate of magnesia in a fluidounce. *Br.*

The first part of the above process embraces the preparation of magnesium oxycarbonate $(MgCO_3)_3.Mg2HO$, which is the officinal magnesii carbonas. By the subsequent operation this is dissolved in water by the aid of carbonic acid gas in excess, whereby magnesium carbonate, $MgCO_3$, and bicarbonate, MgH_22CO_3, are formed.

Properties and Tests.—It is a colorless solution, which should effervesce on opening the vessel, carbonic acid escaping, and has a slightly acidulous taste, free from bitterness. The residue left by evaporating a fluidounce and calcining the residue should weigh five grains, and answer to the tests for magnesia. When the solution is exposed to cold, prismatic crystals of magnesium carbonate, $MgCO_3.5H_2O$, appear, which on exposure to the air lose water and become $MgCO_3.3H_2O$.

Medical Uses.—The intention of this preparation is apparently to provide an agreeable form for administering magnesia in cases of constitutional *gout* and other disorders attended with an excess of *acid* in the system, and acid urinary deposits. An extemporaneous mixture of magnesia with carbonated water answers the same purpose, and so do the granular effervescing vegetable salts of magnesia. The *dose* of this preparation is one or two fluidounces.

LIQUOR MAGNESII CITRATIS, *U. S.*—Solution of Citrate of Magnesium.

Liquor magnesiæ citratis, Br. Add.; *Liquor magnesii citrici.—Limonade au citrate de magnésie, Limonade purgative citro-magnésienne*, Fr.; *Flüssige Citronsaure Magnesia*, G.

Preparation.—Take of Carbonate of Magnesium two hundred grains; Citric Acid four hundred grains; Syrup of Citric Acid two fluidounces; Bicarbonate of Potassium forty grains; Water a sufficient quantity. Dissolve the citric acid in four fluidounces of water, and, having added the carbonate of magnesium, stir until it is dissolved. Filter the solution into a strong twelve-ounce bottle, containing the syrup of citric acid. Then add the bicarbonate of potassium and enough water to nearly fill the bottle, which must be closed with a cork secured with twine. Lastly, shake the mixture occasionally until the bicarbonate is dissolved. *U. S.*

Take of Carbonate of Magnesia one hundred grains; Citric Acid two hundred grains; Syrup of Lemons half a fluidounce; Bicarbonate of Potash in crystals forty grains; Water a sufficiency. Dissolve the citric acid in two ounces of the water, and, having added the carbonate of magnesia, stir until it is dissolved. Filter the solution into a strong half-pint bottle, add the syrup and sufficient water to nearly fill the bottle; then introduce the bicarbonate of potash, and immediately close the bottle with the cork, which should be secured with string or wire. Afterwards shake the bottle until the bicarbonate of potash has dissolved. *Br.*

When magnesium carbonate and citric acid are brought together in the presence of water, carbonic acid gas is given off and magnesium citrate formed. The neutral salt has the composition $Mg_32C_6H_5O_7$, is but slightly soluble in water, and crystallizes from its solutions with $14H_2O$. The salt $MgHC_6H_5O_7$ is much more soluble in water, and it is this compound at which both Pharmacopœias aim in the above formulas. The reaction occurs as follows: $(MgCO_3)_3.Mg2HO+4H_3C_6H_5O_7$ yields $4MgHC_6H_5O_7+3CO_2+5H_2O$. A slight excess of citric acid is employed, which is subsequently neutralized with potassium bicarbonate, whereby some potassium citrate is formed and carbonic acid gas liberated, the latter remaining with the hermetically corked solution. Carbonate of magnesium, as ordinarily met with, varies much less in composition than calcined magnesia after some exposure to the atmosphere; the former compound is, therefore, very properly used in preference to the latter.

To prepare the solution, ten times, or any other convenient multiple of the officinal quantities of citric acid and magnesium carbonate are weighed out, mixed with the corresponding quantity of water; after the magnesia has dissolved, the liquid is passed through a paper filter, equally divided among the requisite number of bottles, into each of which the necessary measure of syrup is introduced; sufficient water, previously boiled and filtered, is then added to each bottle, after which the potassium bicarbonate in crystals is dropped in. The corks are then inserted, and securely fastened by twine, and the bottles laid upon their sides in a cool place. Prepared in this way, the crystals will gradually dissolve in the syrup, and this will slowly mix with the lighter saline solution, unless it be wanted for immediate use, when, by slight agitation, the syrup and bicarbonate are dissolved in the aqueous liquid.

The solution is colorless, free from sediment, and of a pleasant acidulous taste free from bitterness.

Medical Action and Uses.—This medicine has come into popular use as a purgative, and, if its constitution could be depended upon, would answer a useful purpose. But as it sometimes purges violently, and in other cases fails of any purgative effect, it ought not to be employed where certainty and uniformity of action are important. It should generally be given in divided doses of four or six ounces every hour until the desired operation is produced.

LIQUOR MORPHIÆ ACETATIS, *Br.*—SOLUTION OF ACETATE OF MORPHIA.

Soluté d'acétate de morphine, Fr.; *Essigsaure Morphinlösung*, G.

Preparation.—Take of Acetate of Morphia four grains; Diluted Acetic Acid eight minims; Rectified Spirit two fluidrachms; Distilled Water six fluidrachms. Mix the acid, the spirit, and the water, and dissolve the acetate of morphia in the mixture. *Br.*

Medical Uses.—Each fluidrachm contains half a grain of morphia acetate, the decomposition of which is prevented by the spirit.

LIQUOR MORPHIÆ HYDROCHLORATIS, *Br.*—SOLUTION OF HYDROCHLORATE OF MORPHIA.

Soluté de hydrochlorate de morphine, Fr.; *Salzsaure Morphinlösung*, G.

Preparation.—Take of Hydrochlorate of Morphia four grains; Diluted Hydrochloric Acid eight minims; Rectified Spirit two fluidrachms; Distilled Water six fluidrachms. Mix the hydrochloric acid, the spirit, and the water, and dissolve the hydrochlorate of morphia in the mixture. *Br.*

Medical Uses.—Each fluidrachm of this solution contains half a grain of muriate of morphia, and its *dose* is from ten to sixty minims. It will be observed that it contains four grains of the morphia salt to the ounce of water, while the solution of sulphate of morphia, U. S. P., contains but one grain to the fluidounce. Trousseau recommends, for hypodermic injection, a solution of muriate of morphia in glycerin, which preserves the salt from decomposition.

LIQUOR MORPHIÆ SULPHATIS, *U. S.*—SOLUTION OF SULPHATE OF MORPHIA.

Soluté de sulfate de morphine, Fr.; *Schwefelsaure Morphinlösung*, G.

Preparation.—Take of Sulphate of Morphia eight grains; Distilled Water half a pint. Dissolve the sulphate of morphia in the distilled water. *U. S.*

In some parts of the United States a much stronger solution is frequently prescribed under the name of *Magendie's solution of morphia*. It is prepared by dissolving 16 grains of sulphate of morphia in one fluidounce of water, and is, therefore, *sixteen times stronger* than that admitted into the Pharmacopœia. *Magendie's solution* is prepared in France by dissolving 0.8 gram ($12\frac{1}{4}$ grains) of morphia acetate in 30 grams (1 fluidounce) of water, and is, therefore, considerably weaker than the solution known by the same name in the United States.

Medical Action and Uses.—This solution, which in a fluidrachm contains one-eighth of a grain of the sulphate, is a convenient form for the administration of morphia. The commencing *dose* for an adult should not generally exceed a fluidrachm. For hypodermic injection it is too weak, and for that purpose a "Magendie's solution" which contains one-fifth of a grain of sulphate of morphia in six minims of the solution is generally employed.

LIQUOR PLUMBI SUBACETATIS, *U. S.*, *Br.*—SOLUTION OF SUBACETATE OF LEAD.

Liquor plumbi subacetici, P. G.; *Acetum plumbicum*, *Acetum saturni*, *Plumbum hydrico-aceticum solutum*, *Subacetas plumbicus liquidus.*—*Goulard's extract*, E.; *Sous-acétate de plomb liquide*, *Extrait de Goulard*, *Vinaigre de plomb* (*de saturne*), F.; *Bleissig*, G.

Specific gravities of the officinal solution: 1.32 F. P., 1.267 U. S., 1.26 Br., 1.235 to 1.240 P. G.

Preparation.—Take of Acetate of Lead sixteen troyounces; Oxide of Lead in fine powder nine troyounces and a half; Boiling Water a sufficient quantity. Put the acetate and oxide into four pints of boiling water, in a glass or porcelain vessel, and boil for half an hour, occasionally adding boiling water to preserve the measure; then filter through paper. Lastly, keep the liquid in a well-stopped bottle. *U. S.*

Take of Acetate of Lead five ounces; Oxide of Lead in powder 3½ ounces; Distilled Water one pint, or a sufficiency. Boil the acetate of lead and the oxide of lead in the water for half an hour, constantly stirring; then filter, and when the liquid is cold, add to it more distilled water, until the product measures twenty fluidounces. Keep the clear solution in stoppered bottles. *Br.*

Several basic acetates of lead are known, both soluble and insoluble in water, which may be obtained by treating solutions of the neutral acetate with the requisite quantity of oxide of lead. The exact composition of the officinal solutions depends, therefore, upon the proportion of the two compounds. The U. S. Pharmacopœia has adopted the views of Döbereiner, Berzelius, and others, in using the compounds in very nearly the proportion of their molecular weights, while the British Pharmacopœia orders an excess of oxide. In both cases a large amount of white insoluble residue is left, consisting of the oxyacetate $Pb2C_2H_3O_2.5(Pb2HO)$; both solutions contain chiefly the diplumbic acetate $Pb2C_2H_3O_2.Pb2HO$, that of the British Pharmacopœia also some $Pb2C_2H_3O_2.2(Pb2HO)$. The German and French Pharmacopœias use the two ingredients in the proportion of 3 parts of acetate to 1 of oxide, which results in the production of another basic salt having the composition $2(Pb2C_2H_3O_2).Pb2HO$.

The combination of the chemicals may be effected at the ordinary temperature by macerating the finely levigated litharge with the solution of lead acetate, in a corked bottle, and agitating occasionally until the sediment has become white; from two to four days are usually required. By boiling all the ingredients as directed in the formulas above, precisely the same result is obtained in a much shorter time, and the process is preferable to that of the German Pharmacopœia, which directs the heating of the mixed acetate and oxide by means of a steam-bath, until they fuse into a white mass, which is then to be treated with warm water.

Properties and Tests.—Solution of subacetate of lead is a colorless liquid, having a sweet, astringent taste, and an alkaline reaction to test-paper; the specific gravity has been given above. Added to a solution of gum-arabic, a dense white precipitate is produced; otherwise it has the reactions of lead and acetic acid. When completely precipitated by an excess of sulphuric acid, the filtrate, on being evaporated to dryness, leaves no residue, or only a very slight one (absence of other salts). When precipitated by an excess of ammonia, the filtrate should not have a blue color (absence of copper). The British Pharmacopœia requires that 413.3 grains of the solution should be precipitated by not less than 810 grain-measures of the volumetric solution of oxalic acid. On exposure to air, or on being mixed with water containing air in solution, the solution yields a white precipitate of carbonate of lead. It unites readily with liquid and solid fats.

Off. Prep.—Cerat. plumbi subacet. (Ung. plumbi subacet. comp.), *U. S.*, *Br.;* Linimentum plumbi subacet., *U. S.;* Liquor plumbi subacet. dilutus, *U. S.*, *Br.*

Medical Action and Uses.—This solution has occasioned violent toxical symptoms when taken internally, which it never should be for medicinal purposes. It is employed whenever an astringent and local sedative action is required to allay pain or inflammation, to constringe flaccid tissues, or to lessen secretion. Whenever applied to the denuded cutis, its use should not be continued long, lest acute poisonous effects be developed. It is of common use, diluted, in the treatment of *contusions*, *sprains*, *excoriations*, *fractures*, *burns*, *wounds*, *abscesses*, *hernia*, *hemorrhoids*, and various cutaneous *eruptions* of an inflammatory sort. It is best applied on soft cloths, lint, etc., and should be covered with water-proof tissue. Spongio-piline is a convenient vehicle for its use. The mucilage of slippery-elm or of quince seeds causes a precipitation of the lead from this solution; flaxseed and sassafras pith mucilage are less objectionable. For practical use the diluted solution is in most cases preferable.

LIQUOR PLUMBI SUBACETATIS DILUTUS, *U. S.*, *Br.*—DILUTED SOLUTION OF SUBACETATE OF LEAD.

Aqua plumbi, P. G.; *Aqua plumbica (vel saturnina).*—*Lead water*, E.; *Eau de saturne*, *Eau blanche*, Fr.; *Bleiwasser*, *Kühlwasser*, G.

Preparation.—Take of Solution of Subacetate of Lead three fluidrachms; Distilled Water a pint. Mix them. *U. S.*

Take of Solution of Subacetate of Lead, Rectified Spirit, each two fluidrachms; Distilled Water nineteen and a half fluidounces. Mix, and filter through paper. Keep the clear solution in a stoppered bottle. *Br.*

The use of distilled water does not prevent the mixture from becoming turbid at once, the carbonic acid held in solution or contained in the atmosphere producing some carbonate of lead. Other Pharmacopœias use common water, and several of them give, in addition to the above, another formula for *Goulard's lead water*, *Aqua plumbi Goulardi*, P. G.; *Aqua vegeto-mineralis Goulardi vel Lotio plumbea*, *Eau de Goulard*, Fr.; *Goulardsches Wasser*, G.; which is prepared by mixing 90 parts of common water, 2 parts of solution of subacetate of lead, and 8 parts of alcohol (specific gravity .892) or of vulnerary tincture.

Medical Uses.—It is this rather than the stronger solution of subacetate of lead that is commonly employed for the various purposes above indicated. When it is used as a lotion merely, and is not confined by dressings, it is rendered more efficient by the addition of alcohol, in the proportion of three or four drachms to a pint of the solution.

LIQUOR POTASSÆ, *U. S.*, *Br.*—SOLUTION OF POTASSA.

Liquor kali caustici, P. G.; *Kali hydricum solutum*, *Lixivium causticum.* —*Solution of potash*, E.; *Potasse caustique liquide*, *Lessive caustique*, Fr.; *Aetzkalilauge*, *Kalilauge*, G.

Specific gravity of the officinal solutions: 1.065, U. S.; 1.058, Br.; 1.330 to 1.334, P. G., F. P.

A solution of HKO in water.

Preparation.—Take of Bicarbonate of Potassium fifteen troyounces; Lime nine troyounces; Distilled Water a sufficient quantity. Dissolve the bicarbonate of potassium in four pints of distilled water, and heat the solution to the boiling point. Mix the lime with four pints of distilled water, and, having heated the mixture to the boiling point, add it to the alkaline solution, and boil for ten minutes. Then transfer the whole to a muslin strainer, and, when the liquid portion has passed, add enough distilled water through the strainer to make the strained liquid measure seven pints. Lastly, keep the liquid in well-stopped bottles of green glass.

Solution of potassa thus prepared has the specific gravity 1.065, and contains five and eight-tenths per cent. of hydrate of potassium.

Solution of potassa may also be prepared in the following manner:—

Take of Potassa a troyounce; Distilled Water a pint. Dissolve the potassa in the distilled water, and allow the solution to stand until the sediment subsides. Then pour off the clear liquid, and keep it in a well-stopped bottle of green glass. *U. S.*

Take of Carbonate of Potash one pound; Slaked Lime twelve ounces; Distilled Water one gallon. Dissolve the carbonate of potash in the water, and, having heated the solution to the boiling point in a clean iron vessel, gradually mix with it the slaked lime, and continue the ebullition for ten minutes with constant stirring. Then remove the vessel from the fire, and, when by the subsidence of the insoluble matter the supernatant liquor has become perfectly clear, transfer it by means of a siphon to a green glass bottle furnished with an air-tight stopper, and add distilled water if necessary to make it correspond with the tests of specific gravity and neutralizing power. *Br.*

On bringing together potassium carbonate and slaked lime in the presence of water a double decomposition is effected, resulting in the formation of potassium hydrate and calcium carbonate; $K_2CO_3 + CaH_2O_2$ yields $2KHO + CaCO_3$. This reaction cannot be completed in concentrated solutions, but occurs promptly in dilute solutions. The smallest quantity necessary for 1 part of potassium carbonate, according to Watson, is 8 parts of water; Mohr, however, prefers to use not less than 12 parts, and to concentrate the caustic liquor if necessary with sufficient water. The decomposition may be effected in the cold by frequent agitation, but the resulting calcium carbonate is then light and retains much of the liquor, while at the same time silica, if present in the carbonate, is not completely removed. The British Pharmacopœia uses potassium carbonate and water in the proportion of 1 to 10; the United States Pharmacopœia nearly in the proportion of 1 to 11, having substituted the much purer bicarbonate for the carbonate. Should the materials be chemically pure, one part of slaked lime would be sufficient to decompose a fraction over two parts of potassium carbonate, and nearly the same proportion would be required for burned lime and potassium bicarbonate if in boiling the solution of the latter carbonic acid was not given off. It will thus be seen that both Pharmacopœias direct the employment of an unnecessarily large quantity of lime. This excess may be avoided by following the directions of the British Pharmacopœia, to add the milk of lime gradually in small portions to the boiling alkaline liquid; when this addition amounts to a quantity of lime equal to about one-half the weight of the potassium salt, a small portion of the boiling mixture is poured upon a small moistened filter, and the filtrate collected in a test-tube containing a little hydrochloric acid. Should effervescence occur, the boiling must be continued, and more lime added, until on testing as before, a new filter being used each time, no effervescence is observed. The removal of the caustic liquor may be effected either by filtering it at once through muslin, or, better still, we think, by allowing the insoluble matter to subside, drawing off the clear liquor by means of a siphon, and transferring the sediment before it has become hard upon a muslin strainer, and washing the potassa out by means of distilled water. In all cases the liquid should be brought to the proper density by the addition of water, or, if necessary, by evaporation. A well-cleaned iron vessel is best adapted for the above operation.

Other methods for obtaining potassa solution adapted for special purposes have been recommended. Schubert decomposed potassium sulphate accurately by a hot solution of baryta. Hunter (1866) arrived at the same result by substituting lime for the baryta, and by boiling and filtering under a pressure of about 40 pounds to the square inch. F. Schulze (1861) heated a mixture of 1 part of pure potassium nitrate with 3 parts of ferrous oxalate to dull redness while hydrogen gas was being conducted to the bottom of the crucible. Wöhler's process (1853), to heat a mixture of 1 part of potassium nitrate and 2 of copper to dull redness, is apt to yield a product containing potassium nitrite if the mixture has not been intimate, or if the heat is not continued long enough; Polacci (1872) found the solution in water to contain a little copper.

Properties.—Potassa solution is a clear and colorless liquid of the specific gravity stated above, and has a strong alkaline reaction and a very caustic taste. The slight peculiar odor which it usually has is due to its action upon organic bodies which may have been derived from the atmosphere. It dissolves wool, skin, and other animal and many vegetable substances, and decomposes fats, forming therewith soluble soaps. It attracts carbonic acid from the air with great avidity, and must therefore be preserved in well-stopped bottles. Green glass, free from lead, is best adapted for the purpose, but is likewise somewhat decomposed by alkalies, which cause the stopper to become firmly fastened into the bottle, unless protected by a thin layer of paraffin. Potassa solution decomposes the salts of ammonium, of the metals, and of all the alkaloids, and induces the decomposition of tannin and its derivatives.

Tests.—The solution should not effervesce, or but slightly so, when added to an excess of dilute muriatic acid. When acidulated with nitric acid, it may give a slight turbidity with barium nitrate (*sulphate*), silver nitrate (*chloride*), or sodium carbonate (*alumina*); and when the acidulated solution is evaporated to dryness the residue should form a clear or merely a slightly turbid (from presence of *silica*) solution in water, which should not be disturbed by ammonia and magnesium chloride (absence of phosphate). It is not precipitated or colored black by hydrogen sulphide, either before or after being acidulated (absence of *metals*). It differs from soda solution in yielding a white crystalline precipitate with an excess of concentrated solution of tartaric acid, and a yellow one on the addition of hydrochloric acid and platinic chloride. The British Pharmacopœia demands that 462.9 grains (1 fluidounce imperial) should require for neutralization 482 grain-measures of the volumetric solution of oxalic acid, which corresponds to 5.84 per cent. by weight of potassium hydrate, or 27 grains in one fluidounce. The solution of the United States Pharmacopœia is likewise stated to contain 5.8 per cent. of the hydrate; but the solution is denser than that of the British. The following table, computed by Gerlach (1869), gives the specific gravity of potassa solution at 15° C. (59° F.), containing from 1 to 60 per cent. of potassium oxide, and the same percentages of potassium hydrate:—

Per-centage.	K_2O	KHO	Per-centage.	K_2O	KHO	Per-centage.	K_2O	KHO
1	1.010	1.009	21	1.230	1.188	41	1.522	1.425
2	1.020	1.017	22	1.242	1.198	42	1.539	1.438
3	1.030	1.025	23	1.256	1.209	43	1.554	1.450
4	1.039	1.033	24	1.270	1.220	44	1.570	1.462
5	1.048	1.041	25	1.285	1.230	45	1.584	1.474
6	1.058	1.049	26	1.300	1.241	46	1.600	1.488
7	1.068	1.058	27	1.312	1.252	47	1.615	1.499
8	1.078	1.065	28	1.326	1.264	48	1.630	1.511
9	1.089	1.074	29	1.340	1.276	49	1.645	1.527
10	1.099	1.083	30	1.355	1.288	50	1.660	1.539
11	1.110	1.092	31	1.370	1.300	51	1.676	1.552
12	1.121	1.101	32	1.385	1.311	52	1.690	1.565
13	1.132	1.111	33	1.402	1.324	53	1.705	1.578
14	1.143	1.119	34	1.418	1.336	54	1.720	1.590
15	1.154	1.128	35	1.431	1.349	55	1.733	1.604
16	1.166	1.137	36	1.445	1.361	56	1.746	1.618
17	1.178	1.146	37	1.460	1.374	57	1.762	1.630
18	1.190	1.155	38	1.475	1.387	58	1.780	1.641
19	1.202	1.166	39	1.490	1.400	59	1.795	1.655
20	1.215	1.177	40	1.504	1.411	60	1.810	1.667

Pharmaceutical Uses.—By evaporating the solution it yields Potassa (Potassa caustica), *U. S.*, *Br.* It is employed in the officinal processes for the following: Antim. sulphurat., Argenti oxidum, Atropia, Hydrarg. oxidi flavum, *U. S.;* Potassii bromidum, Potassii iodidum, *Br.*

Physiological Action.—Solution of potassa possesses in a degree the caustic properties of the pure alkali, since it contains nearly six per cent. of the latter. The soapy feel which it gives to the fingers is due to its combination with the unctuous secretion of the skin. In medicinal doses, and taken during or after a meal, it speedily combines with the acids then abundantly secreted by the stomach; but, if properly diluted, and used when the stomach is empty, it is absorbed and tends to neutralize the acid secretions, especially the urine along with which it is chiefly eliminated. Used habitually, it lessens the coagulability of the blood and dissolves out the hematin from the red corpuscles, giving rise to paleness and puffiness of the skin, passive hemorrhages, general emaciation, and, in a word, to the ordinary phenomena of scurvy. This aplastic operation explains its efficacy in moderating a tendency to plastic exudations, in promoting the absorption of those already existing, and in modifying nutrition generally.

Medical Uses.—Solution of potassa limits or suspends the formation of *acid urinary deposits* and *concretions*, by neutralizing the free acids with which they are formed, while it spares the urinary passages from the irritation of their contact. But, since these acids always proceed from some defect of primary assimilation, the mere neutralization of them when formed does not necessarily effect a radical cure, which must be sought in the use of remedies tending to bring the digestive powers and the work of digestion into due proportion and harmony. For this purpose, dietetic and hygienic measures are the most efficient. The *gastric symptoms*, which call for solution of potassa and other antacid medicines, are heartburn, sour eructations, aphthæ, œsophageal spasm, vomiting, cramp in the stomach, colic, and irregular diarrhœa. It is probable that such medicines, by correcting acidity, tend to promote the due digestion of food, and thereby indirectly to remove the debility of the system upon which *acid dyspepsia* depends. Certain it is that in cases of "uric acid diathesis," as it has been called, the alkaline treatment duly carried out will sometimes suspend the faulty secretion for an indefinite period. It is true that this result is more usual after the liberal use of diuretic mineral waters, which probably cleanse the urinary channels of accumulated deposits, than by the use of solution of potassa, or of any other alkali alone. The *tympanites* incident to this form of dyspepsia is best palliated by the medicine when it is given in a bitter infusion. *Strangury* from cantharides is said to be both prevented and relieved by twenty minims of solution of potassa largely diluted. In *acne* of the face (gutta rosacea) the internal use of the medicine is sometimes very efficient, and it has been equally recommended for the prevention and cure of *boils* in cases where they occur in successive crops. *Scrofulous glandular swellings* are doubtless diminished during a course of this medicine, but its debilitating effects upon the system should at the same time be counteracted by appropriate food and cod-liver oil. It is injurious in *phthisis*, but, on the other hand, useful in *chronic bronchitis*, especially when associated with emphysema, and when expectoration is difficult and the sputa are scanty and tenacious. The mode of action implied in some of the preceding statements receives a further support by solution of potassa having been used successfully to moderate *obesity*. The hypothesis invoked to explain its action is that "it increases the vital powers of metamorphosis, by saponifying in part the fat contained in the blood and enabling it to be burnt off as carbonic acid." We should incline to the opinion that it acts by slowly poisoning the victim, radically disorganizing his blood, and hindering his nutrition. For the purpose intended it has been given in the dose of one or two fluidrachms three times a day, a dose which probably no stomach could long receive with impunity. Experiments and observations in India furnish some reason for thinking that solution of potassa is an antidote to *serpents' bites*. They are not, however, conclusive. The power of this solution to dissolve organic products has been used to soften the nail in cases of *ingrown nail*, and gradually to permit its removal, leaving the fungous granulations free from its irritation. It has been recommended to add solution of potassa to the lime-water used for atomized inhalation in *diphtheritic* affections of the throat and larynx, in the proportion of about ten or fifteen drops to five or six ounces of lime-water diluted one-half with pure water.

Solution of potassa may be administered internally in the *dose* of from ten minims to a fluidrachm largely diluted by a mucilaginous or sweetened aromatic infusion. It should not be prescribed along with henbane, belladonna, or stramonium, whose medicinal properties it destroys.

LIQUOR POTASSÆ EFFERVESCENS, *Br.*—
EFFERVESCING SOLUTION OF POTASH.

Aqua potassæ effervescens.—*Potash water*, E.; *Eau alcaline gazeuse*, Fr.; *Alkalisches Mineralwasser*, G.

Preparation.—Take of Bicarbonate of Potash thirty grains; Water one pint (imperial). Dissolve the bicarbonate of potash in the water and filter the solution; then pass into it as much pure washed carbonic acid gas, obtained by the action of sulphuric acid on chalk, as can be introduced with a pressure of seven atmospheres. Keep the solution in bottles securely closed, to prevent the escape of the compressed gas. *Br.*

Properties and Tests.—The solution effervesces strongly when the containing vessel is opened, carbonic acid gas escaping; it is clear and sparkling, and has an agreeable acidulous taste. Ten fluidounces, after being boiled for five minutes, require for neutralization 150 grain-measures of the volumetric solution of oxalic acid. Five fluidounces, evaporated to one-fifth, and 12 grains of tartaric acid added, yield a crystalline precipitate, which, when dried, weighs not less than 12 grains.

Medical Uses.—The remarks made under Liquor magnesiæ carbonatis are quite as applicable to this preparation. Solution of potassa is usually given in a bitter infusion; but if, for any reason, that vehicle is objectionable, it can very well be administered in carbonic acid water. The cases are, however, rare in which potassa is preferable to the bicarbonate of sodium.

LIQUOR POTASSII ARSENITIS, *U. S.*—SOLUTION OF ARSENITE OF POTASSIUM.

Liquor arsenicalis, Br.; *Liquor kali arsenicosi*, P. G.; *Solutio arsenicalis Fowleri, kali arsenicosum solutum.—Arsenical solution, Fowler's solution*, E.; *Liqueur (solution) arsenicale de Fowler*, Fr.; *Fowler'sche Tropfen*, G.

The officinal solutions contain 1 part of arsenious acid in 90 parts, P. G.; 100, F. P.; 111, Br. P.; 116, U. S. P., parts by weight.

Preparation.—Take of Arsenious Acid in small pieces, Bicarbonate of Potassium, each sixty-four grains; Compound Spirit of Lavender half a fluidounce; Distilled Water a sufficient quantity. Boil the arsenious acid and bicarbonate of potassium in a glass vessel, with half a fluidounce of distilled water, until the acid is entirely dissolved, and add twelve fluidounces of distilled water. Then add the compound spirit of lavender, and afterwards enough distilled water to make it measure a pint. *U. S.*

Take of Arsenious Acid in powder, Carbonate of Potash, each eighty grains; Compound Tincture of Lavender five fluidrachms; Distilled Water a sufficiency. Place the arsenious acid and the carbonate of potash in a flask with ten ounces of the water, and apply heat until a clear solution is obtained. Allow this to cool. Then add the compound tincture of lavender, and as much distilled water as will make the bulk one pint (imperial). *Br.*

The United States Pharmacopœia very properly directs the mixture of potassium salt and arsenious acid to be boiled in a small quantity of water, whereby a combination and solution is readily effected, the liquid containing potassium arsenite, which is probably HK_2AsO_3. When this is subsequently diluted with water and remains in contact with the air, it absorbs carbonic acid again, and the solution will then be identical with that of the British Pharmacopœia, which must be regarded merely as a solution of arsenious acid in the alkaline carbonate, from which a portion crystallizes again when the solution is long kept. On keeping 100 grams for three years, Ménière (1876) collected 0.15 gram, or 15 per cent. of the amount originally dissolved. The precise circumstances under which this separation takes place have not been ascertained; but the separation is undoubtedly due to the gradual conversion of the arsenious acid into the crystalline modification, which is but sparingly soluble. It is evident, however, that Fowler's solution cannot be kept unchanged for an indefinite period, and it is advisable that it be prepared in no larger quantities than will be sufficient for a few months or a year.

Properties and Tests.—Fowler's solution is a reddish liquid, at first somewhat opalescent, having an alkaline reaction to test-paper, and the odor of lavender. Its specific gravity is 1.009. It gives the usual reactions of arsenic, and requires to be acidulated with muriatic acid before it will be precipitated by hydrogen sulphide. The amount of arsenious acid contained in it is conveniently ascertained with iodine, with starch paste as an indicator, which is not permanently colored blue until the arsenious has all been oxidized to arsenic acid, hydriodic acid being formed at the same time; $As_2O_3 + 5H_2O + 2I_2$ yields $2H_3AsO_4 + 4HI$. The British Pharmacopœia gives the following test: a fluidounce (441.5 grains) of the solution is boiled for five minutes with ten grains of sodium bicarbonate, and then diluted with six fluidounces of distilled water containing a little starch paste; 808 grain-measures of the volumetric solution of iodine should be necessary for the reaction, and will indicate 4 grains of arsenious acid.

Medical Uses.—The action and uses of this medicine have been sufficiently discussed elsewhere (see Acidum arseniosum). It is sufficient in this place to state that its efficacy is most conspicuous in *squamous diseases of the skin*, *intermittent fever*, *neuralgia*, especially of the trifacial, and in *nervous asthma*. The commencing *dose* should not exceed five drops, nor should it be given when the stomach is empty, nor unless greatly diluted.

LIQUOR POTASSII CITRATIS, *U. S.*—SOLUTION OF CITRATE OF POTASSIUM.

Liquor kali citrici.—*Citrate de potasse liquide*, Fr.; *Flüssiges Citronensaures Kali*, G.

Preparation.—Take of Citric Acid half a troyounce; Bicarbonate of Potassium three hundred and thirty grains; Water half a pint. Dissolve the acid and bicarbonate in the water, and strain the solution through muslin. *U. S.*

This is a solution of potassium citrate containing a little free carbonic acid, and differs from mistura potassii citratis in the absence of the yellowish color and the agreeable lemon flavor. Instead of straining the finished solution to remove particles of foreign matter, it is preferable to dissolve the chemicals separately in one-half the water, strain or filter if necessary, and mix the clear solutions; a larger quantity of carbonic acid gas will thus be retained in the liquid.

Medical Action and Uses.—This preparation is nearly identical in its action with Mistura potassii citratis, *U. S. P.*, and Liq. potassii effervescens, *Br. Ph.*, and with the effervescing draught prepared extemporaneously. When the intention is solely to affect the system after absorption of the salt, either of the first two will lessen the tension of the arterial system, and promote *diaphoresis*; but when it is intended at the same time to make an impression upon the stomach itself, the carbonic acid extricated during effervescence becomes an important part of the dose. The primary action of the gas is to stimulate organically, while it perhaps anæsthetizes, the gastric mucous membrane, as may be inferred from the many cases of gastric hyperæmia and irritation in which it allays *nausea* and *vomiting*. It may therefore be sometimes used with advantage when the stomach is disordered, although fever may be absent. Either solution may have its diaphoretic power increased by the addition of spirit of nitrous ether, of solution of morphia, or of antimonial wine or tartar emetic in very small, non-nauseating doses.

The *dose* of neutral mixture is a tablespoonful; of the effervescing mixture a tablespoonful of each of the two solutions should be mixed, and swallowed while effervescing. The dose should be repeated every hour until the object in view is attained or defeated.

LIQUOR POTASSII PERMANGANATIS, *U. S.*—SOLUTION OF PERMANGANATE OF POTASSIUM.

Liquor potassæ permanganatis, Br.—*Soluté de permanganate de potasse*, Fr.; *Flüssiges übermangansaures Kali*, G.

Preparation.—Take of Permanganate of Potassium sixty-four grains; Distilled Water a pint. Dissolve the permanganate of potassium in the distilled water. *U. S.*

Take of Permanganate of Potash eighty grains; Distilled Water one pint (imperial). Dissolve. *Br.*

Both solutions contain four grains of the permanganate in the fluidounce, and have the purple color and the chemical behavior of the salt.

Medical Uses.—The officinal solution, of four grains of the salt to an ounce of distilled water, appears unnecessary, since it is too weak for many purposes, and too strong for others. For its uses and doses, see Potassii permanganas.

LIQUOR SODÆ, *U. S.*, *Br.*—SOLUTION OF SODA.

Liquor natri caustici, P. G.; *Natrum hydricum solutum.*—*Soude caustique liquide*, Fr.; *Aetznatronlauge*, G.

Specific gravity of the officinal solutions: 1.071, U. S.; 1.047, Br.; 1.330 to 1.334, P. G., F. P.

A solution of $HNaO$ in water.

Preparation.—Take of Carbonate of Sodium twenty-six troyounces; Lime eight troyounces; Distilled Water a sufficient quantity. Dissolve the carbonate of sodium in three pints and a half of distilled water, and heat the solution to the boiling point. Mix the lime with three pints of distilled water, and, having heated the mixture to the boiling point, add it to the hot solution of the carbonate, and boil for ten minutes. Then transfer the whole to a muslin strainer, and, when the liquid portion has passed, add enough distilled water, through the strainer, to make the strained liquid measure six pints. Lastly, keep the liquid in well-stopped bottles of green glass.

Solution of soda has the specific gravity 1.071, and contains five and seven-tenths per cent. of hydrate of sodium. *U. S.*

Take of Carbonate of Soda twenty-eight ounces; Slaked Lime twelve ounces; Distilled Water one gallon. Dissolve the carbonate of soda in the water; and, having heated the solution to the boiling point in a clean iron vessel, gradually mix with it the slaked lime, and continue the ebullition for ten minutes with constant stirring. Then remove the vessel from the fire; and, when by the subsidence of the insoluble matter the supernatant liquor has become perfectly clear, transfer it by means of a siphon to a green-glass bottle furnished with an air-tight stopper, and add distilled water, if necessary, to make it correspond with the tests of specific gravity and neutralizing power. *Br.*

Properties.—What has been stated with regard to the preparation and the properties of potassa solution applies equally well to the solution of soda. The latter does not yield a precipitate with platinic chloride, and with excess of tartaric acid only in concentrated solution. 458 grains by weight (1 fluidounce) of solution of the British Pharmacopœia require for neutralization 470 grain-measures of the volumetric solution of oxalic acid, corresponding to 18.8 grains (4.1 per cent. by weight) of sodium hydrate.

The following table by Gerlach (1869) gives the specific gravity at 15° C. (59° F.) of soda solution containing from 1 to 60 per cent. of sodium oxide and the same percentage of sodium hydrate:—

Percentage.	Na_2O	NaHO	Percentage.	Na_2O	NaHO	Percentage.	Na_2O	NaHO
1	1.015	1.012	21	1.300	1.236	41	1.570	1.447
2	1.029	1.023	22	1.315	1.247	42	1.583	1.456
3	1.043	1.035	23	1.329	1.258	43	1.597	1.468
4	1.058	1.046	24	1.341	1.269	44	1.610	1.478
5	1.074	1.059	25	1.355	1.279	45	1.623	1.488
6	1.089	1.070	26	1.369	1.290	46	1.637	1.499
7	1.104	1.081	27	1.381	1.300	47	1.650	1.508
8	1.119	1.092	28	1.395	1.310	48	1.663	1.519
9	1.132	1.103	29	1.410	1.321	49	1.678	1.529
10	1.145	1.115	30	1.422	1.332	50	1.690	1.540
11	1.160	1.126	31	1.438	1.343	51	1.705	1.550
12	1.175	1.137	32	1.450	1.351	52	1.719	1.560
13	1.190	1.148	33	1.462	1.363	53	1.730	1.570
14	1.203	1.159	34	1.475	1.374	54	1.745	1.580
15	1.219	1.170	35	1.480	1.384	55	1.760	1.591
16	1.233	1.181	36	1.500	1.395	56	1.770	1.601
17	1.245	1.191	37	1.515	1.405	57	1.785	1.611
18	1.258	1.202	38	1.530	1.415	58	1.800	1.622
19	1.270	1.213	39	1.543	1.420	59	1.815	1.633
20	1.285	1.225	40	1.558	1.437	60	1.830	1.643

Pharmaceutical Uses.—In preparing Antimon. sulphurat., Bismuthi oxid., *Br.;* Cinchon. sulph., *U. S.;* Ferri oxid. magnet., Ferri peroxid. humid., Hydrarg. oxidi flav., Quiniæ sulph., *Br.;* Soda (Soda caust.), *U. S.*, *Br.;* Sodæ valerianas, *Br.*

Medical Uses.—This preparation is seldom used therapeutically, and chiefly in cases of "torpor of the liver." *Dose*, ten to sixty drops largely diluted.

LIQUOR SODÆ ARSENIATIS. See SODII ARSENIATIS.

LIQUOR SODÆ CHLORINATÆ, *U. S.*—SOLUTION OF CHLORINATED SODA.

Liquor sodæ chloratæ, Br.; *Liquor natri chlorati*, P. G.; *Liquor natri hypochlorosi.—Labarraque's solution*, E.; *Chlorure de soude liquide, Liqueur de Labarraque*, Fr.; *Chlornatronlösung, Bleichflüssigkeit*, G.

A solution of $NaCl.NaClO$ in water.

Preparation.—Take of Chlorinated Lime twelve troyounces; Carbonate of Sodium twenty-four troyounces; Water twelve pints. Dissolve the carbonate of sodium in three pints of the water, with the aid of heat. Triturate the chlorinated lime, a little at a time, with small portions of the water, gradually added, until a smooth, uniform mixture is obtained. Mix this intimately with the remainder of the water, and set the mixture aside for twenty-four hours. Then decant the clear liquid, and, having transferred the residue to a muslin strainer, allow it to drain until enough liquid has passed to make, with the decanted liquid, eight pints. Mix this thoroughly with the solution of carbonate of sodium, transfer the mixture to a muslin strainer, and allow it to drain; adding water, if necessary, towards the close, until eleven pints and a half of liquid have passed. Lastly, keep the liquid in well-stopped bottles, protected from the light. *U. S.*

Take of Carbonate of Soda twelve ounces; Black Oxide of Manganese four ounces; Hydrochloric Acid fifteen fluidounces; Distilled Water two pints. Dissolve the carbonate of soda in thirty-six fluidounces of the distilled water, and put the solution into a glass vessel. Mix the oxide of manganese and hydrochloric acid in a glass flask with a bent tube attached by means of a cork to its mouth, apply a gentle heat, and with a suitable arrangement of apparatus cause the gas which is evolved to pass first through a wash-bottle containing four ounces of water and then into the solution of carbonate of soda, regulating the heat so that the gas shall be slowly but constantly introduced. When the disengagement of chlorine has ceased, transfer the solution in which it has been absorbed to a stoppered bottle, and keep it in a cool and dark place. *Br.*

The process of the U. S. Pharmacopœia yields the chlorinated soda by double decomposition of chlorinated lime with sodium carbonate, whereby calcium carbonate is precipitated, the chlorinated soda remaining in solution together with the sodium chloride resulting from the decomposition of the chloride of calcium present in the lime compound. No heat being employed after mixing the solutions, the calcium carbonate separates in a very light condition, and retains much of the liquid. The processes of the French and German Pharmacopœias are based upon the same reaction, but the strength of the resulting solution must vary very considerably, 1 part of chlorinated lime being used for a total quantity of water amounting to 7.5 parts, German Pharmacopœia, 16 parts (nearly), U. S. Pharmacopœia, and 45 parts, French Codex.

By the British Pharmacopœia chlorine gas is directed to be passed into the dissolved sodium carbonate, whereby one-half of the salt is acted upon, resulting in the production of chloride and hypochlorite of sodium, and the liberation of carbonic acid which unites with the other half of the salt to bicarbonate of sodium; $2Na_2CO_3 + Cl_2 + H_2O$ yields $NaCl.NaClO + 2NaHCO_3$. If the action of chlorine is continued, the hypochlorite of sodium is decomposed, chloride of sodium and hypochlorous anhydrid being formed; $NaClO + Cl_2$ yields $NaCl + Cl_2O$. This last-mentioned compound, which has a yellowish color, seems to decompose the bicarbonate with difficulty, so that if an excess of chlorine has been used, the solution will contain chloride of sodium, bicarbonate of sodium, and free hypochlorous anhydrid.

Properties and Tests.—The solution is clear and colorless, not greenish-yellow as described by the U. S. Pharmacopœia, a yellowish color being imparted only when the process of the British Pharmacopœia has been followed and an excess of chlorine has been used. It has a feeble odor of chlorine, and a saline, somewhat styptic and sharp taste, and bleaches vegetable colors like chlorine, but less energetically. On the addition of hydrochloric acid effervescence takes place, the gas consisting of carbonic acid and chlorine, the latter resulting from the mutual reaction of the hydrochloric and hypochlorous acids, thus: $NaCl.NaClO + 2HCl = 2NaCl + HCl + HClO$, and $HCl + HClO = Cl_2 + H_2O$. It is upon the amount of this *available chlorine* that the value of this preparation depends; and the British Pharmacopœia determines it by adding 70 grains of the solution to a solution of 20 grains of potassium iodide in 4 fluidounces of water, and acidulated with 2 fluidrachms of hydrochloric acid. The chlorine set free liberates an equivalent quantity of iodine, which imparts to the solution a brown color, to discharge which 500 grain-measures of the volumetric solution of hyposulphite of sodium should be required.

A preparation analogous to the preceding in composition and identical in bleaching effects, is *Liquor potassæ chlorinatæ*, *Chlorinated potassa solution*, which is perhaps better known by its French designation *Eau de javelle.* It is obtained by substituting equivalent quantities of potassium carbonate for the sodium carbonate ordered in the above processes.

Physiological Action.—In animals it produces violent gastro-intestinal irritation, spasms, and death. In man the same symptoms occur from poisonous doses, together with the phenomena of collapse. In medicinal doses it appears to increase the perspiration and urine, to repress mucous profluvia, and lessen glandular enlargements. It also tends to prevent or suspend gangrenous ulceration.

Medical Uses.—Under the impression that its antiseptic qualities fitted it to counteract morbid processes which were theoretically supposed to depend upon putridity, it has been largely employed in *typhoid* fever and typhoid diseases generally, but without obvious advantage. But as a topical application to *gangrenous sores*, and to other *unhealthy ulcers*, such as affect the mouth in *mercurialization*, in *diphtheria*, *scarlatina*, and *scurvy*, the nostrils in *ozæna*, the *uterus*, the *vagina*, and the *auditory canal*, it corrects the offensive odor of the secretions, and stimulates the parts to separate dead tissue and to assume a healthy action. For *simple ulcers* of an indolent aspect, especially such as result from *burns*, or which affect the *nipples* and the *genital organs* of females, this liquid generally acts as a wholesome stimulant.

It may be given internally in *doses* varying from thirty to sixty drops in water or some mild liquid, and repeated every two or three hours. As a gargle it should be diluted with *eight or ten* parts of water, and used of the same strength as an injection into the vagina, uterus, or bladder, and as a lotion for burns, excoriations, and cutaneous eruptions.

LIQUOR SODÆ EFFERVESCENS, *Br.*—EFFERVESCING SOLUTION OF SODA.

Aqua sodæ effervescens, *Aqua alcalina effervescens.*—*Soda water*, E.; *Eau alcaline gazeuse*, Fr.; *Sodawasser*, G.

Preparation.—Take of Bicarbonate of Soda thirty grains; Water one pint. Dissolve the bicarbonate of soda in the water, and filter the solution; then pass into it as much pure washed carbonic acid gas, obtained by the action of sulphuric acid on chalk, as can be introduced with a pressure of seven atmospheres. Keep the solution in bottles securely closed, to prevent the escape of the compressed gas. *Br.*

This corresponds to the effervescing solution of potash (see page 847), and has the same physical properties. Ten fluidounces, after being boiled for five minutes, require for neutralization 178 grain-measures of the volumetric solution of oxalic acid. *Br.*

The corresponding solution of the French Codex is made by dissolving 3.12 grams (48 grains) of bicarbonate of sodium, 0.23 grm. (3½ grains) bicarbonate of potassium, 0.35 grm. (5½ grains) sulphate of magnesium, and 0.08 grm. (1¼ grains) of chloride of sodium in 650 grms. (21 troyounces) of water, and impregnating the solution with carbonic acid gas.

Medical Uses.—This preparation appears to be superfluous. The quantity of bicarbonate of sodium required in any particular case can be administered in carbonated water.

LIQUOR SODII ARSENIATIS, *U. S.*—SOLUTION OF ARSENIATE OF SODIUM.

Liquor sodæ arseniatis, Br.—*Solution of arseniate of soda*, E.; *Liqueur (Soluté) d'arseniate de soude*, Fr.; *Arsensaure Natronlösung*, G.

Preparation.—Take of Arseniate of Sodium rendered anhydrous by a heat not exceeding 300° F. sixty-four grains; Distilled Water a pint. Dissolve the arseniate of sodium in the water. *U. S.*

Take of Arseniate of Soda (rendered anhydrous by a heat not exceeding 300° F.) four grains; Distilled Water one fluidounce. Dissolve. *Br.*

The *Liqueur arsenical de Pearson* of the French Codex is made by dissolving one part of crystallized arseniate of sodium in 600 parts of distilled water, and is, therefore, only about one-tenth the strength of the above, which contain one part of the exsiccated salt in 114 *U. S.* and 110 *Br.* parts.

The solutions are colorless, and give the reactions of arseniate of sodium, which see.

Medical Uses.—This preparation does not appear to possess any demonstrable advantages over the solution of arsenite of potassium. It may be employed in similar *doses*, or from three to five drops, largely diluted, and after meals.

LIQUOR STRYCHNIÆ, *Br.*—SOLUTION OF STRYCHNIA.

Soluté de strychnine, Fr.; *Strychninlösung*, G.

Preparation.—Take of Strychnia in crystals four grains; Diluted Hydrochloric Acid six minims; Rectified Spirit two fluidrachms; Distilled Water six fluidrachms. Mix the hydrochloric acid with four drachms of the water, and dissolve the strychnia in the mixture by the aid of heat. Then add the spirit and the remainder of the water. *Br.*

Medical Uses.—This solution, being stable, is convenient for medical prescription. The *dose* is from five to ten minims, *i. e.*, from one-twenty-fourth to one-twelfth of a grain of muriate of strychnia.

LIQUOR ZINCI CHLORIDI, *U. S.*, *Br.*—SOLUTION OF CHLORIDE OF ZINC.

Chlorure de zinc liquide, *Solution de Burnett*, Fr.; *Flüssiges Chlorzink*, G.

Preparation.—Take of Zinc in small pieces six troyounces; Nitric Acid, Precipitated Carbonate of Zinc, each one hundred and fifty grains; Muriatic Acid, Distilled Water, each a sufficient quantity. To the zinc, contained in a glass or porcelain vessel, add gradually enough muriatic acid to dissolve it; then strain the solution, add the nitric acid, and evaporate to dryness. Dissolve the dry mass in five fluidounces of distilled water, add the precipitated carbonate of zinc, and agitate the mixture occasionally during twenty-four hours; then filter through paper, adding enough distilled water, through the filter, to make the liquid measure a pint. *U. S.*

Take of Granulated Zinc one pound; Hydrochloric Acid forty-four fluidounces; Solution of Chlorine a sufficiency; Carbonate of Zinc half an ounce, or a sufficiency; Distilled Water one pint. Mix the hydrochloric acid and water in a porcelain dish, add the zinc, and apply a gentle heat to promote the action until gas is no longer evolved. Boil for half an hour, supplying the water lost by evaporation, and allow the product to cool. Filter it into a bottle, and add solution of chlorine by degrees, with frequent agitation, until the fluid acquires a permanent odor of chlorine. Add the carbonate of zinc, in small quantities at a time, and with renewed agitation, until a brown sediment appears. Filter the liquid into a porcelain basin, and evaporate until it is reduced to the bulk of two pints. *Br.*

Zinc dissolves in hydrochloric acid with the evolution of hydrogen gas, $Zn_2 + 4HCl$ yields $2ZnCl_2 + 2H_2$. The iron contained in the solution is first oxidized in the one case by nitric acid, and in the other by chlorine gas. To avoid contamination with nitrate, the former solution is evaporated to dryness, redissolved in water, and then treated with zinc carbonate, whereby ferric oxide is precipitated. The process of the British Pharmacopœia arrives at the same result in a similar manner, except that an evaporation of the liquid to dryness is not resorted to. 1 pound of zinc yields about 24½ ounces of zinc chloride, which are contained in 40 (imperial) fluidounces of the solution. The formula of the U. S. Pharmacopœia yields about 9¼ troyounces of zinc chloride, dissolved to make one apothecaries' pint. The two preparations are, therefore, practically identical.

Properties.—The solution is a colorless and inodorous liquid, which has the disagreeable metallic taste of zinc salts, and is miscible with alcohol and water. Its reactions and tests are those of *Zinci chloridum*, which see. Ch. Bullock (1868) determined the specific gravity of some solutions of this salt, marked *, and, by calculating the remainder, constructed the following table, giving the percentage of anhydrous zinc chloride. The specific gravities ascertained by Kremers (1858) differ somewhat from these results; but the figures given by R. Hoffmann (Tabellen, etc., 1877) are considerably larger for the solutions containing over 9 per cent. of $ZnCl_2$.

The French Codex directs the dissolving of 1 part of fused chloride of zinc in 2 parts of water, the solution to be of specific gravity 1.33. Sir Wm. Burnett's liquid contained 200 grains of zinc in the imperial fluidounce, and was stated to have the specific gravity 2.0; it contained about 50 per cent. of $ZnCl_2$.

Per ct.	Sp. grav.	Per ct.	Sp. grav.	Per ct.	Sp. grav.	Per ct.	Sp. grav.	Per ct.	Sp. grav.
1	*1.0090	9.1	*1.0779	30.3	*1.2388	50	1.3748	70	1.5133
2	*1.0186	10.1	*1.0860	33	1.2597	52	*1.3881	72.8	*1.5264
3	*1.0273	12.05	*1.1016	35	1.2736	55	1.4105	75	1.5448
4	*1.0361	15	1.1250	38	1.2945	58	1.4330	78	1.5632
5	*1.0448	20.2	*1.1640	40.4	*1.3085	60.6	*1.4480	80	1.5755
6	*1.0535	23	1.1864	43	1.3284	63	1.4676	83	1.593
7	*1.0611	25	1.2014	45	1.3416	65	1.4807	85	1.6062
7.9	*1.0686	28	1.2238	48	1.3615	68	1.5003	91	*1.6431

Medical Action and Uses.—Under the name of *Burnett's Disinfecting Fluid* a solution of chloride of zinc was extensively employed, and its utility probably suggested an officinal preparation for similar purposes. That solution has in numerous cases produced fatal mischief by being taken internally, occasioning all the phenomena belonging to a violent irritant poison, leaving in the mouth, œsophagus, and alimentary canal traces of its corrosive action, and giving the intestinal walls a leathery aspect and consistence. In some cases it is stated that the dead body showed no signs of putrefaction. The chief application of this solution is to deodorizing and disinfecting sinks, sewers, water-closets, dissecting-rooms, hospitals, etc. It has been made use of to preserve dead bodies by injecting it into the bloodvessels; but owing to its corrosive action upon steel, such bodies are not suitable for dissection. Largely diluted (gtt. x to gtt. xx in water f℥iv) it has been used as an injection for *gonorrhœa* in both sexes, and for *leucorrhœa;* also as a collyrium in *gonorrhœal*, and in *diphtheritic ophthalmia.* It should be employed, if at all, with extreme caution, the weakest solution being first applied to test the susceptibility of the parts.

LIRIODENDRON, *U. S.*—TULIP TREE BARK.

White poplar bark, E.; *Écorce de tulipier*, F.; *Tulpenbaumrinde*, G.

The bark of Liriodendron tulipifera, *Lin.* *Nat. Ord.*—Magnoliaceæ.

Origin.—The tulip tree or tulip poplar is a stately tree, 100 to 140 feet high, which is found in woodlands and rich soil throughout the United States from New England to Michigan and Illinois, and southward to the Gulf of Mexico. Its leaves are alternate, petiolate, broad, three-lobed, with the terminal lobe broadest, and emarginately truncate. The large flowers, which appear in May, are tulip-shaped, and have three sepals and six greenish-yellow, near the base orange-red petals. The fruit consists of flat, indehiscent, one- or two-seeded capsules with lance-oblong wings above, and cohering together in an elongated cone. The bark is collected from the branches, and also from the trunk.

Description.—The branch bark is in curved pieces or quills, which have a brown- or blackish-gray to purplish-brown outer surface, marked with numerous small warts, their shallow scars or confluent lines forming more or less regular, elongated meshes, which become longitudinally cleft in the older bark. The fissured, gray, corky layer is removed from the trunk bark, which then consists exclusively of liber, has a pale-yellowish color, and a smooth, very finely and closely striate inner surface. The dry bark breaks, when young, with a short, the older with a fibrous fracture, and shows, upon cross-section, broad wedges of medullary rays, and in the inner layers tangential rows of bast fibres. The similar root bark has a darker color. The slight odor of the fresh bark disappears almost completely on drying; the taste is somewhat pungently aromatic and bitter, combined with some astringency. When long kept the bark is said to become insipid; bark collected by us ten years ago, and kept in a dry place without special precaution, has still the characteristic taste in a marked degree.

Constituents.—The most important constituent appears to be the *liriodendrin* of Prof. Emmet (1831), which he obtained crystallized by concentrating the tincture made with strong alcohol, adding water until a permanent turbidity commences to appear, and evaporating spontaneously. It forms white needles or prisms and small scales, insoluble in water, soluble in alcohol and ether, fusible at about 82° C. (180° F.), and volatilizing partly undecomposed near 132° C. (270° F.). It is contained in the infusion of the bark, and precipitated from it by an alkali. A portion is always obtained in an amorphous condition, but has the same bitter and pungent taste as the crystallized. Wallace Procter (1872) did not succeed in obtaining it crystallized by treating the alcoholic extract with petroleum-benzin; it separated in transparent, yellowish globules of a persistently bitter and acrid taste.

Medical Uses.—Used popularly as a domestic tonic by the country people, it was first introduced into medicine, as a tonic, by Dr. Benjamin Rush, who ascribed to it only the virtues of a simple bitter. Like other bitters, it has had some repute as a vermifuge, and as an antiperiodic; and, in warm infusion, as a diuretic and sudorific. The *dose* of the powder is one or two drachms. An infusion or decoction may be prepared with an ounce of the bark in a pint of water, and given in the dose of two fluidounces. A saturated tincture may be prescribed in the dose of a fluidrachm.

LITHII BROMIDUM.—BROMIDE OF LITHIUM.

Bromure de lithium, Fr.; *Bromlithium*, G.
Formula LiBr. Molecular weight 87.

Preparation and Properties.—This salt is readily soluble in water and alcohol, 100 parts of the former liquid dissolving at 0° C. (32° F.) 143 parts, and at 34° C. (93.2° F.) 196 parts of the bromide. According to Yvon (1875), it may be prepared by dissolving lithium carbonate in hydrobromic acid and evaporating. Or 37 grams of the carbonate are converted into neutral sulphate, dissolved in a small portion of water, and mixed with a concentrated aqueous solution of 119 grams of potassium bromide. The mixture is well stirred, the liquid separated by filtration, evaporated to dryness, and treated with alcohol, which leaves potassium sulphate undissolved; the alcoholic solution is evaporated to dryness. Lithium bromide may be obtained in crystals by evaporating its syrupy solution over sulphuric acid. The anhydrous salt contains nearly 92 per cent. of bromine.

Medical Action and Uses.—In 1870 Dr. S. Weir Mitchell accidentally found that bromide of lithium seemed to cause a more rapid and intense sleepiness than the other bromides. He observed, moreover, that it was the most soluble salt of its class, that it contained a larger proportion of bromine than any other, and that, clinically, it excels them all as a hypnotic, and is efficient in smaller doses than the bromide as an anti-epileptic. In 1877 he declared of this salt that it had stood the test of his own experience as well as that of many French and German therapeutists, who had come to regard it as the most valuable of the bromides. According to Levy, its action, compared with that of potassium bromide, is as follows: It acts with greater force and rapidity upon the spinal cord and nerves; the anæsthesia it produces begins in the nerves and is propagated to the cord; in other words, it is a sedative of morbid excitement in the spinal cord. It does not appear to act upon the heart.

Bromide of lithium was used in the treatment of *epilepsy*, as already stated, and apparently with very remarkable advantages; but its efficiency was differently estimated by some other physicians, of whom Echeverria regarded it as inferior to the potassium bromide, and Sée prescribed it without any favorable results. It has been given in this disease in the *dose* of from five to ten grains three times a day, in a simple bitter infusion. But much larger doses may be prescribed. It has also been used in *gout* with no demonstrable advantage.

LITHII CARBONAS, *U. S.*—CARBONATE OF LITHIUM.

Lithiæ carbonas, Br.; *Lithium carbonicum*, P. G.; *Carbonas lithicus*.—*Carbonate of lithia*, E.; *Carbonate de lithine*, *Carbonate lithique*, Fr.; *Kohlensaures Lithion*, G.
Formula Li_2CO_3. Molecular weight 74.

Origin and Preparation.—Lithium is met with as phosphate in *montebrasite* and several other minerals, and as fluoride or silicate in *lepidolite*, *spodumene*, and others. It is found in minute quantities in the ashes of some plants, and in many mineral springs, often as carbonate; the waters of the Mur-spring at Baden-Baden, and of a hot spring at Wheel-Clifford, in Cornwall, are the richest known; the latter, according to W. A. Miller (1864), containing 26.05 grains LiCl in the imperial gallon. To prepare the carbonate lepidolite is heated with sulphuric acid, the aqueous solution treated with lime to separate metallic oxides and earths, and then precipitated by potassium carbonate, or neutralized with muriatic acid and evaporated. From the residue the chloride of lithium is dissolved by a mixture of alcohol and ether, and thus freed from the chlorides of rubidium, cæsium, sodium, and potassium, with which metals it is associated in the lepidolite. The concentrated aqueous solution of lithium chloride, treated with ammonium carbonate, yields a precipitate of lithium carbonate, which is washed with alcohol.

Properties.—Carbonate of lithium is a light white powder, or is in minute crystalline grains, fuses at a dull red heat with the evolution of some carbonic acid, and, after congealing, may be broken into pearly pieces. It is insoluble in alcohol, but dissolves in about 100 parts of water; the solution precipitates the salts of the heavy metals, and, on boiling, decomposes the ammonium salts. It dissolves with effervescence in dilute hydrochloric acid, and the solution evaporated to dryness leaves a residue of lithium chloride, which imparts a carmine color to the flame of a spirit lamp. The neutral solution of the chloride yields a white precipitate with phosphate of sodium.

Tests.—Magnesium and calcium salts are the principal impurities; salts of heavier metals are rarely present. The salt, dissolved in hydrochloric acid, should yield no precipitate with hydrogen sulphide either before or after neutralization with ammonia. The same solution yields no precipitate with sulphuric acid (*barium*), nor after neutralization with ammonium oxalate (*calcium*) or lime-water (magnesium). Ten grains of the salt, neutralized with sulphuric acid and heated to redness, leave 14.86 grains of dry sulphate of lithium (*Br.*). Alkaline impurities are detected, after being converted into chlorides, by their insolubility in a mixture of equal volumes of alcohol and ether, as stated above.

Off. Prep.—Liquor lithiæ effervescens, *Br.;* Lith. citras, *U. S.*, *Br.*

Chemical Action.—When a calculus composed of uric acid and oxalate of lime is suspended in a warm solution of carbonate of lithium it loses sensibly in weight; and when a portion of bone infiltrated with gouty concretions is placed in a solution of the salt, after two or three days the whole of the deposit disappears. In fact, the urate of lithium is the most soluble salt formed with uric acid. These facts have been adduced to explain the efficacy in chronic gout of numerous mineral springs in Europe, and of the Gettysburg Spring in Pennsylvania.

Medical Uses.—Opinions are by no means uniform in regard to the value of carbonate of lithium in removing *uric acid deposits* and *gouty concretions*. On the one hand, it is asserted that when patients are voiding uric acid gravel, it causes the deposit to diminish or to cease altogether; and that, in gout, it often diminishes the frequency of the attacks. At the same time, it is stated to be powerfully diuretic. On the other hand, some authorities confidently affirm that they have seen no benefit arise from its use. Others, again, declare that it is suitable only for the treatment of chronic gout, that the daily dose of it should be small, and that its good effects become apparent only after several weeks' use. On the whole, there appears to be no substantial ground for a belief in its alleged virtues in gout and calculous diseases.

Carbonate of lithium in solution is said to exhibit extraordinary powers in the solution of *false membrane*.

This medicine may be given in the *dose* of from one to three grains three times a day, dissolved in three or four ounces of hot water, or preferably in carbonated water.

LITHII CITRAS, *U. S.*—Citrate of Lithium.

Lithiæ citras, Br.; *Lithium citricum.*—*Citrate of lithia*, E.; *Citrate de lithine*, Fr.; *Citronensaures Lithion*, G.

Formula $Li_3C_6H_5O_7$. Molecular weight 210.

Preparation.—Take of Carbonate of Lithium one hundred grains; Citric Acid in crystals two hundred grains; Distilled Water two fluidounces. Dissolve the citric acid in the water gently heated, and to the solution gradually add the carbonate of lithium until perfectly dissolved, heating the solution so long as effervescence is produced. Evaporate, by means of a steam- or sand-bath, to a viscid consistence, dry the residue in an oven, at a temperature of about 240° F.; then rapidly pulverize it, and preserve the powder in a well-stopped bottle. *U. S.*

Take of Carbonate of Lithia fifty grains; Citric Acid in crystals ninety grains; Warm Distilled Water one fluidounce. Dissolve the citric acid in the water, and add the carbonate of lithia in successive portions, applying heat until effervescence ceases, and a perfect solution is obtained. Evaporate by a steam- or sand-bath till water ceases to escape, and the residue is converted into a viscid liquid. This should be dried in an oven or air-chamber at the temperature of about 240° F., then rapidly pulverized and inclosed in a stoppered bottle. *Br.*

Both formulas direct the acid and carbonate nearly in the proportion in which they combine, the first having a slight excess of citric acid, the second of lithium carbonate. Carbonic acid is given off, and the reaction may be thus represented: $3Li_2CO_3+2H_3C_6H_5O_7$ yields $2Li_3C_6H_5O_7+3CO_2+3H_2O$. The yield is equal to the weight of citric acid used.

Properties.—Lithium citrate is a white and amorphous powder, which dissolves in 25 parts of water, and may be obtained crystallized from a concentrated solution on standing. When heated, it blackens, gives off the odor of burning citric acid, inflammable gases are evolved, and finally a white residue is left, which, if neutralized with hydrochloric acid, is soluble in alcohol, and the solution, ignited, burns with a carmine-colored flame. 20 grains of the salt, when heated to low redness with free access of air, leave a residue weighing 10.6 grains. The salt is recognized as a citrate by mixing its aqueous solution with calcium chloride, filtering, and heating the clear liquid, when again a precipitate of calcium citrate will be deposited.

Tests.—Other acids beside citric are detected by their several tests. Basylous impurities are recognized by igniting some of the salt, dissolving the residue in hydrochloric acid, evaporating to dryness, redissolving in water, and testing as described in the preceding article.

Other Lithium Salt.—LITHII BENZOAS, *Benzoate of lithium*, has been recommended by Shuttleworth (1875). It is prepared by heating a mixture of 1 oz. of lithium carbonate and 9 ozs. of water, adding gradually $3\frac{1}{4}$ ozs. of benzoic acid, or as long as effervescence is produced, filtering and evaporating to dryness. The yield is nearly $3\frac{1}{2}$ ozs. The salt is soluble in $3\frac{1}{2}$ parts of cold and $2\frac{1}{2}$ parts of boiling water, and in 10 parts of cold alcohol specific gravity 0.838.

Medical Action.—Like the vegetable salts of sodium and potassium, the citrate of lithium is decomposed in the body, and excreted as a carbonate with the urine. Its operation is the same as that of the carbonate of lithium.

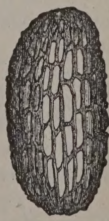
The scarcity and high price of lithium salts necessarily limit their use.

LOBELIA, *U. S.*, *Br.*—LOBELIA.

Herba lobeliæ, P. G.—*Indian tobacco*, E.; *Herbe de lobélie enflée*, Fr.; *Lobelienkraut*, G.

The leaves and tops of Lobelia inflata, *Lin.* Barton, Med. Bot., t. 16; Bentley and Trimen, Med. Plants, 162. *Nat. Ord.*—Lobeliaceæ.

Fig. 100.



Lobelia Seed, magnified.

Origin.—The inflated lobelia is an annual herb, native of the North American continent, growing in dry open fields and on the borders of woods, from the northern parts of Canada, southward throughout the United States to Georgia and Mississippi. It flowers from July to September, and should be collected when some of the capsules have ripened.

Description.—The herb grows from 12 to 20 inches high, has a branching stem, which is somewhat furrowed and beset with spreading hairs. The leaves are alternate, two to three inches long, ovate or oblong, irregularly toothed, pubescent, and pale green; the lower ones petiolate, the upper sessile and gradually reduced to bracts. The flowers are in long racemes, terminating the stem and branches. The calyx tube is adherent to the ovary, has the limb divided into five narrow teeth, and becomes inflated in fruit. The pale-blue corolla is somewhat two-lipped, and has the upper side of the tube split to the base. The five stamens are free from the corolla, and by the union of the filaments and anthers form a tube which incloses the single style. The fruit is a thin sub-globular capsule, which is two-celled, opens at the apex, and contains a large number of minute brown oblong seeds, the surface of which has, under the microscope, a reticulated appearance. It has an herbaceous, somewhat irritating odor, and an herbaceous, afterwards burning and acrid tobacco-like taste.

Constituents.—Lobelia owes its virtues, at least in part, to an alkaloid, *lobelina*, which was first recognized by Calhoun (1833), but isolated by Procter (1838). To obtain it, the tincture made with alcohol containing acetic acid is evaporated to a syrupy consistence, triturated with excess of magnesia, the filtrate agitated with ether, and the ethereal solution evaporated; the impure alkaloid requires purification by combining with an acid, treating with animal charcoal, and again decomposing with magnesia. W. D. Richardson (1872) obtained more alkaloid from the above mother liquor by precipitation with potassium iodo-hydrargyrate. *Lobelina* is a yellow, somewhat aromatic liquid, having an acrid taste; it is lighter than water, is soluble in alcohol, ether, and fixed oils, and less so in water. Its salts, except the acetate, are crystallizable, are freely soluble in water, scarcely so in ether, and not altered by a boiling temperature; whereas the alkaloid is thereby deprived of its acrid taste. Richardson found it even to be altered by simple exposure to air, whereby it became resinified and unable to combine with acids. Bastick (1850) considers it volatile, but to evaporate not entirely unchanged.

In 1871 Enders obtained the acrid principle *lobelacrin* by concentrating the tincture in the presence of charcoal, washing this with water, and exhausting with boiling alcohol (Pharmacographia). It forms warty tufts of a brown color, is soluble in ether and chloroform, slightly so in water, is decomposed by boiling with water, and yields sugar and *lobelic acid* under the influence of acids and alkalies. It is possible that the alkaloid, as heretofore obtained, has been more or less contaminated with this body.

The *lobelic acid* of Enders is probably identical with the compound of Pereira (1842) and Procter bearing the same name. Procter obtained it from the decoction of the leaves by precipitating it with sulphate of copper and decomposing with hydrogen sulphide. It is crystallizable, soluble in ether, and yields with ferric salts an olive-brown, with copper sulphate a light-green, and with lead acetate and baryta water a yellow precipitate. The barium compound of Enders's acid is soluble in water.

Reinsch (1848) obtained from the herb also waxy, resinous, fatty, and gummy matters, and Procter from the seeds about 30 per cent. of rapidly drying fixed oil.

Allied Species. LOBELIA SYPHILITICA, *Lin.*, *Great Lobelia.*—It is two to three feet high, has acute elliptic-oblong, irregularly serrate leaves, and showy blue flowers in the axils of the upper leaves, forming a terminal raceme; the calyx has a short hemispherical tube, five long acute lobes, and at their base conspicuous deflexed appendages. It is met with in low grounds in the United States.

LOBELIA CARDINALIS, *Lin.*, *Cardinal plant.*—It is common in marshy and low grounds throughout the greater portion of the United States, attains a height of two to three feet, is nearly smooth, has oblong lanceolate, acute, and slightly toothed leaves, and bears long racemes of large showy scarlet-red flowers on short pedicels in the axils of the leaf-like bracts.

Off. Prep.—Acet. lobeliæ, *U. S.;* Tinct. lobeliæ, *U. S.*, *Br.;* Tinct. lobeliæ æther., *Br.*

Physiological Action.—The effects produced by lobelia and its alkaloid upon animals are almost identical with those of tobacco and nicotia, but larger doses are required to develop them. It is ranked as a respiratory poison, and in the cat it greatly reduces the temperature.

The symptoms caused by lobelia in man are: nausea, salivation, malaise, præcordial distress, dyspnœa and dysphagia, burning and rawness in the fauces, eructation, vomiting, urination; general muscular relaxation, the pulse becoming small, irregular, and slow; and, when the dose has been very excessive, extreme prostration, anxiety, contracted pupils, insensibility, and occasionally death, preceded by convulsions. A large number of cases have been published of death from the maladministration of this drug by ignorant persons assuming to be practitioners of medicine.

Medical Uses.—The chief medicinal value of lobelia is in the treatment of *asthma*, whether the disease be purely spasmodic or associated with pulmonary emphysema, chronic bronchitis, heart disease, etc. It eliminates from the attack the bronchial spasm, which in the first-named affection constitutes the whole disease, and in the others a complication only. A fluidrachm of the tincture should be given every hour, or, if the symptoms are urgent, every half hour, until relief is obtained, or the characteristic effects of the medicine are produced. Its efficacy in the other diseases mentioned, as well as in *whooping cough*, will depend mainly upon the predominance of the nervous element in them; whenever the dyspnœa is due less to spasm than to inflammatory changes in the bronchia, or depends upon the presence in these tubes of secreted matters, lobelia displays no special virtues that entitle it to be preferred before numerous "expectorants." Thus, while it is of no more advantage in *inflammatory laryngitis* than various other nauseants and emetics, it is decidedly more efficacious in *spasmodic laryngitis* than most other remedies.

The *dose* of lobelia as an emetic is from ten to twenty grains; as an expectorant from one to five grains. The preparations most frequently employed are the tincture and the vinegar of lobelia, of either of which the dose as an expectorant is from ten to sixty minims. In asthmatic attacks one or two fluidrachms should be administered every half hour or hour, according to the urgency of the symptoms.

LOLIUM.—DARNEL.

Bearded darnel, E.; *Ivraie*, Fr.; *Lolch*, *Taumelkorn*, G.

The fruit (caryopsis) of Lolium temulentum, *Lin.*, s. L. arvense, *With.* Bentley and Trimen, Med. Plants, 295.

Nat. Ord.—Graminaceæ.

Origin.—The bearded darnel grows on waysides and in grain-fields in Western Asia and throughout Europe, and has been introduced to some extent in most grain growing countries; it is rare in the United States. It is an annual about 2½ feet high, with rather large leaves, and has an elongated inflorescence, the spikelets being nearly an inch long, about 7-flowered, somewhat compressed, alternate, sessile, appressed to the concave rachis, and about as long as the glumes.

Description.—The fruit is oblong-ovoid, nearly ¼ inch long, inclosed in the paleæ, grooved on the inner and convex on the outer surface, smooth, pale brown, internally white, inodorous, and of a farinaceous, afterwards bitterish, taste.

Constituents.—The chemical investigations undertaken for the purpose of isolating the poisonous principle have been recently (1875) reviewed by Wittstein. The deleterious properties of the plant, according to Ludwig and Stahl

(1864), appear to be due to an acrid fixed oil and to an amorphous yellowish glucoside. Bley (1834) and Muratori (1837) ascribed them to an acid body, and Baillet and Filhol (1863) to a non-saponifiable oily compound. The fruit contains the ordinary constituents of grain, among them from 30 to 50 per cent. of starch, the granules of which, according to Schwerdtfeger (1853), are about one-third the size of wheat starch, circular, with a moderately wide margin, and a bright, strongly translucent surface without marks.

LOLIUM PERENNE, *Lin.*, called *ray-* or *rye-grass*, is a pasture grass, has a perennial creeping rhizome, the glumes shorter than the spikelets, and awnless or short-awned flowers. It is not poisonous.

Medical Action and Uses.—A large number of persons have at different times been poisoned by bread made with flour containing lolium. Upon different animals it acts differently; it is poisonous to dogs, sheep, and horses, but not to hogs, cows, and ducks, and quails are said to be fond of the seeds as food. Its effects have been known from ancient times to be narcotic and anæsthetic. They comprise the following symptoms: headache, vertigo, disturbed and sometimes yellow vision, ringing in the ears, paresis of the tongue, oppression in breathing, anxiety, vomiting and sometimes purging, urination, general muscular trembling, cold sweating, and overpowering and deep sleep. In several cases the poisoning has proved fatal. There is reason to suspect that the old custom of using darnel to adulterate malt and distilled liquors is not wholly obsolete. The peculiar intoxication produced by some of these drinks strongly suggests such a fraudulent and wicked addition to them. Lolium has been mixed with poultices applied for the relief of local *pains*, pleuritic, neuralgic, and rheumatic; and, although it has been given internally, neither the grounds of its administration nor its alleged results are entitled to any confidence.

LOTIONES.—LOTIONS.

Washes, E.; *Lotions*, Fr.; *Waschungen*, G.

Lotions are liquid preparations, usually containing water as their principal vehicle, and are ordinarily applied by wetting lint or muslin with them, and keeping this upon the affected part.

LOTIO HYDRARGYRI FLAVA, *Br.*—YELLOW MERCURIAL LOTION.

Aqua phagedænica, P. G.—*Yellow wash*, E.; *Eau phagédénique*, *Eau divine de Fernel*, Fr.; *Phagedänisches Wasser*, *Altschadenwasser*, G.

Preparation.—Take of Perchloride of Mercury eighteen grains; Solution of Lime ten fluidounces. Mix. *Br.*

Mix 1 part of powdered corrosive sublimate with 300 parts of lime-water. *P. G.*

A double decomposition takes place, resulting in the formation of calcium chloride and finely divided yellow mercuric oxide. It should be well shaken when used.

Surgical Action and Uses.—This preparation is stimulant or even caustic. Its use is restricted almost exclusively to the treatment of indolent *chancres* and other *syphilitic ulcers*. It should be applied upon lint.

LOTIO HYDRARGYRI NIGRA, *Br.*—BLACK MERCURIAL LOTION.

Aqua phagedænica nigra, P. G.; *Aqua nigra, Aqua mercurialis nigra.—Black wash*, E.; *Eau phagédénique noir*, Fr.; *Schwarzes Wasser*, G.

Preparation.—Take of Subchloride of Mercury thirty grains; Solution of Lime ten fluidounces. Mix. *Br.*

Rub together 1 part of calomel and 60 parts of lime-water. *P. G.*

The chemical reaction between the two substances results in producing calcium chloride and black mercurous oxide. It must be well shaken when used.

Surgical Action and Uses.—The action of black wash appears to be mildly stimulant and astringent as well as protective. It may be applied on lint to *syphilitic* ulcers.

LUPULINA, *U. S.*—LUPULIN.

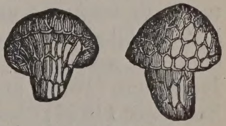
Glandulæ lupuli, P. G.; *Lupulinum.—Lupuline, Lupulite*, Fr.; *Hopfenmehl, Lupulin*, G.

The yellow glandular powder separated from the strobiles of Humulus lupulus, *Lin.*

Origin.—See Humulus, page 702. On handling dry hops the glandular powder becomes detached, and is freed from fragments of the bracts, etc., by sifting; about 10 per cent. of the weight of the hops may be obtained.

Description.—Lupulin when fresh is a brownish-yellow, afterwards yellowish-brown, granular resinous powder, which has the aromatic odor and bitter and aromatic taste of hops. Under the microscope it is seen to consist of two hemispheres, the lower and firmer of which is somewhat obtusely conical or top-shaped, the upper one rounded, the surface of both reticulate. In the dry state the lower one nearly retains its shape, but the more delicate upper part collapses, and forms a flattish hood. The glands contain a brown-yellow liquid which dries up to a resinous mass. Lupulin should be free from sand, which readily subsides from it when agitated with water.

Fig. 101.



Lupulin (fresh).

Constituents.—On distilling hops with water, Personne (1854) obtained *valerianic acid* and a *volatile oil* which boils between 140° and 300° C. (284° and 572° F.), is colorless and neutral, but becomes resinous and acid on exposure, and consists of a lighter portion, $C_{10}H_{16}$, and *valerol*, $C_6H_{10}O$, from which by gradual oxidation valerianic acid is formed. The residue from the distillation when treated with lime yields a distillate of *valeral*, $C_5H_{10}O$. The *resin* of lupulin was examined by Vlaanderen (1858), who found it tasteless, combining with metals, and becoming more hydrated in the course of purification. The principal constituent of lupulin is wax, which Lermer (1863) found to be *myricin* (myricylic palmitate). He also isolated the bitter principle, and called it *lupamaric acid* (Hopfenbittersäure). To prepare it, the ethereal extract of fresh hops is treated with 90 per cent. alcohol, which leaves the wax behind; the alcohol is evaporated, the residue dissolved in ether, and this solution agitated with strong potassa solution to remove resin; agitation with water now dissolves the potassium lupamarate, which is precipitated with copper sulphate, and the precipitate, decomposed by hydrogen sulphide, yields the acid in white crystals, becoming yellow on exposure, insoluble in water, but soluble in alcohol, ether, chloroform, carbon bisulphide, and oil of turpentine. Its composition is $C_{32}H_{50}O_7$.

Off. Prep.—Extract. lupulinæ fluid., Oleores. lupulinæ, Tinct. lupulinæ, *U. S.*

Medical Action and Uses.—The account given of the operation of hop (see Humulus) makes an extended discussion of lupulin unnecessary, since it is upon this product that the virtues of hop chiefly depend. In doses of from twenty to twenty-five grains, lupulin occasions a lively sense of warmth at the epigastrium, which afterwards extends to the whole abdomen. Constipation, with colicky pain, is apt to ensue, but the appetite and digestion appear to be invigorated. It is alleged that full doses of lupulin diminish the frequency of the pulse. It certainly tends to allay the susceptibility which is a frequent cause of an excited circulation. Probably in this manner, rather than by a direct action upon the brain, it favors sleep, and tends to repress that excitement which occasions *priapism* and *seminal emissions*, and *nocturnal incontinence of urine.* It has seemed to allay *irritability of the bladder* when opium was not tolerated. It may be prescribed in *doses* of from five to ten grains and upwards, mixed with jelly or syrup.

LYCIUM.—MATRIMONY VINE.

Lycium vulgare, *Dunal*, s. L. barbarum, *Lin.* *Nat. Ord.*—Solanaceæ.

Description.—This shrub is indigenous to the countries bordering on the Mediterranean, and is cultivated and wild in the United States. It is from 10 to 20 feet high, and has numerous, slender, recurved branches, which are covered with a smooth brownish-gray bark, and armed with few thorns. The leaves are one or two inches long, alternate, oblong-lanceolate, entire, smooth, shortly petiolate and often clustered. The greenish-purple flowers have a tubular five-lobed corolla, and produce oval red two-celled berries, containing many reniform seeds. The bark and leaves have a sweetish and slightly bitter and acrid taste.

Constituents.—An alkaloid, *lycina*, $C_5NH_{11}O_2$, has been isolated by Husemann and Marmé (1863), by precipitating the decoction with subacetate of lead, removing the lead by sulphuric acid, and precipitating the filtrate with phosphomolybdic acid; the precipitate is mixed with prepared chalk, the mixture dried, and the alkaloid dissolved by alcohol. It forms white prisms, which are deliquescent, sparingly soluble in ether, and has an acrid taste free from bitterness. Husemann (1875) proved it to be identical with *betaina*, an alkaloid isolated by Scheibler (1866) from beet-root juice, and, like it, not pre-existing in the plant, but formed from it during the process by the action of free acid. The leaves of lycium yielded a larger proportion than the branches.

Allied Species.—Lycium afrum, *Lin.*, of Northern Africa, and L. umbrosum, *Humb. and B.*, of South America. The infusion of the leaves is used in erysipelas and skin diseases.

Medical Action and Uses.—There is nothing to establish a therapeutical character for lycium, unless it be that lycina in the *dose* of two or three grains causes paralysis in frogs.

LYCOPERDON.—PUFF-BALL.

Lycoperdon solidum, *Gron.*, s. Pachyma cocos, *Fries.*
Nat. Ord.—Fungi, Gasteromycetes.

Origin.—This curious product is found attached to the roots of fir trees, in the southern part of the United States from Virginia westward to Kansas, and is known as *Indian bread*, or *tuckahoe.* It likewise grows in China, where it is used under the name of *füh-ling.* Currey and Kelley consider it to be an altered state of the root of the tree, occasioned by the presence of a fungus, the mycelium of which traverses, disintegrates, and even obliterates the wood and bark. This view is sustained by the results of the analyses made by R. T. Brown (1871) and J. L. Keller (1876).

Description.—The tuckahoe is an irregularly globular or elongated body, varying from a few inches to a foot or more in diameter, and from a few ounces to several pounds in weight. It is externally of an ashy-black, and has a rugose surface; internally it is whitish, fissured, more or less spongy, but firm, of a somewhat farinaceous appearance, sometimes quite compact, and breaks into irregular masses. It is without odor and has an insipid taste.

Constituents.—Brown found it to contain 14 per cent. of water, 0.93 of glucose, 2.63 of gum, 17.34 of pectose, 64.45 of cellulose, and 0.16 per cent. of ash; the nitrogen amounted only to 0.36 per cent. Keller's specimen yielded 77.27 per cent. of pectose, 3.76 of cellulose, and 3.64 of ash, the other constituents being nearly in the same proportion as in the former analysis.

Allied Plants.—Lycoperdon bovista, *Lin.*, s. Bovista gigantea, *Nees;* Common puff-ball, *E.;* Vesse-loup, *Fr.;* Bovist, *G.*—This fungus forms globular or obconical masses, of a more or less yellow color, and varying in size from a few inches to about two feet in diameter. The lower part has a spongy texture, and was formerly used like spunk (see page 652) for arresting hemorrhages.

Lycoperdon cervinum, *Lin.* (Scleroderma, *Pers.;* Elaphomyces, *Fr.*); Puff-ball, *E.;* Truffe de cerf, *Fr.;* Hirschbrunst, *G.*—Its size is about that of a walnut, or smaller. It is brown, verrucose, internally purplish-brown, and was considered to possess stimulant properties.

Tuber cibarium, *Sibth.* (Lycoperdon tuber, *Lin.*); Truffle, *E.;* Truffe, *Fr.;* Trüffel, *G.*—It is of subterraneous growth, subglobular, about the size of a walnut, externally blackish and verrucose, internally white, marbled with brown, fleshy. Like some allied species, it is edible.

Physiological Action and Medical Uses.—In 1853 Dr. B. W Richardson's attention having been directed to the fact that the smoke of the *common puff-ball* had been used in the country for stupefying bees in order to secure the contents of the hive without sacrificing the insects, he conceived the idea that it might be made use of as a surgical anæsthetic. He accordingly experimented upon dogs, cats, and rabbits, and in one case removed a tumor from a dog without any sign of pain being shown during the operation. When a moderate quantity was inhaled gradually, the narcotism came on and passed off slowly, the animal exhibiting all the symptoms of intoxication, with convulsions, and sometimes vomiting. It destroyed life slowly; a dog would inhale the fumes for twenty minutes or half an hour after being completely narcotized, previous to expiring. The heart's beat in all cases survived the respiration. The lungs after death were pale; there was no sign of congestion in any organ; the blood retained its red color, but did not coagulate quickly; cadaveric rigidity set in within two or three hours. During recovery from protracted narcotism an animal would sometimes be quite conscious, although insensible to pain. Herapath made experiments which proved that the gas which is the active agent in producing the preceding phenomena is carbonic oxide, and his conclusion, confirmed by Snow, was accepted by Dr. Richardson.

No practical application has been made of this curious discovery.

In 1869, Dr. Porcher stated, concerning this mushroom, that it is found in abundance near Charleston, S. C., particularly where the cattle are driven to graze. It is used sliced and fried in butter, or stewed in milk like the common mushroom. A correspondent wrote to him, "I and a number of others have made several meals on *lycoperdon*, and I think I have discovered in myself well-marked evidences of its narcotic influence, and two other experimenters have described similar sensations to me." A case is also referred to in which a person "had been seriously affected in this way by too large a meal of lycoperdon."

The powder of this fungus has been used as a *hæmostatic* in slight and superficial wounds, and, like other dry absorbing powders, in *intertrigo.*

The *tuckahoe* is said to be used as food by the Indians.

LYCOPODIUM, *U. S.*—Lycopodium.

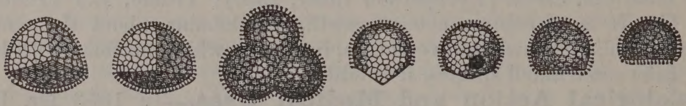
Semen lycopodii, Pulvis lycopodii, Sulphur vegetabile.—Lycopode, Soufre végétal, Fr.; *Bärlappsamen, Streupulver, Hexenmehl,* G.

The sporules of Lycopodium clavatum, *Lin.*, and of other species of Lycopodium.

Nat. Ord.—Lycopodiaceæ.

Origin.—The common *club-moss* is a low creeping perennial, which is found in dry woods distributed over the greater portion of the globe, but is most frequent in northern countries. The stem is two to four feet long, with evergreen imbricated linear awl-shaped inflexed leaves, and with ascending very leafy branches, the fertile ones terminated by a long peduncle bearing two or three erect linear-cylindrical spikes, with roundish ovate bristly pointed bracts, in the axils of which are kidney-shaped sporangia containing the sporules. The spikes are collected before they are fully matured, and after the powder has fallen out, it is separated by a sieve from the other parts. It is collected in Germany and other countries of Central Europe.

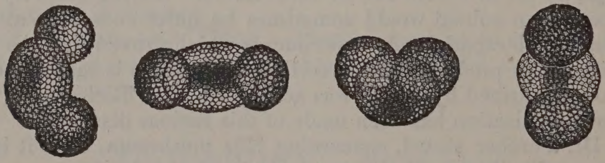
Fig. 102.



Sporules of Lycopodium.

Description.—Lycopodium is a fine, very mobile, pale-yellowish powder which is free from odor and taste. It floats upon water and is wetted by it with difficulty and only after continued trituration, unless it has been previously washed with alcohol, ether, or chloroform, to remove a superficial layer of oily matter; after which it sinks in water. When triturated it acquires a darker tint, becomes more coherent and greasy; when slowly heated, it burns quietly, but when thrown into a flame, it burns suddenly and with a hissing noise. Examined by the microscope it is found to be rounded on one side, while the other forms a short three-sided pyramid. The entire surface is covered by fine polyhedric meshes, and at the intersection of the ridges by small projections.

Fig. 103.



Pollen of Pine.

Constituents.—Flückiger (1872) determined the presence in lycopodium of a much larger amount of fixed oil than 6 per cent. observed by Buchholz (1807), and after rupturing the granules by long trituration with sand, obtained 47 per cent. of a bland oil which does not solidify at —15° C. (5° F.). Buchholz found also in it 3 per cent. of sugar. Stenhouse obtained small quantities of volatile bases, and Flückiger determined the ash to amount to 4 per cent., to be not alkaline, and to contain alumina and 1 per cent. of phosphoric acid.

Impurities and Adulterations.—The sporules of allied species of Lycopodium, particularly of *L. complanatum, annotinum* and *innundatum,* Lin., which are found in both hemispheres, are sometimes collected; they are very similar in appearance and properties. Mineral substances like powdered *talc*, *gypsum*, etc., are detected by the larger amount of ash, and will readily subside when a little is agitated with carbon bisulphide. *Starch* is separated in the same manner, and sublimed *sulphur*, if present, will be dissolved by the liquid and afterwards obtained on evaporating it. Starch is also recognized by the blue color it acquires with solution of iodine. All admixtures are, however, easily detected by means of the microscope; the pollen of pine, which is sometimes found mixed with it, consists of an oval plano-convex cell, at each end of which is a smaller globular one projecting on the flat side.

Medical Uses.—This powder, on account of its extreme lightness and dryness, is used as a convenient protective for tender and raw surfaces of the skin, in *intertrigo*, *erysipelas*, *eczema*, *herpes*, etc., and by druggists to place in boxes containing pills to prevent their adhering to one another.

LYCOPUS, *U. S.*—BUGLEWEED.

Herbe de lycope de Virginie, Fr.; *Virginischer Wolfsfuss*, *G.*

The herb of Lycopus virginicus, *Lin.* *Nat. Ord.*—Labiatæ, Satureieæ.

Origin.—Bugleweed is a perennial herb, growing in woods and shady, moist places in Canada and the United States, southward to South Carolina. It flowers from July to September.

Description.—The stem is nearly smooth, about 12 to 18 inches high, obtusely quadrangular, and with slender runners at the base; the leaves are opposite, short, petioled, elliptic-lanceolate, toothed, wedge-shaped, and entire at the base, and glandular punctate beneath; the flowers are small, in axillary clusters, purplish, and have a calyx with four ovate and bluntish, but pointless teeth. The herb has a somewhat mint-like odor, and an aromatic and bitter taste.

Constituents.—The plant has most likely the general constituents of the labiatæ, prominent among which is volatile oil, some resin, and a little tannin; in this case, perhaps, also a bitter principle. We know of no analysis of the plant.

LYCOPUS EUROPÆUS, *Lin.*; Water horehound, *E.*; Lycope d'Europe, *Fr.*; Wasserandorn, *G.*, has been used in Europe as *Herba marrubii aquatici*. It is indigenous to Europe and North America, and resembles the bugleweed, being mainly distinguished by the often taller, sharply four-angled stem, the more deeply toothed, at the base often pinnatifid leaves, and the five triangular, sharp-pointed calyx teeth. It varies somewhat in its foliage, and is not unfrequently collected with the preceding.

Medical Action and Uses.—Bugleweed is reputed to be astringent and sedative, to reduce the frequency of the pulse, to arrest hemorrhage from the lungs, to allay coughing, and to be a mild narcotic. It has been compared with digitalis. As more than half a century has elapsed since such virtues were first ascribed to it, and it still continues to be neglected and generally unknown, it may be inferred that its supposed powers were in great part imaginary. It is used in an infusion made with half an ounce of the herb in a pint of boiling water. This quantity may be taken in a day.

LYTHRUM.—LOOSESTRIFE.

Herba salicariæ.—Purple willowherb, E.; *Salicaire*, Fr.; *Weiderich*, G.

Lythrum salicaria, *Lin.* *Nat. Ord.*—Lythraceæ.

Origin.—The loosestrife is a perennial herb growing in moist places in the New England States, in Europe and Northern Asia, and is sometimes cultivated in gardens. It flowers in July and August.

Description.—The stem is angular, 3 to 6 feet high. The leaves are opposite, or whorled in threes; lanceolate, sessile, clasping with the heart-shaped base, roughish downy on the lower side, about 3 inches long. The flowers are rather large, in axillary cymes, apparently whorled, form a long, interrupted, wand-like spike, and have 6 purple or sometimes whitish petals and 12 stamens. The herb has a mucilaginous, astringent taste. The blackish-brown, branching, and fibrous root is likewise astringent.

Constituents.—Loosestrife appears to contain mucilage and tannin as its principal constituents.

Medical Action and Uses.—Loosestrife unites in itself demulcent and astringent qualities. It has been much used in Europe in diarrhœa, dysentery, leucorrhœa, blenorrhœa, and passive hemorrhages. It is generally given in a decoction prepared by boiling an ounce of the root in a pint of water, and in doses of one or two fluidounces.

MACIS, *U. S.*—MACE.

Arillus myristicæ.—*Macis*, Fr., G.; *Fleur de muscade*, Fr.; *Muskatblüthe*, G.

The arillus of the fruit of Myristica fragrans, *Houttuyn.*

Origin.—See Myristica. When the nutmeg is gathered, the arillus, which envelops the seed, is cut off and dried in the sun, whereby its bright-red color is changed to brownish-orange. With the view of its better preservation it is often sprinkled with sea-water. It is principally obtained from the Banda Islands.

Description.—Mace is about 1½ inch long, smooth, flat, about $\frac{1}{10}$ inch thick at the base, thinner above, longitudinally slit into irregular, narrow, and somewhat branching bands, of a brownish-orange, and nearly dull color, somewhat translucent, and fatty when pressed or scratched. It breaks readily with a short fracture, but cannot be triturated to powder on account of the oil. It has a very agreeable aromatic odor, closely analogous to that of nutmeg, and a warm, aromatic taste. 70,682 pounds of mace were imported during the fiscal year 1876–1877.

Constituents.—The most important constituent appears to be the volatile oil which is present to the amount of about 8 per cent. Schacht (1862) found it to consist mainly of a hydrocarbon $C_{10}H_{16}$, called *macene*, which is related to, and by Koller (1865) even considered identical with, the myristicene of oil of nutmeg. The oxygenated portion of the volatile oil is even less known than the hydrocarbon. Henry (1824) found red fat soluble, and yellow fat insoluble, in alcohol; but the 24.5 per cent. residue obtained by Flückiger (Pharmacographia) with boiling ether, and drying at 100° C. (212° F.), appeared to have consisted solely of resin and semi-resinified volatile oil. The same author obtained with alcohol 1.4 per cent. of uncrystallizable sugar, and, with hot water, 1.8 per cent. of a body which turned blue, and after drying reddish-violet, with iodine, and appears to be intermediate between starch and mucilage.

Adulterations are not likely to be met with, at least not of the unpowdered mace. The mace of the wild nutmeg (*M. fatua*) is of a darker red color, less divided at the base, with more slender bands, and destitute of the grateful fragrance and taste of true mace.

Medical Action and Uses.—The operation of mace appears to be the same as that of nutmeg, and there is reason to believe that an excessive dose of it may induce dangerous narcotism. It is used to impart an aromatic taste to medicines, but more commonly as a condiment for flavoring food and promoting its digestion.

MAGNESIA, *U. S.*, *Br.*—MAGNESIA.

Magnesia usta, P. G.; *Magnesia calcinata.—Calcined magnesia*, E.; *Magnésie*, *Magnésie calcinée*, Fr.; *Gebrannte Magnesia*, G.

Formula MgO. Molecular weight 40.

Preparation.—Take of Carbonate of Magnesium a convenient quantity. Put it into an earthen vessel, and expose it to a red heat for two hours, or until the carbonic acid is entirely expelled, rubbing it constantly with an iron spoon during calcination. *U. S.*

Take of Carbonate of Magnesia four ounces. Put it into a Cornish or Hessian crucible closed loosely by a lid, and expose it to a low red heat until a small quantity taken from the centre of the crucible, when it has cooled, and dropped into diluted sulphuric acid, causes no effervescence. *Br.*

The British Pharmacopœia recognizes two varieties of magnesia, the heavy, made from the heavy magnesium carbonate by the process just given, and *Magnesia levis* or *light magnesia*, which is made in precisely the same manner from the light magnesium carbonate. In the United States both kinds are extensively used, but when the heavy variety is desired, it is usually designated in prescriptions as *Magnesia ponderosa*.

The officinal carbonate of magnesium consists of magnesium carbonate and hydrate. On heating it water and carbonic acid are given off, and magnesium oxide remains behind: $3(MgCO_3).Mg2HO.3H_2O$ yields $4MgO + 3CO_2 + 4H_2O$. The carbonate of magnesium is pressed somewhat firmly into a crucible, and this is placed in a suitable furnace, loosely covered with a lid, to prevent the product from becoming contaminated with ashes and other impurities, and then heated to dull redness. The expulsion of the water and carbonic acid gas keeps the surface of the powder continually in motion, and there is no necessity of testing it as long as that motion is kept up; when the motion ceases, a small quantity of the powder is taken from beneath the surface and near the centre, mixed with sufficient water to displace the air, and then poured into an excess of dilute sulphuric acid. If no evolution of carbonic acid gas takes place, the product is finished, and may be dipped out with a ladle, and the crucible filled with a fresh portion of magnesium carbonate without removing it from the furnace. Made by the process detailed in the U. S. Pharmacopœia, a large and rather flat earthen vessel should be used, to allow of the magnesia being stirred continuously, in which case the heat may be raised to full redness; but it should never be raised to that degree if the stirring is omitted, because the magnesia would become dense and granular, and with difficulty soluble in dilute acids. The yield is between 40 and 43 per cent. of the weight of the magnesium carbonate.

Properties.—The two varieties of magnesia have the same composition and chemical properties, and differ from each other only in the degree of aggregation of their molecules. Heavy magnesia is more readily miscible with water than the light kind, and, like the latter, should remain suspended in the water for some time, and settle gradually. Should it subside very rapidly, the probability is that it was exposed to too high a degree of heat. Magnesia is a white powder, without odor, and of an earthy, but destitute of saline taste. Exposed to a high heat, it becomes more compact, but does not fuse except before the oxyhydrogen blowpipe. According to Fresenius, it requires 55,000 parts of water for solution; but the liquid has a distinct alkaline reaction. Its specific gravity varies between 2.3 and 3.3. When mixed with water it unites with it, forming a hydrate, having the composition Mg2HO, and, when heated, losing 31 per cent. of its weight. Exposed to the atmosphere a similar change takes place, but carbonic acid is also absorbed, and a corresponding quantity of oxycarbonate is formed. It should, therefore, be preserved in well-stoppered bottles.

Tests.—The degree of hydration allowable is not given by the Pharmacopœias; but when well kept the loss by heating to redness should not exceed five or six per cent. It should dissolve in dilute acid without any or with but very slight effervescence. When treated with dilute nitric acid it should dissolve without leaving any residue, and the solution should yield no precipitates with barium nitrate (*sulphates*) or silver nitrate (*chlorides*), and potassium ferrocyanide should impart only a bluish tint, but not a deep blue precipitate (iron). On adding ammonium chloride and an excess of ammonia, the solution remains clear on the further addition of ammonium oxalate (absence of *calcium*), and on the addition of sulphydrate of ammonium (*zinc*, etc.); but yields with phosphate of sodium a white precipitate of ammonio-magnesium phosphate.

Several proprietary articles, consisting of heavy magnesia, are occasionally met with; this magnesia is generally characterized by freedom from grittiness and ready miscibility with water; but is not superior to a dense magnesia obtainable by careful manipulation from a properly prepared magnesium carbonate.

The metal *magnesium* is widely distributed, but is less abundant than calcium; it is found as silicates in *meerschaum*, *olivine*, *mica*, *serpentine*, and other minerals; as chloride in sea-water and the waters of saline springs, and as carbonate in *magnesite* and in *dolomite* or magnesian limestone. The metal is obtained by heating sodium with anhydrous magnesium chloride; the resulting sodium chloride is dissolved by water, and the magnesium left behind in the form of a gray powder, which is fused and moulded as desired. It is a silver-white metal, of a strong metallic lustre, malleable, fusing at a red, and volatilizing at a white heat, but burning with a bright white light when held in the flame of a gas jet. Its density is only 1.78; it is not altered in dry air, and but slightly tarnished in a damp atmosphere. *Soapstone* or *French chalk* is a double silicate of magnesium and aluminium.

Off. Prep.—Pilulæ copaibæ, *U. S.;* Pulvis rhei comp., *U. S., Br.;* Trochisci magnesiæ, *U. S.*

Medical Action and Uses.—The action of magnesia and of its carbonates consists partly in neutralizing the acid in the alimentary canal, and partly in rendering acid secretions, as the urine, either neutral or alkaline. If a sufficient quantity of acid exists in the stomach, or is attracted thither by the magnesia, a neutral purgative salt is formed; but in default of such a combination the magnesia may pass into the intestine unchanged in part, and if it be taken habitually, may accumulate there and form concretions large enough to obstruct the bowel.

Magnesia has the advantage over other laxatives in being almost tasteless, and in rarely causing nausea or colic. It produces feculent rather than watery stools, which are remarkable for their slight degree of fetor. It is slower than salines in its operation, but quite as thorough. Its use is most distinctly indicated in whatever condition is attended with gastro-intestinal acidity, with *heart-burn*, *sour eructations*, and *flatulence*. It has even arrested the *vomiting of pregnancy* when the liquid rejected was acid. Although it corrects gastric acidity, it does not remove the cause of this symptom, for which purpose aromatics and bitter tonics are usually required. It is ordinarily associated with rhubarb in the treatment of dyspeptic *diarrhœa*, especially in children; and is a very appropriate laxative in *hemorrhoidal* cases attended with constipation. It is useful in the *aphthous* affections of the mouth which attend infantile diarrhœa. In *gout* and its allied disorders its antacid qualities render it appropriate; the following formula is commonly employed: ℞. Magnesii sulph., ℥j–ij; Aquæ menthæ virid., f℥x; Vin. colchici seminis, Syrup. simpl., āā f℥j; Magnesiæ, ʒij.—M. S.—From one to three tablespoonfuls every two hours until from four to six stools are produced in the twenty-four hours. In infantile *colic* the following carminative mixture is used: ℞. Magnesiæ, gr. xxx; Tinct. assafœtidæ, gtt. xl; Tinct. opii, gr. xx; Sacch. alb., gr. lx; Aquæ, f℥j.—M. S.—Twenty drops and upwards every hour until relief occurs. Magnesia is appropriate, as already stated, in cases of *uric acid gravel*, but is probably less so than the carbonates of sodium and potassium; but in such cases, when marked by gastric acidity, it should not be neglected.

As an antidote to *arsenious acid* freshly precipitated magnesia ranks next in value to freshly prepared sesquioxide of iron. It is also antidotal to *acids*, including oxalic acid, and to *phosphorus*. In all cases of poisoning for which it is appropriate, magnesia should be very largely administered, diffused in water.

As a purgative, the *dose* of magnesia is about forty grains, and five grains for infants. As an antacid it may be taken in doses of ten grains after meals, suspended in water. Mixture with milk, which is usual to disguise its taste, renders its operation slower.

MAGNESII ACETAS.—Acetate of Magnesium.

Acétate de magnésie, Fr.; *Essigsaure Bittererde*, G.

Formula $Mg2C_2H_3O_2$. Molecular weight 142.

Preparation.—One hundred and twenty parts of carbonate of magnesium are dissolved in sufficient acetic acid, and the filtered solution evaporated until three hundred parts remain.

Properties.—When entirely exsiccated, it has the formula given above; but, being deliquescent and uncrystallizable, it is difficult to remove all the water. It is gum-like in appearance, freely soluble in water and alcohol, and has a bitterish taste, less pleasant than magnesium citrate. Prepared as above, is is a syrupy liquid, the taste of which may be improved by syrup of orange peel.

Medical Action and Uses.—This salt was introduced as a substitute for citrate of magnesium, probably on account of its greater cheapness, it being assumed to possess the same mode of action as the citrate. A committee of the Pharmaceutical Society of Paris reported it to be a purgative, whose slight taste and great solubility recommended it. It does not, however, seem to have been approved by physicians.

MAGNESII CARBONAS, *U. S.*—Carbonate of Magnesium.

Magnesiæ carbonas, Br.; *Magnesia carbonica*, P. G.; *Magnesia alba*, *Magnesia hydrico-carbonica*, *Carbonas magnesicus*.—*Carbonate of magnesia*, E.; *Carbonate de magnésie*, *Magnésie blanche*, Fr.; *Weisse Magnesia*, G.

Formula $(MgCO_3)_3.MgO.4H_2O$, or $3MgCO_3.Mg2HO.3H_2O$. Molecular weight 364.

Preparation.—Take of Sulphate of Magnesia ten ounces; Carbonate of Soda twelve ounces; Boiling Distilled Water a sufficiency. Dissolve the sulphate of magnesia and the carbonate of soda each in a pint of the water, mix the two solutions, and evaporate the whole to perfect dryness, by means of a sand-bath. Digest the residue for half an hour with two pints of the water, and having collected the insoluble matter on a calico filter, wash it repeatedly with distilled water until the washings cease to give a precipitate with chloride of barium. Finally, dry the product at a temperature not exceeding 212° F. *Br.*

The above process yields *heavy* magnesium carbonate; if the two solutions are mixed, and then boiled for 10 or 15 minutes, but not evaporated, the precipitate will be more bulky, and, after washing and drying, constitutes the *Magnesiæ carbonas levis* or *light carbonate of magnesia* of the British Pharmacopœia.

On mixing cold solutions of magnesium sulphate and sodium carbonate, a white voluminous precipitate takes place, which, in the course of several days, is gradually converted into the compound $MgCO_3.3H_2O$, identical with that which often crystallizes from the effervescing solution of magnesia (see p. 839), but, when heat is applied, carbonic acid is given off, and the insoluble portion remaining is a hydrato-carbonate, the composition of which varies somewhat, a larger amount of carbonic acid being given off, if the heat be continued, and the heavy magnesium carbonate obtained, as described above, has probably the formula determined by Berzelius, $3MgCO_3.MgH_2O_2.3H_2O$, which compound, on ignition, would yield nearly 44 per cent. of magnesia, MgO, as required by the British Pharmacopœia. Light magnesium carbonate yields less (between 40.3 and 41.7 per cent.) magnesia, according to Otto and Laake. The formula $3MgOCO_3.MgH_2O_2.4H_2O$ requires 41.9 per cent. MgO. A compound of the composition $4MgOCO_3.MgH_2O_2.5H_2O$ would yield 41.3, and with an additional H_2O only 40 per cent. MgO.

Properties.—Besides the slight difference in composition just referred to, the heavy and light magnesium carbonates differ only in the degree of aggregation of their molecules, the former being slightly granular, the latter a smooth and less dense powder, both being inodorous and of a slight earthy taste. It is almost insoluble in water, requiring, according to Fyfe, 2500 parts of cold and 9000 parts of boiling water for solution, and when it is moistened with water and applied to turmeric-paper, a brown color is gradually produced. When heated to dull redness, water and carbonic acid gas are given off and magnesia remains. It dissolves with effervescence in dilute sulphuric, muriatic, and other acids, and the solutions have the chemical behavior of magnesium salts.

Tests.—Magnesium carbonate may be obtained from the mother-liquors or bittern of salt-works, and is prepared on an extensive scale in England from magnesian limestone, by treating it in the state of powder with cold water and carbonic acid, under a pressure of 5 or 6 atmospheres; magnesium bicarbonate is first dissolved, removed from the calcium salt, and, by boiling, converted into the officinal carbonate. From both these sources the magnesium carbonate may be contaminated with calcium compound; and from the former source, by incomplete washing, also with the acidulous radicals contained in the mother-liquor, more particularly with chlorides, bromides, and sulphates. These impurities are detected by dissolving the carbonate in dilute nitric acid, and this solution should not be precipitated by nitrate of silver (*chloride* and *bromide*), or barium nitrate (*sulphate*); neutralized with ammonia, it should not be precipitated by ammonium oxalate (*calcium*). On the addition of ammonia in excess, a white precipitate is produced, which is completely soluble in ammonium chloride (an insoluble portion would indicate *alumina*), and the ammoniacal solution does not yield a white precipitate with hydrogen sulphide (*zinc*). Traces of iron are usually present, and are unobjectionable.

Off. Prep.—Liquor magnes. carbon., *Br.;* Liq. magnes. citrat., Magnesia, *U. S.*, *Br.;* Trochisci bismuthi, *Br.*

Medical Uses.—The carbonate is less efficient than magnesia itself, but its action and uses are the same. It is said to remove *warts* from the skin when taken night and morning in teaspoonful doses, and continued for several weeks.

Carbonate of magnesium may be given as a laxative in doses of from 30 to 120 grains; as an antacid, from five to twenty grains may be taken after meals. It may be agreeably administered in carbonic acid water.

MAGNESII SULPHAS, *U. S.*—SULPHATE OF MAGNESIUM.

Magnesiæ sulphas, Br.; *Magnesia sulfurica*, P. G.; *Sal amarum*, *Sal Epsomense*, *Sal anglicum*, *Sal Sedlicense*, *Sulfas magnesicus*.—*Sulphate of magnesia*, *Epsom salt*, E.; *Sulfate de magnésie*, *Sel d'Epsom*, *Sel de Sedlitz*, *Sel amer*, Fr.; *Bittersalz*, *Schwefelsaure Magnesia*, G.

Formula $MgSO_4.7H_2O$. Molecular weight 246.

Origin and Preparation.—Sulphate of magnesium is contained in sea-water, and in the waters of many mineral springs, which thereby acquire a bitter taste. The *Crab Orchard salt* of Kentucky is the same salt in an impure state, and, as analyzed by J. T. Viley (1871), contains about 65 per cent. of magnesium sulphate after having been dried at 120° C. It probably results from the mutual decomposition of gypsum and magnesian limestone, and is obtained by evaporating the water which collects in wells dug in the ground. The pure salt is made on the large scale from *magnesite*, which is principally $MgCO_3$, by dissolving it in dilute sulphuric acid, and crystallizing. Large quantities are made by various processes from magnesian limestone, and more recently it is extensively obtained at the Stassfurt salt works, principally from the mineral *kieserite*, which is $MgSO_4$ combined with varying quantities of water, and in its natural state as insoluble as gypsum.

Properties.—As found in the market, magnesium sulphate has generally been purified by resolution in water and rapid crystallization, and forms small rhombic prisms, which resemble those of oxalic acid and sulphate of zinc, are perfectly transparent, without odor, but have a cooling and bitter saline taste. It dissolves at the ordinary temperature in about $1\frac{1}{2}$ times its weight, and on boiling in less than its own weight of water; it is also soluble in diluted alcohol, but sparingly so in strong alcohol. Exposed to air the crystals slowly effloresce, becoming superficially opaque; when heated the salt melts, gives off $6H_2O$, and at a still higher temperature parts with the last molecule of water, fuses, and on cooling congeals into a white mass. The total weight of water amounts to 51.22 per cent.

Tests.—The aqueous solution yields a white precipitate of barium sulphate on the addition of barium chloride. It is not precipitated in the cold by potassium bicarbonate or ammonium carbonate, but gives white precipitates with the carbonates and the hydrates of sodium and potassium, which are redissolved by ammonium chloride. Ammonia added to its solution likewise causes a white precipitate soluble in ammonium chloride, and this solution, on the addition of ammonium phosphate, deposits all magnesium in the form of a crystalline powder, which is phosphate of magnesium and ammonium, $MgNH_4PO_4.6H_2O$. The filtrate from it, evaporated to dryness and ignited, should leave no residue, or only a slight one consisting of phosphoric acid, in which potassium or sodium compounds should not be indicated by the proper tests.

Impurities are detected in precisely the same manner as in the nitric acid solution of magnesium carbonate (see page 872).

Pharmaceutical Uses.—Sulphate of magnesium is used for preparing Magnes. carbonas and Liquor magnes. carbon., and forms a constituent of Enema magnes. sulphat. and Mistura sennæ comp., *Br*.

Medical Action and Uses.—Sulphate of magnesium, dissolved in a large quantity of water and taken on an empty stomach, is very prompt in its operation, producing copious watery dejections and generally diuresis. Indeed, if the skin be kept cool, the latter mode of operation may exceed the purgative effect, particularly if the dose be not large. Delicate persons, especially in cool weather, are apt to feel chilly and weak during its operation. This refrigerant influence renders it appropriate in warm weather and in febrile affections. If the dose be excessive and largely diluted, hypercatharsis may occur. On the other hand, large doses not thus diluted have sometimes occasioned an alarming sedation, with pallor, debility, coldness, and even syncope, although no purgation whatever occurred. In at least one case, that of a boy ten years old, death resulted. These effects, according to the dose and degree of dilution with water, are more or less applicable to all saline cathartics.

When properly administered it is nearly always a safe and harmless purgative; indeed, it is generally used without medical advice by persons affected with *constipation*, slight *febrile attacks*, etc. It is highly objectionable when habitually employed for the former purpose in a full purgative dose, for it soon ceases to act purgatively, and confirms the evil it was used to cure. It is also one of the least eligible cathartics in cold weather. On the other hand, if used in small doses largely diluted, as a drachm in half a pint of water, it may be continued for a long time without sensibly diminishing in activity. As an antiphlogistic purgative at the commencement of *fevers*, especially of malarial fevers, it is justly esteemed, whether or not it is preceded by a dose of eight or ten grains of calomel, which many think essential to the result. In *typhoid fever*, there is much reason to believe that a gentle purgative action maintained during the first week of the attack by this medicine tends to moderate the fever, mitigate the special typhoid phenomena of the disease, and lessen the danger of intestinal perforation. In *dysentery* of a sthenic type, saline laxatives, and this one among the number, have a decided influence in lessening the tormina, tenesmus, and bloody and mucous stools, and reducing the febrile action. But to be efficient its administration ought to commence as early as possible in the disease, and before ulcers form in the rectum. In both of the last-mentioned affections an ounce of the salt may be dissolved in a pint of water, and a wineglassful of the solution administered every two or three hours. When this treatment has been pursued for twenty-four or forty-eight hours, it should be suspended for about twelve hours, and then resumed. In various inflammations, serous and parenchymatous, it was formerly the custom to administer Epsom salt in small doses, largely diluted, and with the addition of half a grain of tartar emetic to each pint of the solution, which was given in wineglassful doses at intervals of three hours. The method is temporarily supplanted by the use of medicines which reduce the pulse-rate and temperature without providing any outlet for the effete products of morbid action.

In all cases of *intestinal obstruction* not clearly due to organic causes, the use of this or some similar medicine should have a fair trial, care being taken to employ a weak solution and to administer it in moderate doses at proper intervals. In *painters' colic*, sulphate of magnesium with the addition of sulphuric acid has been regarded as a specific for the disease, but erroneously.

Administration.—From half an ounce to an ounce of Epsom salt dissolved in half a pint of water is a full purgative dose; but even a less proportion of the salt and a larger proportion of water will produce nearly an equal effect. Its taste may be partially disguised by aromatic sulphuric acid in the proportion of half a fluidrachm to the half pint of liquid. The addition to the saline solution of a little strong coffee helps to mask its nauseous flavor. It is frequently given in an infusion of senna when a prompt and vigorous operation is required. This mixture forms the basis of the so-called "black draught."

MAGNOLIA, *U. S.*—MAGNOLIA.

Magnolia bark, E.; *Écorce de magnolier*, Fr.; *Magnolienrinde*, G.

The bark of Magnolia glauca, *Lin.*, Magnolia acuminata, *Lin.*, and Magnolia tripetala, *Lin.* (M. umbrella, *Lam.*).

Nat. Ord.—Magnoliaceæ.

Origin.—*M. glauca*, *sweet bay*, *white bay*, *beaver tree*, or *swamp sassafras*, is indigenous to swampy localities near the coast of the United States from

Massachusetts to Louisiana; in the northern part of the country it is shrubby; further south it is a small tree 15 to 25 feet high. It has oval oblong leaves which are shining above and white beneath, and bears fragrant white flowers about 2 inches in diameter, with about 10 ovate or obovate obtuse petals. The leaves may be used for marking by placing the white surface upon the fabric and writing with some pressure upon the upper surface.

M. acuminata, called *cucumber tree* from the appearance of the young fruit, is found in groves and rich woods from Western New York to Ohio and southward, chiefly along the Alleghenies to Georgia. It grows to the height of 60 to 80 or 90 feet, and has oblong acuminate, underneath pubescent leaves, and light bluish-green flowers tinged with yellow, about 4 or 5 inches in diameter.

M. umbrella, *umbrella tree*, so called from the large leaves appearing whorled at the ends of the branches, is found in rich soil from Pennsylvania and Ohio southward along the Alleghenies. Its leaves are 2 to 3 feet long, obovate lanceolate, pointed at both ends, silky when young, and its white flowers are about 7 inches in diameter.

The magnolias produce their flowers in May and June; they have a white or greenish calyx of 3 sepals, many stamens with short filaments, and many ovaries collected on an elongated receptacle, forming a cone-like aggregation of fruits which open at maturity, the berry-like seeds being suspended by a thread-like funiculus.

Description.—The bark necessarily varies as obtained from the different species. The young bark of M. glauca is light orange-brown, glossy, with some gray spots, and underneath the thin corky layer of a green color. The bark of the larger branches is nearly smooth, externally of a light-gray or whitish color, marked with scattered warts and some longitudinal cracks. Older bark has the warts somewhat confluent, and the cracks deepened into fissures. The inner surface is whitish, or, after drying, yellowish or pale-brownish, smooth, and very finely and closely striate. The bark of M. tripetala is thicker, is of a pale brown underneath the ash-gray layer, and has a thick liber with rather tough bast fibres. Magnolia bark breaks with a more or less fibrous fracture in the bast layer, and exhibits upon the light-brownish transverse section rather broad wedges of the bast and medullary rays. The dried bark has scarcely any odor, but its taste is warm, spicy, and bitter, particularly in the young bark.

Constituents. — The bark of *magnolia grandiflora* was examined by Stephen Procter (1842), who found in it a little volatile oil, resin, and a crystalline principle resembling liriodendrin. The root and stem-bark of M. glauca were investigated by W. D. Harrison (1862), the former yielding a little volatile oil and nearly tasteless and colorless crystals; the latter contained tannin, producing a dark green precipitate with ferric salts, but did not yield the crystalline principle, nor could the bitter principle be isolated. By treating the alcoholic extract of the fruit of M. umbrella with hot petroleum benzin, Wallace Procter (1872) obtained colorless crystals of *magnolin*, which are soluble in alkalies, alcohol, ether, chloroform, carbon bisulphide, and fixed oils, but sparingly so in boiling water, in which they fuse; the solutions have an irritating taste. The crystals are colored red by sulphuric acid, and brown by nitric acid. The pungent taste of the fruit is due to a soft resin, and the odor to a little volatile oil.

Medical Uses.—The bark of the several medicinal species of magnolia is bitter and aromatic without astringency. Like numerous other plants of similar qualities it has been used in hot decoction to produce diaphoresis in fevers, bronchial *catarrhs*, *rheumatism*, and *gout*, and in cold decoction or tincture as a tonic. The tree is said to render clear waters near which it grows, and to prevent malarial affections. The preparations of the bark spoken of above are used in the cure of intermittent fevers. The *dose* of the recently dried bark in powder is stated to be from thirty to sixty grains, frequently repeated. The infusion or decoction is less eligible than the tincture, which is not, however, officinal.

MALTUM HORDEI.—BARLEY MALT.

Malt d'orge, *Drêche*, Fr.; *Gerstenmalz*, G.

Preparation and Properties.—Different kinds of grain may be employed for the preparation of malt; but the kind most generally used is barley. The grain is soaked in water, and then placed in heaps; heat is spontaneously generated, and, by occasional turning, prevented from rising too high. Under these conditions, germination takes place, and when the germ has acquired the desired length, the grain is rapidly dried, and constitutes *malt*. According to the degree of heat employed in drying, the color of the malt varies somewhat, and is known as either *pale*, *pale amber*, *amber*, or *amber-brown*. For some purposes, malt is made to undergo a roasting process in revolving cylinders, to obtain *roasted* or *black* malt, if the integuments are of a dark-brown color; or *crystallized* malt, if the interior of the grain has assumed that color. Malt has an agreeable odor and a sweet taste, and yields with water a more or less deep yellowish-brown or brown infusion.

Constituents.—The chemical changes taking place in germinating grain and sprouting potatoes were explained by Payen and Persoz (1833), who discovered a peculiar ferment *diastase*, which exists in the vicinity of the embryo, but not in the radicle of the germ; on making an infusion of fresh malt, precipitating salts and some proteids with a little alcohol, and then adding more alcohol, diastase, in an approximately pure condition, is precipitated; but, according to Dubrunfaut (1868), is a mixture which contains the true fermentative principle *maltin*. The remaining constituents of malt are those of barley, with the exception of *dextrin* (see page 170), and *sugar*, which have been formed from a portion of the starch, the remainder of which, still present in the malt, is likewise converted into the same compounds by the process of *mashing*, which consists in preparing an infusion of ground malt, called *wort*, and keeping it at a temperature of about 70° C. (158° F.).

During the process of malting, good barley increases about 9 per cent. in volume, but loses about 20 per cent. in weight; and good malt should yield to water soluble principles amounting to two-thirds of its weight. Diastase has the property of converting starch into dextrin and sugar, and in this respect resembles *ptyalin*, a ferment met with in the salivary glands of animals. Coutaret (1870) regards the two ferments as being identical.

Pharmaceutical Uses.—EXTRACTUM MALTI; Extract of malt, *E.;* Essence de malt, *Fr.;* Malzextract, *G.*—One part of ground barley malt is macerated for three hours with its own weight of water; 4 parts of water are then added, and the whole digested for an hour at 65° C. (149° F.), heated to the boiling point, and at once expressed and strained. The clear liquid is rapidly evaporated to the consistence of a thick extract (*P. G.*). As found in the market extract of malt usually has the consistence of a thick syrup, a yellowish-brown color, and the sweet taste of malt. It is serviceable in emulsionizing fixed oil, and as a vehicle for various medicaments.

EXTRACTUM MALTI FERRATUM, *P. G.*, is made by dissolving 2 parts of pyrophosphate of iron in 3 parts of water, and incorporating the solution with 95 parts of extract of malt. Hager (1876) recommends instead the use of 3 parts of saccharated iron (see page 627), rubbed up with 7 of glycerin and 90 of extract of malt.

If quinia is combined with malt, the neutral tannate of quinia is best employed. Hops may be used with it in the form of fluid extract of lupulin. A combination with pepsin should be made extemporaneously, since the taste is gradually modified.

Medical Action and Uses.—Liquid and semifluid extracts of malt were much used a few years ago in Germany, where they were first introduced, as tonic and nutritious substitutes for malt liquors. Thence they were diffused to every part of the world, until their local manufacture displaced the imported preparations, and both were superseded by some later fashionable medicine. In many cases they were found quite beneficial in states of chronic debility due to organic disease or infirmity, or to mere nervous exhaustion, but seldom more, and often less so, than good malt liquors into the composition of which hops enter. The semiliquid preparation, which is the only true extract of malt, is very difficult to take, owing to its tenacious and adhesive qualities, and is generally prescribed in teaspoonful doses mixed with soup, wine, beer, or milk.

MANGANESII OXIDUM NIGRUM, *U. S.*—BLACK OXIDE OF MANGANESE.

Manganum hyperoxydatum, P. G.; *Oxydum manganicum, Magnesia vitriariorum (vel nigrum).—Peroxide of manganese, Pryolusite*, E.; *Oxyde (peroxyde) de manganèse*, Fr.; *Braunstein*, G.

Formula MnO_2. Molecular weight 87.

Origin.—Pyrolusite, or, as it is commercially called, *black manganese* or *manganese*, is found in different parts of Germany, France, Spain, and Great Britain, and also in Nova Scotia, Vermont, Pennsylvania, and other parts of North America. Sometimes it is found nearly pure, but it is generally associated with other manganic ores, and often with iron, lime, baryta, silica, etc.

Properties.—It is amorphous, and is then of a dull gray-black color, or in masses composed of tabular, fibrous or radiating crystals, having a bright metallic lustre, and yielding a black powder. Its specific gravity is 4.8 to 4.94. It may also be obtained artificially by carefully fusing manganous carbonate with potassium chlorate, and washing the mass. It is insoluble in water and in weak acids; it dissolves in hydrochloric acid to manganous chloride, while chlorine is given off; $MnO_2 + 4HCl$ yields $MnCl_2 + 2H_2O + Cl_2$. When it is treated with sulphuric acid in the presence of oxalic acid, the latter is oxidized to carbonic acid, manganous sulphate being dissolved; $MnO_2 + H_2SO_4 + H_2C_2O_4$ yields $2CO_2 + MnSO_4 + 2H_2O$. When heated to redness, the black oxide parts with a portion of its oxygen, leaving brown manganic oxide, Mn_2O_3, or, at a bright red heat, red manganoso-manganic oxide, $MnO.Mn_2O_3$.

Valuation.—The value of black oxide of manganese for the production of chlorine may be determined in various ways, either by ascertaining directly the loss in weight occasioned by the evolution of carbonic acid gas in the reaction just described, when the weight of $2CO_2$ (88) will indicate 1 molecule of MnO_2 (87); or after the reaction has been completed, the excess of the oxalic acid added is estimated by a standardized solution of potassium permanganate, which is added until it ceases to be decolorized. The generation of chlorine and its oxidizing effect upon ferrous salts is utilized for the same purpose in the following manner: 5 grams (or 50 grains) of the finely powdered oxide are mixed in a flask with about 15 grams of water and 45 grams (or 1 ounce) of strong hydrochloric acid; 32 grams (or 320 grains) of pure granular ferrous sulphate are likewise weighed out and added, at first in larger, afterwards in smaller, portions, until, after some digestion, the odor of chlorine has entirely disappeared, and a drop of the liquid is colored blue by ferridcyanide of potassium from the excess of ferrous salt. If the oxide was pure MnO_2, it would require 32 grams (or 320 grains) of the ferrous sulphate; from the exact quantity of the latter used, the percentage of the former is easily calculated. Since the Pharmacopœia requires black manganese to contain at least 66 per cent. of MnO_2, the above quantity, after the addition of 21.1 grams (or 211 grains), should give a blue reaction with the ferridcyanide. The 32 grams (or 320 grains) of the ferrous sulphate may also be added at once, and after the completion of the reaction, its excess ascertained by standardized permanganate of potassium.

Impurities.—The presence of carbonates is detected by the effervescence occurring with *cold* dilute muriatic acid, and the presence of iron is ascertained in the solution obtained with strong or with hot dilute muriatic acid, by the blue precipitate with ferrocyanide of potassium.

Composition.—Black oxide of manganese consists of 63.2 parts (1 atom) of manganium, and 36.8 parts (2 atoms) of oxygen.

The metal *manganium* or *manganesium* may be obtained by reducing one of its oxides with carbon at a very high temperature. It resembles iron, but is rather darker, harder, and more brittle; its specific gravity is 8. Besides the oxygen compounds mentioned above, it unites with this element also in several other proportions. *Manganous oxide*, MnO, is a grayish-green powder, which readily oxidizes in contact with the air. *Manganic acid*, H_2MnO_4, is not known in the free state, but only in the form of salts, which have a green color. *Permanganic acid*, $H_2Mn_2O_8$, is a deep violet-colored liquid, which is a powerful oxidizing agent (see Potassium permanganate).

Uses.—Black oxide of manganese is extensively used for the preparation of chlorine, and the solution obtained in this process may be employed for preparing other compounds of manganium. It is employed in preparing Aqua (liquor) chlorinii, *U. S.*, *Br.;* Hydrarg. perchloridum, Liq. sodæ chloratæ, Potass. chloras, Potass. permanganas, *Br.*

Medical Action and Uses.—Black oxide of manganese was introduced into medicine when its chemical affinities were found to be nearly analogous to those of iron. But the chemical ground of judgment proved, as it usually does, a fallacious one in therapeutics, and none of the curative effects anticipated were secured. On a different ground, probably, it was employed in the treatment of morbid sensibility of the stomach, an affection which was, doubtless, in some cases, gastralgia, and in others simple ulcer. When it was of service in such cases it probably acted as bismuth subcarbonate or subnitrate acts, by furnishing an inert and insoluble coating to the part. It was given in the *dose* of from five to forty grains.

MANGANESII SULPHAS, *U. S.*—SULPHATE OF MANGANESE.

Manganum sulphuricum, *Sulfas manganosus.*—*Manganous sulphate*, E.; *Sulfate de manganèse*, *Sulfate manganeux*, Fr.; *Schwefelsaures Manganoxydul*, G.

Formula $MnSO_4.4H_2O$. Molecular weight 223.

Description.—Black oxide of manganese is mixed with sufficient strong sulphuric acid to obtain a thin magma, which is heated to boiling and evaporated to dryness; the mass is now heated in a crucible to dull redness for some time for the purpose of decomposing the iron sulphate. When cool, it is treated with water, and the solution, if iron be still present, digested with manganous carbonate, then filtered and evaporated to crystallize.

Properties.—When crystallized below 6° C. (43° F.), the salt contains $7H_2O$, and is isomorphous with ferrous sulphate; above that temperature and below 20° C. (68° F.), it contains only $5H_2O$, and has the form of copper sulphate. But the salt usually met with is crystallized between 20° and 30° C. (86° F.), and forms right rhombic prisms, containing $4H_2O$, three of which are given off at a temperature of 115° C. (239° F.). A salt of the same composition as this residue is also obtained by adding sulphuric acid to solution of manganous sulphate and evaporating; it forms a granular powder. The crystals of the officinal salt are of a pale rose-red color, slightly efflorescent in a dry atmosphere, insoluble in alcohol, but freely soluble in water at the ordinary temperature, and somewhat less at the boiling point. The solution has a styptic taste, and yields with ammonium sulphide a flesh-colored precipitate, and with ferrocyanide a white one, but is not disturbed by tannic acid. The fixed alkalies and alkaline carbonates produce white precipitates, which, on exposure to air, are rapidly oxidized, turning brown.

Tests.—The impurities likely to exist are sulphate of iron, the presence of which will cause the precipitate with potassium ferrocyanide to have a blue color; sulphate of copper, which produces a black precipitate by sulphuretted hydrogen; and the sulphates of magnesium and the fixed alkalies, which are indicated by the residue left after precipitating the solution completely with ammonium sulphydrate, evaporating the filtrate to dryness, and igniting.

Other Compounds. MANGANESII CARBONAS.—Carbonate of manganium is prepared by precipitating in the presence of a little syrup a solution of manganous sulphate with carbonate of sodium, washing the precipitate well, and drying it rapidly with a moderate heat. It is a white powder, having a brownish tinge, and dissolving in carbonic acid water, leaving only a slight residue of brown manganic oxide.

MANGANESII CHLORIDUM.—Chloride of manganium is most economically obtained when preparing chlorine from black oxide of manganese and muriatic acid; the resulting liquid is digested with manganous carbonate until the iron has been completely precipitated, the filtrate is evaporated, crystallized, and by recrystallization purified from calcium chloride if present. The salt is in granular, or when slowly evaporated in tabular, crystals of a pale rose-red color, and has the composition $MnCl_2.4H_2O$. It is soluble in alcohol, and requires at ordinary temperature about 2½ parts of water for solution.

MANGANESII IODIDUM.—Manganous iodide is a very deliquescent salt, and is best administered in the form of *syrup*, which may be prepared by dissolving manganous carbonate in hydriodic acid, or by the following formula proposed by Prof. Procter (1850): Take of sulphate of manganese 16 drachms; iodide of potassium 19 drachms; sugar, water, each sufficient. Dissolve each of the salts in three fluidounces of water containing two drachms of syrup; mix, and after precipitation filter the solution into a bottle containing twelve ounces of sugar; add water to make a pint, and shake the bottle till the sugar is dissolved. Each fluidounce contains one drachm of iodide of manganium; it may be given in doses of ten drops to half a fluidrachm.

The same author has also proposed a *syrup of the iodides of iron and manganese*, to be prepared as follows: Take of iodide of potassium 1000 grains; ferrous sulphate 630 grains; sulphate of manganese 210 grains; clean iron filings 100 grains; powdered sugar 4800 grains; distilled water sufficient. Rub the sulphates and iodide separately to powder, mix with the iron filings, add half a fluidounce of water, and rub to a uniform paste; add the same quantity of water a second and a third time, at intervals of fifteen minutes, and rub. Place the sugar in a bottle, and drain the dense solution into it through a filter, adding water slowly to the magma, until the solution of the iodides is displaced and the water measures twelve fluidounces. Lastly, agitate the bottle till the sugar is dissolved. Each fluidounce contains fifty grains of the iodides in the proportion of three parts of iodide of iron to one of iodide of manganium. The dose is the same as the preceding. Both syrups contain some potassium sulphate.

MANGANESII LACTAS.—Lactate of manganium is formed by adding manganous carbonate to hot lactic acid; on evaporating the filtrate, the salt is obtained in pale rose-red shining crystals, which contain 19 per cent. of water of crystallization, are soluble in 12 parts of cold water, and dissolve likewise in hot alcohol, crystallizing again on cooling.

MANGANESII PHOSPHAS.—Manganous phosphate is obtained by precipitating 10 parts of manganous sulphate with 11 parts or sufficient of phosphate of sodium, each separately dissolved in about 80 parts of water, washing the precipitate well to remove the sodium sulphate, and drying. It is a white crystalline powder, sometimes with a reddish tint, having the composition $Mn_32PO_4.4H_2O$, and dissolving readily in dilute acids. A syrup has been recommended by T. S. Wiegand (1854); the salt may be dissolved in dilute muriatic, or, better still, in phosphoric acid, and sufficient sugar dissolved in the cold solution.

MANGANESII TANNAS.—Tannate of manganium was recommended by Marletta (1865). It is obtained by adding recently precipitated manganous carbonate to a hot solution of tannic acid in distilled water, until it ceases to dissolve, filtering, and evaporating to dryness. The carbonate must be absolutely free from iron, and the solution must be protected from contact with iron, otherwise it will acquire an inky color. The salt is soluble in water, and when prescribed in solution, syrup or glycerin should be added for preservation.

MANGANESII TARTRAS, Tartrate of manganium.—On dissolving 10 parts of Rochelle salt and 8 parts of manganous sulphate each in its own weight of hot water, and mixing the solutions, small white or pale-reddish crystals of manganous tartrate are obtained on cooling, which must be washed with cold water, since hot water decomposes them into a soluble acid and an insoluble basic salt.

Physiological Action.—The sulphate of manganese is as energetic as the black oxide is inert. In experiments upon animals, when given internally in large doses it occasions vomiting and gastro-intestinal inflammation; injected into the veins it causes vomiting and purging, dyspnœa, rapid exhaustion, paralysis, and death, and, after this, traces of gastro-intestinal inflammation, and even ulceration, with congestion of the liver and spleen, while liquid or coagulated blood is found on both sides of the heart. In some experiments it is stated that a profuse secretion of bile was observed. It is generally affirmed that this salt possesses the qualities of caustic potassa or soda, dissolving the tissues, and in no wise the astringent action of iron salts.

More than half a century ago Gmelin performed the experiments with sulphate of manganese which are summarized in the preceding paragraph.

More recent experiments have shown that the salts formed by manganese with organic acids weaken the heart's action, prolong its diastole, diminish the arterial blood pressure, tend to paralyze the muscular system, and increase the excretion of nitrogenous compounds. Apparently ignorant of these experiments or of their bearing, a non-medical scientist on the one hand, and on the other a pharmacist and a surgeon, drew the conclusion that because manganese had been detected in the blood, and because in its chemical habitudes it closely resembles iron, therefore it must possess therapeutical virtues analogous to those of iron, and might be used at least to reinforce the latter metal. The folly of some of these theorists went even so far as to suggest the idea that, inasmuch as in nearly all martial preparations there is some manganese, they may possibly derive their virtues from it and not from the iron they contain. The above statement of the physiological action of manganese exhibits the absolute antagonism of its action to that of iron in every point.

Medical Uses.—Sulphate of manganese has been employed as a *cholagogue* purgative in jaundice and other affections associated with hepatic engorgement; but its irritating qualities render it an unsafe remedy. The *dose* of one or two drachms indicated for this purpose cannot be safely given. Its advantages as a substitute for iron are quite illusory. An ointment of this salt, which acts as an irritant upon the skin, has been applied by friction to *glandular indurations* and swellings of the *joints*. The chloride has occasionally been used to stimulate indolent *ulcers*, especially those of syphilitic origin; but it possesses no superiority over the usual topical applications made for this purpose.

MANNA, *U. S.*, *Br.*—MANNA.

Manne, Fr.; *Manna*, G.

The concrete saccharine exudation in flakes, of Fraxinus ornus, *Lin.* (s. Ornus europæa, *Pers.*). Steph. and Church, Med. Bot., plate 53; Bentley and Trimen, Med. Plants, 170.

Nat. Ord.—Oleaceæ.

Origin.—The manna ash, or flowering ash, is a slender tree about 12 to 20 feet high, with opposite pinnate leaves and small white diandrous flowers grouped together on a terminal, drooping, very elegant panicle. It is indigenous to the countries bordering the Mediterranean on the north, from Asia Minor west to Spain, and has been introduced into Central Europe and England as an ornamental tree. The foliage, even on the same tree, is frequently very variable, and *Fraxinus rotundifolia*, Lam., cannot be regarded as a distinct species, nor even as a well-marked variety.

Collection.—Manna is at present collected for commercial purposes solely in Sicily, as was ascertained by Hanbury, the plantations or *frassinetti* being chiefly on the northern shore of that island. When the tree is about eight years old, and its trunk at least 3 inches in diameter, it will yield manna and remain productive for ten or twelve years, when the stem is cut down and replaced by a shoot from the stump. The incisions are made in dry weather with a hooked knife, one each day, commencing near the root, and directly above each other; they are transverse, 2 inches or less in length, and penetrate through the bark to the wood. In the following year the same operation is repeated on the untouched side, and this is continued from year to year until the tree ceases to be productive. The juice flowing from the lower incisions is collected on tiles or in receptacles made from the stem of an opuntia; that from the upper incisions hardens on the stem, or, for producing a superior variety called *manna a cannolo*, which does not enter commerce, is allowed to harden on sticks or straws, inserted into the cuts. When sufficiently hard the large pieces are gathered, and completely dried before being packed, while the smaller ones are afterwards scraped from the stem and sold separately. The annual exportation averages about 3000 cwt.

Description.—The varieties of manna generally distinguished in our commerce are *large flake*, *small flake*, and *sorts*. Flake manna consists of three-edged pieces varying in length from $\frac{1}{2}$ inch to 6 or 8 inches, $\frac{1}{2}$ to 1 or 2 inches wide, and somewhat less in thickness; flat or curved on one side where it adhered to the tree, and uneven from roundish projections on the others, showing the marks of different layers. It is externally of a yellowish-white, in some places pale-brownish color, friable, internally porous, and the cavities filled with white glistening crystals of mannite. Its odor is saccharine, somewhat nauseous, and its taste sweet and honey-like, but combined with a very slight bitterness and acridity. Large and small flake manna differ only in size, the latter, however, being often of a darker shade. Manna in sorts consists of the scrapings, and is met with in fragments of the size of a pin's head to about $\frac{1}{2}$ inch in diameter, with a rather adhesive surface, and of a brownish color outside, but internally nearly white and crystalline; not unfrequently the fragments are united by a viscid brownish matter, which, without the flakes, constitutes *fat manna*, a variety rarely seen in this country. It flows from the incisions late in autumn, and is more particularly yielded by old trees; it is soft and glutinous, entirely devoid of crystals, and less agreeable in odor and taste than flake manna, from which it differs in containing much less mannite and more gum, sugar, and coloring matter.

Manna dissolves in about six parts of cold water, yielding a nearly clear solution, and is soluble in alcohol, leaving little residue.

Sophistication.—Manna has occasionally been sophisticated by mixtures made of bread-crumb, starch, glucose, etc., which are very readily discovered if practised with flake manna; starchy substances can also be readily detected in manna sorts by the iodine tests.

Constituents.—The best flake manna contains about 90 per cent. of *mannite*, the remainder being fermentable *sugar*, *resin*, and *mucilage*. Mannite, $C_6H_{14}O_6$, was discovered by Proust (1806), and may be obtained by treating manna with boiling alcohol, and recrystallizing several times from hot alcohol. Chas. T. Bonsall (1853) recommends the dissolving of manna in three times its weight of boiling water, precipitating gum and coloring matter by a little subacetate of lead, removing excess of lead by sulphuretted hydrogen or a little sulphuric acid, concentrating the filtrate and pouring the hot syrupy liquid into twice its bulk of cold alcohol; the mannite will crystallize on cooling. It crystallizes in colorless needles or glossy rhombic prisms, which fuse at 165° C. (329° F.), and boil near 200° C. (392° F.), when a portion sublimes unaltered, but most of it is converted into *mannitan*, $C_6H_{12}O_5$, a sweetish syrupy liquid. Mannite dissolves in about 6 parts of cold and in much less hot water, in 90 parts of cold 67 per cent. alcohol, and is insoluble in ether and nearly so in absolute alcohol. The solutions scarcely affect polarized light, are not altered by boiling with dilute acids, and do not reduce Fehling's solution. It unites with bases, forming compounds, which are insoluble in alcohol. Nitric acid converts it into racemic acid and sugar, and ultimately into saccharic and oxalic acids. Gorup-Besanez (1861) observed that moist platinum-black converts it into *mannitic acid*, $C_6H_{12}O_7$, and *mannitose*, $C_6H_{12}O_6$, which is fermentable, but optically inactive. Berthelot (1856) has shown that under certain circumstances mannite will undergo alcoholic fermentation. Mannite has been found in a large number of plants, is formed in small quantity during the alcoholic fermentation of sugar, and may be obtained artificially by acting upon glucose with sodium-amalgam.

The fermentable sugar present in manna reduces Fehling's solution very readily, and the mucilaginous matter is precipitated by acetate of lead. The resin is soluble in ether, and has a brown-red color and an acrid taste. The green color observed in some pieces of manna is due to *fraxin*, $C_{32}H_{36}O_{20}$, which was discovered by Salm-Horstmar (1857) in the bark of *Fraxinus excelsior*, the European ash (see pages 650 and 698), and splits with dilute acids into glucose and *fraxetin*, $C_{10}H_8O_5$.

Other Mannas.—The exudations of various trees have received the name of manna; that sometimes obtained in Southern Europe from incisions into the trunk of Fraxinus excelsior, *Lin.*, is identical with the foregoing. The leaves of the European larch, Pinus larix, *Lin.*, yield in the middle of summer a white exudation known as *Briançon manna*, and containing the sugar *melezitose*, $C_{12}H_{24}O_{12}$. The leaves of Eucalyptus viminalis, *Labil.*, of Australia, yield *Australian manna*, containing *melitose*, $C_{12}H_{28}O_{14}$. *Persian manna* comes from Alhagi camelorum, *Fisch.*, Leguminosæ, and contains spines and leaflets of the plant. *Tamarisk manna* exudes from Tamarix mannifera, *Ehrenb.*, in consequence of the puncture made by an insect, Coccus manniparus, *Ehrenb.*, and is collected near Mount Sinai, and sold by the monks of the convent St. Catharine; it contains cane-sugar, glucose, and dextrin. *Armenian* (*oak*) *manna* results from the puncture of a coccus upon the leaves of Quercus vallonea, *Kotschy*, and Q. persica, *Jaub. et Spach;* it is either dissolved from the leaves by water which is evaporated, or else scraped off, and then is mixed with numerous small fragments of the leaves; it consists chiefly of grape sugar. *Lebanon manna* is in small sweet grains obtained from Cedrus libanotica, *Link*. Saccharine exudations have been observed upon a number of other plants, and the saccharine products of some insects, like the *trehala* (*tigala*) of Syria, containing the peculiar sugar *trehalose*, and the *lerp* of Australia, have sometimes been classed with the mannas; they are not entirely soluble in water.

Medical Uses.—Manna has been much used as a *laxative* peculiarly adapted to children and pregnant women; it is also a gentle *cholagogue*, and at the same time a suitable *expectorant* in febrile affections of the lungs. Some writers have held it to be peculiarly fitted, owing to the mildness of its action, to be employed in cases of *genito-urinary irritation.* It is slow in its operation, and is not apt to leave the bowels confined, but it tends to occasion flatulence and colic. Formerly, as at the present day, it was often associated with rhubarb, tamarinds, or senna; and it forms one of the ingredients of *the black draught:*—℞. Sennæ, ℥ss; Magnesiæ sulph., Mannæ, āā ℥ss; Sem. fœniculi, ʒj; Aquæ bull., Oss.—M. Macerate in a covered vessel until the liquid cools. One-third of it may be given every four or five hours, until it operates. The same infusion may be made with cold water by percolation. It is less nauseous, and has a slighter tendency to gripe.

MARANTA, *U. S.*—ARROWROOT.

Amylum marantæ, P. G.—*Arrowroot*, Fr., G.; *Salep des Indes occidentales*, Fr.; *Marantastärke*, G.

The fecula of the rhizome of Maranta arundinacea, *Lin.* Bentley and Trimen, Med. Plants, 265.

Nat. Ord.—Cannaceæ.

Origin.—The maranta is a perennial herb with a branching, fleshy, cylindrical rhizome, either covered with whitish scales or annulate with their scars. The slender branching stem is 5 to 6 feet high, has thickened nodes, ovate lanceolate leaves with long sheaths, and small whitish flowers, usually in pairs at the ends of the branches. The plant is indigenous to the West India Islands and Central America, and is largely cultivated in the Bermudas, in Georgia, and in Brazil. *M. indica*, Tussac, is now regarded by botanists as being identical with the preceding; it is found in Bengal, Java, and the Philippines, and has been introduced into tropical America and Africa.

Fig. 104.

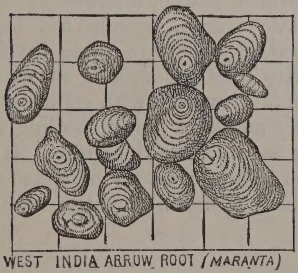
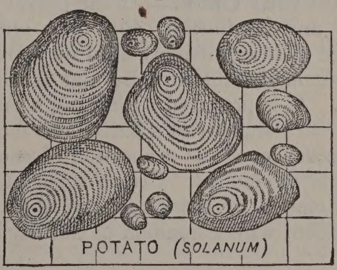


Fig. 105.



Preparation.—When about a year old the rhizomes are dug up, carefully cleaned from the scales, well mashed, and either ground in a mill or rasped until reduced to a pulp, which is suspended in water, the fibrous portion being either separated by hand or by sieves. The starch which settles from the water is repeatedly stirred with fresh portions of clean water, finally allowed to settle, and dried with a gentle heat. The rhizomes yield from 13 to 20 per cent. of fecula. (See papers by Robert Battey in *Proceedings of the Amer. Pharm. Assoc.*, 1858, p. 332, and by W. Eberhard in *Archiv d. Pharm.*, 1868, vol. 184, p. 257.)

Description.—Arrowroot is pulverulent or in small irregular lumps less than $\frac{1}{4}$ inch thick, white, opaque, tasteless and inodorous, and has the general properties of starch. Under the microscope it is seen to consist of ovate or somewhat oval granules, the layers of which are marked by fine but distinct lines, and have upon the broader end a small nucleus or a transverse fissure; the granules are nearly uniform in size.

Substitutions and Adulterations.—*East India arrowroot* is frequently maranta starch, but sometimes consists of the starch of *Curcuma leucorrhiza* and *angustifolia*, Roxb., which is in flattened elliptic or elongated ovate granules, marked with numerous fine lines and at the narrow end with a hilum. For an account of the canna and manihot starch, see the articles *Canna* (p. 334) and *Tapioca*. *Potato starch* is sometimes substituted for arrowroot or used for adulterating it; the granules are of two sizes, a portion being small and subspherical, another portion larger than maranta starch, of an ovate or irregular oval shape, marked with rather coarser lines, and with an inconspicuous hilum at the narrowed end. *Other starches* which may be used for adulteration are easily recognized by means of the microscope.

Tests.—According to the German Pharmacopœia, 1 part of arrowroot gives with 96 parts of boiling water a moderately thin pellucid mucilage; and when it is agitated for 10 minutes with a mixture of 2 parts of muriatic acid and 1 part of water, nearly the whole of the starch should separate unchanged and without the formation of a mucilage or the production of an herbaceous odor. Schaer (1875) has shown that some samples of maranta starch yield in a short time a turbid jelly which gradually becomes limpid, while in most cases it separates unchanged, but is partly dissolved within twenty-four hours. This difference is probably due to climatic influences. The starches of manihot and curcuma have a similar behavior; wheat starch yields no jelly, but, after several hours, a strongly opalescent solution. Potato starch, however, is very readily transformed into a thick, almost clear jelly, forming a complete solution in a few hours, and having a strong herbaceous or bean-like odor.

Preservation.—Arrowroot, like other starches, should be kept in a dry place. In the presence of moisture, and when kept in well-closed vessels, it acquires a musty odor, from which it may be freed by washing with much pure water, after which it should be rapidly dried.

Off. Prep.—Trochisci ipecacuanhæ.

Medical Uses.—As the purest natural form of starch, arrowroot is nutritious and demulcent, and does not, like potato starch, irritate the bowels. Hence it is extensively used in *febrile affections*, especially in those involving the stomach and bowels, and is also a favorite food for infants at weaning time. It is prepared by mixing a tablespoonful of arrowroot with sufficient cold water to reduce it to a paste, and then gradually adding a pint of boiling water (or milk), or a due proportion of each, stirring the mixture the while. It may then be sweetened. Cream is sometimes mixed with the watery mucilage when the stomach or bowels are irritable. In exhausting diseases a little wine may be added, with cinnamon or nutmeg.

MARMOR, *U. S.*—MARBLE.

Marmor album, Br.—*Marbre*, Fr.; *Marmor*, G.
Formula $CaCO_3$. Molecular weight 100.

Native white granular carbonate of calcium.

Properties.—Marble is found in various parts of the globe, the white kind being nearly pure carbonate of calcium, while the colored varieties are more or less tinged or variegated by the presence of oxides of iron and manganium or by bituminous matter. It is met with in masses, which are an aggregation of minute crystals, imparting a granular and glistening appearance. It has the specific gravity 2.7, is brittle, hard, insoluble in the ordinary solvents, but entirely soluble in dilute muriatic acid, carbonic acid gas being given off. It is used in pharmacy for generating the gas mentioned, for which purpose black marble containing bituminous compounds is inadmissible, but other varieties may be used. In case the solution in hydrochloric acid is to be used for the preparation of other calcium compounds, it must be completely freed from iron by digesting it with milk of lime, and, after filtration, should not be precipitated by a solution of sulphate of calcium (absence of barium and strontium), nor by ammonium phosphate, after the previous addition of excess of ammonium chloride and ammonium carbonate and filtration (absence of magnesium).

Marble has the same composition as chalk, and when heated to redness parts with carbonic acid gas, leaving lime or oxide of calcium, CaO.

Pharmaceutical Uses.—In producing carbonic acid gas and for preparing Liquor calcii chloridi.

MARRUBIUM, *U. S.*—HOREHOUND.

Herba marrubii.—Hoarhound, E.; *Herbe de marrube blanc*, Fr.; *Andornkraut*, *Weisser Andorn*, G.

The leaves and tops of Marrubium vulgare, *Lin.* Bentley and Trimen, Med. Plants, 210.

Nat. Ord.—Labiatæ, Stachydeæ.

Origin.—Horehound is a perennial herb, and is found in waste places in Asia, from Northern India westward to the Mediterranean, and throughout Europe except the extreme north; it has been naturalized in Canada and in many parts of the United States westward to California, also in some parts of South America. It is not unfrequently met with in gardens, and it flowers from June to September.

Description.—The branching stem is about a foot high, quadrangular, covered with a white felt. The leaves are opposite, petiolate, about an inch long, roundish-ovate, somewhat heartshaped or rounded at the base, obtuse, serrate or coarsely crenate, wrinkled by the prominent veins below, pale green and downy above, and white hairy beneath. The flowers are in dense axillary whorls, with woolly, linear, and hooked bracts, a tubular ten-ribbed calyx divided into 10 short, spreading, stiff, and hooked teeth, and a white bilabiate corolla inclosing four stamens. The four akenes are dark brown.

Horehound has a strong, peculiar, and aromatic odor, and an aromatic and persistent bitter taste.

Constituents.—Horehound contains, besides some resin, tannin, and other common principles, a small quantity of volatile oil, and *marrubiin*, a bitter principle discovered by Mein (1855). Harms obtained 30 grains from 25 pounds of the dry herb by treating the aqueous extract with alcohol, distilling the latter, and agitating the residue with ether, which dissolves the marrubiin. Kromayer (1861) agitates the infusion with charcoal, and exhausts the latter with hot alcohol, which dissolves the bitter principle and tannin; the latter is removed by oxide of lead. Marrubiin is slightly soluble in cold water, crystallizes from alcohol in prismatic and from ether in tabular crystals, is not precipitated by tannin, and has a very bitter and somewhat acrid taste.

Medical Uses.—Anciently regarded as a general stimulant, expectorant, deobstruent, carminative, and local anodyne, horehound continues to be employed as a stomachic tonic in *dyspepsia*, and in *chronic bronchitis* to restrain secretion. It has also been used in chronic rheumatism, hepatic and uterine disorders, and, like other bitter herbs, in intermittent fever. It has some reputation as an *anthelmintic*, and is said to diminish salivation. The *dose* of the powder is stated to be from thirty to sixty grains. An infusion made with an ounce of horehound in a pint of hot water may be given in doses of a wineglassful. The expressed juice should be administered with honey or milk, in the dose of a teaspoonful or two several times a day. An extract is prepared in Europe.

MASTICHE, *U. S.*, *Br.*—MASTIC.

Mastix, P. G.; *Resina mastiche.*—*Mastich*, E.; *Mastic*, Fr.; *Mastix*, G.

The concrete resinous exudation from Pistacia lentiscus, *Lin.* Woodville, Med. Bot., t. 11; Bentley and Trimen, Med. Plants, 68.

Nat. Ord.—Anacardiaceæ.

Origin.—A small tree or shrub, which is indigenous to the basin of the Mediterranean, has pinnate leaves with leathery sessile leaflets, varying in form between linear and ovate, short-stalked reddish-yellow pistillate, and larger greenish staminate flowers, and small blackish drupes. Mastich is obtained in a few islands of the Grecian Archipelago, principally in Scio, from the var. γ *Chia*, which is tree-like and has broad leaves.

Collection.—The resin being secreted in the bark, vertical incisions are made in June and July in the bark of the trunk and larger branches; and in July and August, after the exuding resin has hardened, it is carefully removed from the tree and collected in baskets; this is the finest quality. An inferior quality consists of the tears which have dropped from the incisions upon tiles or flat stones kept under the tree. A vigorous tree may yield 10 lbs. of mastich; the total harvest is very variable, and occasionally reaches 50,000 cwt., but is generally considerably less.

Description.—The best quality of mastich is in globular or more or less elongated tears of the size of a pea, which are externally covered with a whitish dust, or have been freed from it by washing, and are then of a pale-yellow color, perfectly transparent, of a glass-like lustre, and break readily with a conchoidal fracture. Placed between the teeth, it is easily crushed and then softens into a plastic mass. Its specific gravity is about 1.07; it becomes soft below the boiling point of water, but fuses at some degrees above it. It has a balsamic odor, more apparent on being heated, and a slight terebinthinous taste. It dissolves partly in alcohol, and is also soluble in benzol, acetone, volatile oils, cold creasote, and warm petroleum, leaving a whitish residue. The alcoholic solution reddens litmus.

The inferior kinds of mastich consist of similar tears, to which sand and fragments of bark adhere, mixed with gray- or brown-colored pieces.

Constituents.—Mastich contains a minute quantity of *volatile oil*, and about 90 per cent. of *alpha-resin* or *mastichic acid*, which is soluble in cold alcohol, combines with bases, and, according to Johnston, has the composition $C_{20}H_{32}O_2$. The portion insoluble in alcohol is white, tenacious, soluble in ether and oil of turpentine, and has been named *beta-resin* or *masticin;* its composition is $C_{20}H_{31}O_2$.

Varieties and Adulterations. *Bombay mastich.*—Under this name a drug has appeared in the market, which, when well selected and clean, closely resembles the Scio mastich, but is usually in less clean and more opaque tears. It is obtained from *Pistacia cabulica* and *khinjuk*, Stocks, which are indigenous to Northwestern India and Beloochistan.

Substitutions and admixtures are of comparatively rare occurrence. *Sandarac* is readily distinguished by the tears being more elongated, less perfectly transparent, almost wholly soluble in alcohol, and becoming pulverulent when masticated; it is obtained in Northwestern Africa, from Callitris quadrivalvis, *Ventenat; Nat. Ord.* Coniferæ, Cupressineæ. The tears of *olibanum* are generally larger, translucent, and destitute of glassy lustre. The exudation of Atractylis gummifera is sold in Greece as *pseudo-mastich* or *acantho-mastich*, and consists of agglutinated tears which are oblong in shape and about 2 inches long by one inch in thickness.

Off. Prep.—Pilulæ aloes et mastiches, *U. S.*

Medical Uses.—Formerly employed internally for purposes similar to those for which other terebinthinates are prescribed, its medicinal use is now almost entirely restricted to forming a solution in ether with which cotton may be saturated for the purpose of filling *carious teeth*, and protecting their tender surface from the influence of cold and the contact of food during mastication. A solution of it in alcohol may be applied to arrest bleeding from leech-bites and other slight wounds. Mastich is an ingredient of the "dinner pill" (Pil. aloes et mastiches).

MATICO, *U. S.*—MATICO.

Maticæ folia, Br.—*Feuilles de matico*, Fr.; *Maticoblätter*, G.

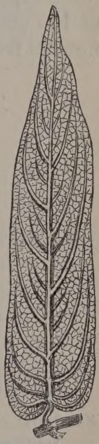
The leaves of Artanthe elongata, *Miquel*, s. Piper angustifolium, *Ruiz et Pavon*, s. Steffensia elongata, *Kunth*. Bentley and Trimen, Med. Plants, 242.

Nat. Ord.—Piperaceæ.

Origin.—A shrubby plant, about 8 feet high, sometimes cultivated, and found in moist woods of tropical America, from Mexico southward to Venezuela, Brazil, and Peru. The minute yellowish flowers are very numerous, aggregated into a solid, cylindrical, slender spike, about 6 inches long, and produce blackish fruits of the size of a poppy seed.

Description.—The leaves, which are very frequently mixed with branches and spikes of flowers or fruits, are rather thick, about 6 inches long, oblong-lanceolate, entire, narrowed at the apex to a blunt point, heart-shaped, and somewhat unequal at the base, and have a very short petiole. The upper surface is nearly smooth, of a green color, and very uneven or tessellated in appearance from the depressed veins, which are prominent beneath, making the downy lower surface reticulate, the meshes being small, and the veins densely covered with brownish hairs. The leaves, particularly when rubbed between the fingers, have an aromatic odor, and a warm, aromatic, bitterish taste.

Fig. 106.



Matico Leaf.

Constituents.—Matico contains about 1½ per cent. of a thickish, pale yellow, volatile oil, consisting of two oils, one of which is sometimes heavier than water. Wiegand (1846) proved the non-existence of Hodges' maticin. Stell (1858) showed the absence of piperina and cubebin, and obtained a ruby-colored resin of a very acrid and pungent taste. Subsequently Marcotte isolated a crystallizable acid, named *artanthic acid*. Matico contains also some tannin, and other principles common to vegetables.

Substitutions.—In different parts of South and Central America, the Spanish names *matico*, and *yerba* or *palo del saldado* (soldier's herb or tree) are given to other plants besides the one described above, namely, to Eupatorium glutinosum, *Kunth* (Compositæ), and Waltheria glomerata, *Presl.* (Sterculiaceæ), the leaves of which are likewise used for arresting hemorrhage. Artanthe (s. Piper) lanceæfolia, *Miquel*, is similarly used in New Granada. Bentley (1864) met with the leaves of Artanthe adunca, *Miq.* (Piper aduncum, *Lin.*), which were offered as matico. They are similar in shape, and the upper surface is marked by some sunken, ascending, and parallel nerves, and the lower surface by corresponding reticulations, but they have not the tessellated appearance nor the roughness and hairiness on the lower surface observed on the officinal matico leaves; their properties appear to be the same.

Off. Prep.—Infusum maticæ, *Br.;* Extract. matico fluid., *U. S.*

Medical Action and Uses.—In its nature and operation matico closely resembles the terebinthinate medicines, while its odorous and special stimulant qualities rank it with cubeb and copaiba. Like these substances, it is absorbed into the blood, and appears to produce a constriction of the capillary vessels, whereby it controls mucous fluxes and hemorrhages, while it occasions more or less diuresis. It has been employed, like copaiba, in the treatment of *bronchitis*, *gonorrhœa*, *leucorrhœa*, *vesical catarrh*, and *chronic diarrhœa* and *dysentery*, and in *hemorrhage* from the *lungs*, *stomach*, *bowels*, *rectum*, and *kidneys*. Like oil of turpentine, it has been used as a topical hæmostatic. The *dose* of the powder is from half a drachm to two or three drachms several times a day. An extract has been made, of which the dose is from sixty to seventy-five grains. The infusion and tincture are officinal.

MATRICARIA, *U. S.*—GERMAN CHAMOMILE.

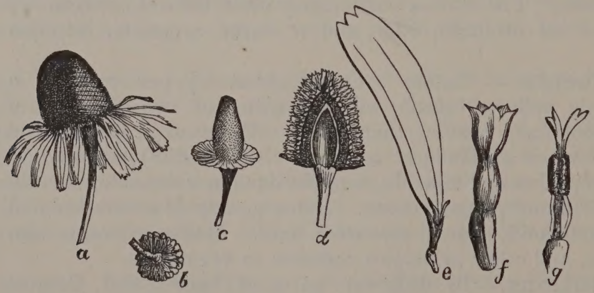
Flores chamomillæ vulgaris, P. G.—*Fleurs de camomille commune (d'Allemagne)*, Fr.; *Kamille*, *Kamillenblumen*, G.

The flowers of Matricaria chamomilla, *Lin.*, s. Chamomilla officinalis, *Koch.* Bentley and Trimen, Med. Plants, 155.

Nat. Ord.—Compositæ, Senecionideæ.

Origin.—An annual herb, with a branching stem about a foot high, smooth, twice or thrice pinnatifid leaves, with spreading setaceous segments and numerous flower-heads terminating the slender branches. The plant is common in fields and waste places throughout Europe as far north as Finland, and in the temperate parts of Asia; it has been completely naturalized in Australia, and is occasionally cultivated in German settlements in the United States. It flowers from May till August.

Fig. 107.



Matricaria.—*a.* Flower-head; *b.* Involucre; *c.* Receptacle and involucre; *d.* Longitudinal section of receptacle, with disk florets; *e.* Ray floret; *f.* Disk floret; *g.* Stamens and style of disk floret.

Description.—The flower-heads are $\frac{1}{2}$ to $\frac{3}{4}$ inches broad, and have a flattish involucre, with two or three rows of small, oblong-linear, obtuse scales, having the margin membranous. The receptacle is at first convex, but becomes strongly conical and hollow, and is free from chaff. The ray-florets are about fifteen in number, soon reflexed, white, ligulate, oblong, with two notches at the apex, and inclosing the bifid style, but no stamens. The numerous yellow disk-florets are tubular, 5-toothed, somewhat glandular, hermaphrodite, and have the anthers united into a tube through which the bifid style projects. The akenes are small, curved, 5-ribbed, brownish, without pappus, but with a slightly elevated margin at the apex. German chamomile flowers have a peculiar aromatic odor, and a bitterish, aromatic taste. They are easily distinguished from allied composite plants by their smooth, conical, and hollow disks, which shrink very considerably on drying.

Constituents.—German chamomile flowers contain about $\frac{1}{4}$ per cent. of volatile oil, some bitter extractive, malates, tannates, and a little tannin, besides the principles common to vegetables.

The volatile oil, *oleum chamomillæ æthereum*, P. G., is a dark blue, in thin layers, transparent, thickish liquid, which gradually turns green and brown when exposed to light and air, and more rapidly if obtained from dried flowers; it has a strong odor of the flowers, and a warm, aromatic taste; dissolves in about 8 parts of 80 per cent. alcohol, has the specific gravity 0.93, and seems to consist of a terpene $C_{10}H_{16}$, associated with $C_{10}H_{18}O$. The blue color is due to the presence of a volatile principle, which was named *azulene* by Piesse, and *cœrulein* by Gladstone (1863), and which, according to both investigators, is present in all other volatile oils having a blue or green color; in the latter associated with a yellow principle.

An oil of German chamomile, containing oil of lemon, is still sometimes met with in our market; it was formerly officinal in Europe as *Oleum chamomillæ citratum*, and, according to the late Prussian Pharmacopœia, prepared by adding to 480 parts of recently collected flowers, one part of oil of lemon, and then distilling with water; it has a deep blue color, but is more limpid than the pure oil, and more prone to change in color.

OLEUM CHAMOMILLÆ INFUSUM, P. G., is employed externally, and made by macerating 2 parts of the flowers with 1 part of alcohol for several hours, and then digesting with 20 parts of olive oil until the alcohol has been expelled, expressing and filtering; it has a yellowish-green color.

Medical Uses.—German chamomile has less agreeable qualities than English chamomile (*anthemis*), but medicinally may be substituted for it.

MEDEOLA.—MEDEOLA.

The rhizome of Medeola (Gyromia, *Nutt.*) virginica, *Lin.*

Nat. Ord.—Liliaceæ.

Origin.—The medeola or *Indian cucumber* grows in damp soil in woods and shady places of the United States, and flowers in June. It has a slender stem, about 18 inches high, beset with a deciduous fine wool, and bearing above its middle a whorl of 6 or 8 spreading oblong-lanceolate leaves, which are about 3 inches long, and acute at both ends. Near the top is a whorl of 3 or 4 smaller ovate pointed leaves, and above them 3 or 4 greenish-yellow recurved flowers, having 6 sepals and stamens, and producing a purplish-blue three-celled berry, each cell containing about 5 triangular seeds.

Description.—The rhizome is horizontal, 1 or $1\frac{1}{2}$ inches long, about $\frac{1}{4}$ inch thick, pointed at the lower end, beset with hair-like simple rootlets, pale brown-yellowish externally, white internally, and with few small wood-bundles. It is without odor, and has a sweetish, in the fresh state somewhat cucumber-like, taste. Its constituents, among which is starch, have not been investigated.

Medical Action and Uses.—There appears to have been nothing added for many years to the scanty knowledge originally possessed of this root, viz.: that it was reputed to be hydragogue and diuretic, and therefore useful in dropsies.

MEL, *U. S.*, *Br.*—HONEY.

Miel, Fr.; *Honig*, G.

A saccharine secretion deposited in the honey-comb by Apis mellifica, *Lin.*, the hive bee.

MEL DESPUMATUM, *U. S.*—CLARIFIED HONEY.

Mel depuratum, Br., P. G.—*Miel despumé*, *Mellite simple*, Fr.; *Gereinigter Honig*, G.

Origin.—A saccharine liquid is secreted by the nectaries of flowers and collected by the working bees in their so-called honey-bags, where it probably undergoes some changes before it is disgorged again in the hive. Evidently the source from which it has been collected by the bees must exert considerable influence on its flavor, and it may even contain injurious principles when the flowers of poisonous plants have been frequented by the bees; to this cause at least have been referred cases of poisoning which occurred after partaking of honey. It has been stated that honey bees introduced into Australia ceased to produce honey after the first year, probably because in that climate they could collect the necessary food during the entire year. Honey is largely produced in Europe and North America; much that is used in the United States is imported from the West Indian Islands, and recently a well-flavored honey from California has been introduced in the Atlantic States.

Preparation.—The finest honey, called virgin honey, is obtained simply by draining the comb; when pressure or heat is used a darker colored product is obtained. The yield of a hive is about 15 to 20 pounds (see paper by B. F. Creighton, in *Amer. Journ. Phar.*, 1875, p. 487).

Clarification.—Take of Honey a convenient quantity. Melt it by means of a water-bath, and then remove the scum. *U. S.*

The object of clarification is to remove the wax and other impurities of honey, which rise to the surface when the honey is kept for awhile in the condition of a thin fluid by exposing it to the heat of a water-bath. The British Pharmacopœia directs it then to be strained through flannel previously moistened with water. The French Codex dissolves four parts of honey in one part of water, heats the mixture, removes the scum, clarifies with paper pulp, strains, and evaporates to the proper density. The German Pharmacopœia orders honey to be diluted with twice its weight of water, heated to 100° C. (212° F.) for one hour, filtered and evaporated. Various other methods have been suggested, among which may be mentioned the following: To dilute the honey with some water, add white of egg, heat gradually up to near boiling, strain and concentrate; or to add to 28 pounds of honey, diluted with water, a little (3 drachms) gelatin, heat and exactly precipitate the gelatin by (1 drachm) tannin; or to treat the diluted honey with prepared chalk, or with animal charcoal, or with both, or to interrupt the boiling repeatedly for about a minute by the addition of sufficient cold water, and after filtration to concentrate to the proper consistence. The long-continued heat necessary for concentrating diluted honey, impairs its aroma, and imparts to it a darker color. In our experience the first two processes give quite satisfactory results, though the product is never absolutely transparent, a result aimed at by the other processes.

Properties.—When recently prepared, honey is a nearly transparent, pale yellowish, or brownish syrupy liquid, which, on keeping, separates a granular deposit, and is ultimately changed into a crystalline mass intermixed with some liquid. It has an agreeable odor, differing more or less from causes mentioned above, and a sweet taste, followed by a slight acridity. In some parts of Africa a brown and even greenish honey has been observed, which may be produced by different species of *Apis*. Clarified honey has the same properties, except that it is more transparent.

Honey dissolves readily in water, also in diluted alcohol, yielding in both cases slightly turbid solutions which have a faint acid reaction.

Constituents.—The odor of honey is doubtless due to a minute quantity of volatile oil, which, according to Calloud, is intimately associated with a yellow coloring matter, *melichroin*, separated by the nectaries, and which is bleached on exposure to sunlight. A little wax and gummy matter are usually present; but the main constituents are *grape-sugar* or *dextrose* and *fruit-sugar* or *levulose*. The honey of an American wasp, *Polybia apicipennis*, according to Karsten, contains cane-sugar, and the same may be the case with honey from other sources; this constituent, however, is gradually changed to *invert sugar*, which is a mixture of grape- and fruit-sugars. It is the grape-sugar which renders honey granular, while the fruit-sugar remains liquid; the former turns polarized light to the right, the latter to the left. Honey has a specific gravity of 1.35 to 1.42.

Adulterations.—The coarse adulteration with starchy substances is easily recognized in the insoluble matter left on treating with dilute alcohol, and by the blue color produced on the addition of solution of iodine. Adulterations with artificial grape-sugar, prepared from starch by boiling with sulphuric acid, are difficult to establish. Aside from the physical properties, the presence of soluble sulphate (of calcium) affords the best criterion. E. Dietrich (1877) observed that, by dialyzing honey into water, the dialyzed portion, on concentration, had a golden-yellow color and a remarkably fine floral odor, while the residue upon the dialyzer was destitute of honey odor, and had a sweet but insipid taste.

Pharmaceutical Uses.—Clarified honey is used as an excipient for some *pill masses* and *confections*, as the basis of *mellita* and *oxymellita*, and is an ingredient in Pilula ferri carbon., Tinct. cardamomi comp., and Tinct. opii comp., *U. S.*

MELLITA. Medicated honeys, *E.*; Mellites, *Fr.*; Honige, *G.*—These are simply mixtures of honey with certain medicinal substances. Owing to their proneness to change, the number of these officinal mixtures has been considerably diminished, and, with but few exceptions, none are kept on hand, but are prepared extemporaneously when required by the physician.

OXYMELLITA, Oxymels, *E.*, *Fr.*, Sauerhonige, *G.*, are medicated honeys containing acetic acid (see Oxymel).

Medical Action and Uses.—Honey is one of the most ancient of medicines, and its nutritious qualities were always well known. Medical history shows that the Greeks and Arabians were well acquainted with its uses and the noxious qualities of certain kinds of it. Honey may be used with other food without any unpleasant effects in most instances; but there are persons who cannot take even a small quantity of it without feeling the head heavy or confused, while in others it causes flatulence or diarrhœa. Among the plants which bees producing poisonous honey frequent are *Nerium oleander*, *Azalea pontica*, *Daphne mezereum*, *Aconitum*, and *Kalmia latifolia*. The last, or mountain laurel, is the chief source of poisonous honey in this country. The symptoms it produces are dimness of sight, vertigo, a mild or furious delirium, abdominal pain, vomiting and purging, perspiration, convulsions, foaming at the mouth, and, in a few instances, death. In some cases an eruption also appears upon the skin, and there is soreness of the throat with hoarseness of the voice.

Anciently honey was employed for most of the medicinal purposes for which sugar is now used, and especially with barley water for bronchial affections and sore throats. Its use is almost exclusively local, and for the same purposes as of old, particularly to stimulate mucous surfaces, and even cutaneous sores, when their condition denotes impaired vitality. It is habitually employed to cure *aphthæ*, *thrush*, and *pseudo-membranous deposits*, but its efficacy is increased by the addition of muriatic acid, borate of sodium, chlorate of potassium, etc. Hence the officinal preparations *Mel rosæ*, *Mel sodii boratis*, etc. It is sometimes useful as an ingredient of poultices for *boils* and *carbuncles*, as an application to *fissures of the nipple*, etc., and is applied in plasters to the mamma for *drying up the milk.*

In this connection it may be mentioned that *propolis*, a resinous exudation with which bees cover the bottom of their hives, is reported to be beneficial in the treatment of acute and chronic *diarrhœa.*

MEL ROSÆ, *U. S.*—HONEY OF ROSE.

Mel rosatum, P. G.; *Mellitum rosatum.*—*Mellite de roses rouges*, *Miel rosat*, Fr.; *Rosenhonig*, G.

Preparation.—Take of Red Rose in moderately fine powder two troyounces; Clarified Honey twenty-five troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with half a fluidounce of diluted alcohol, pack it firmly in a conical glass percolator, and gradually pour diluted alcohol upon it until six fluidrachms of filtered liquid have passed. Reserve this portion, and continue the percolation until half a pint more of liquid is obtained. Evaporate this by means of a water-bath to ten fluidrachms, add the reserved liquid, and mix the whole with the clarified honey. *U. S.*

This process is essentially the one recommended by I. J. Grahame (1859), and aims to preserve in the reserved portion the main quantity of the little volatile oil present in the rose petals. The French and German Pharmacopœias direct the rose to be infused in six times its quantity of water, the infusion to be strained, and mixed with the honey, and concentration by evaporation by means of a water-bath.

Medical Uses.—Its agreeable flavor and slight astringent and stimulant virtues render it a very pleasant and useful addition to water as a mouth-wash and gargle; or it may be applied undiluted to the affected part. It is a convenient vehicle for the administration of aromatic sulphuric acid, and other acids.

MEL SODII BORATIS, *U. S.*—HONEY OF BORATE OF SODIUM.

Mel boracis, Br.—*Borax honey*, E.; *Miel boraté*, *Mellite de borax*, Fr.; *Boraxhonig*, G.

Preparation.—Take of Borate of Sodium in fine powder sixty grains; Clarified Honey a troyounce. Mix them. *U. S.*

Take of Borax in fine powder sixty-four grains; Clarified Honey one ounce. Mix. *Br.*

It is made extemporaneously.

Medical Uses.—This mixture, which should have been left to extemporaneous preparation, is a very useful application for *aphthous* and other *ulcers* of the mouth and fauces. It is equally curative in similar affections of the female *genital organs.*

MELILOTUS.—MELILOT.

Herba (*Summitates*) *meliloti.—Sweet clover*, E.; *Mélilot*, Fr.; *Steinklee*, *Melilotenklee*, G.

Melilotus officinalis, *Willd.*, and Mel. alba, *Lam.*

Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—Both plants are frequent in Europe, along roadsides and in cultivated ground, and have been, to some extent, naturalized in North America. They are about three feet high, smooth, and have entire awl-shaped stipules and trifoliate leaves, the former species with oval or obovate-oblong leaflets; the latter with the lower leaflets truncate and the upper ones lanceolate. The flowers are in erect racemes, and of a yellow (Mel. officinalis) or white color (Mel. alba). The German Pharmacopœia recognizes only the yellow melilot. Both species have an agreeable odor.

Constituents.—The odorous principle was observed by Vogel (1820), and supposed to be benzoic acid. Guillemette (1835) proved it to be identical with Guibourt's *coumarin*, obtained from tonka beans. It may be prepared by exhausting the herb with strong alcohol, distilling off most of the solvent, separating the fat, crystallizing, and purifying by recrystallization from alcohol. Coumarin, $C_9H_6O_2$, which has since been isolated from many odorous plants (see p. 657 and 806), crystallizes in colorless shining prisms, which fuse at 67° C. (152.6° F.), and are readily soluble in fixed and volatile oils, alcohol, and hot water.

When treated with sodium amalgam, it is converted into *melilotic* and *coumaric acids*, which are also present in the herb, sometimes in combination with coumarin. Both acids are crystallizable, and have a bitter taste. Melilotic acid, $C_9H_{10}O_3$, fuses at 82° C. (179.6° F.), and its salts, when strongly heated, yield phenol. Coumaric acid, $C_9H_8O_3$, is also obtained from coumarin by boiling it with concentrated potassa solution; it fuses at 195° C. (383° F.), and the solutions of its salts are fluorescent.

TONKA BEANS, *E.*, Fève tonka, *Fr.*, Tonkabohnen, *G.*, are the seeds of a papilionaceous tree of Guiana, Dipteryx (Coumarouna, *Aubl.*) odorata, *Willd.* They are nearly two inches long, somewhat two-edged, deeply wrinkled, blackish-brown, of a fatty lustre, and usually covered with a crystalline efflorescence of coumarin. The so-called English tonka beans, from Dip. oppositifolia, *Willd.*, are smaller, about an inch long, smoother, and contain less coumarin.

Medical Action and Uses.—The peculiar odor of melilot, which is closely analogous to that of tonka bean, of vanilla grass, etc., as well as its active properties, are attributed to a proximate principle, coumarin. Given to dogs in the dose of from seven to ten grains, this substance produced great and even fatal depression; and in man in the dose of from thirty to sixty grains it occasioned nausea, giddiness, depression, vomiting, and drowsiness. In Europe melilot is sometimes mingled with hay to stimulate the appetite of cattle; it is strewn among clothing and furs to protect them from moths; and is mixed with snuff to scent it. Formerly it was used in a variety of disorders, including colic, diarrhœa, dysury, dysmenorrhœa, and rheumatism, but at present it is only applied externally, in decoction or infusion, to allay *local pains*, especially in the abdomen and joints. These preparations are made with from half an ounce to an ounce of the flowering tops in a pint of water.

MELISSA, *U. S.*—BALM.

Folia melissæ, P. G.; *Herba melissæ.—Lemon balm*, E.; *Mélisse, Céline, Herbe au citron*, Fr.; *Melissenblätter, Citronenkraut*, G.

The leaves and tops of Melissa officinalis, *Lin.*

Nat. Ord.—Labiatæ, Satureieæ.

Origin.—Balm is a perennial herb, from the woody root-stock of which a number of branching, pubescent stems, two to three feet high, are produced. The plant is indigenous to Western Asia and Southern Europe, has become naturalized to some extent in the United States, and is not unfrequently cultivated. The variety α *citrata*, Bischoff, or lemon balm, is generally preferred, and is alone recognized by some of the European Pharmacopœias.

Description.—The leaves are about two inches long, petiolate, ovate, with a rounded or somewhat heart-shaped base, coarsely crenate-serrate at the margin, obtusely pointed at the apex, the upper surface with scattered hairs, the lower surface glandular in the axils of the nerves. The upper leaves are smaller, often softly pubescent on both sides, and at the base rather wedge-shaped. The axillary cymules are about four-flowered; the calyx is hairy, tubular, bell-shaped, with the upper lip three-toothed, and the lower two cleft. The milk-white or pale-purplish corolla has the tube curved upwards; the stamens are four in number, the lower pair longer, all converging towards the upper lip. The dried herb has a mild agreeable odor, in the variety mentioned above, somewhat like that of lemon; the taste is slightly bitter.

Melissa cordifolia, *Pers.*, is indigenous to Southern Europe, where it is sometimes medicinally employed; the leaves are larger and more woolly, and have a rather disagreeable odor; the plant is now regarded as a mere variety of M. officinalis.

Adulterations are not likely to be met with. The leaves of *Nepeta cataria*, Lin., var. β *citriodora*, have an odor resembling that of lemon balm; but they are cordate-ovate, of a gray-green color, soft, downy above and tomentose beneath, and by these characters are easily distinguished from melissa.

Constituents.—The leaves contain, besides the common constituents of plants, about $\frac{1}{8}$ to $\frac{1}{4}$ per cent. of volatile oil, which is colorless or yellowish, has a spec. grav. of about 0.89, dissolves in about five parts of alcohol spec. grav. 0.85, and contains a stearopten.

Medical Uses.—Balm tea is a popular and refreshing drink, when made with the fresh plant, and taken cold. The hot infusion of the dried plant is one of the mildest that can be used to favor the operation of diaphoretic medicines. It is officinal.

MENISPERMUM CANADENSE.—YELLOW PARILLA.

The rhizome of Menispermum canadense, *Lin.* *Nat. Ord.*—Menispermaceæ.

Origin.—The yellow parilla, or *Canadian moonseed*, is a North American climber, with peltate, roundish-cordate, and angular leaves, small clusters of greenish-yellow flowers, and black glaucous roundish, kidney-shaped drupes. The rhizome was formerly brought into commerce as *Texas sarsaparilla*, and its botanical source was established by R. P. Thomas (1855).

Description.—The rhizome is several feet long, about a quarter of an inch thick, cylindrical, when dry, with numerous fine longitudinal wrinkles, of a yellowish-brown color, and beset with thin branching rootlets. Internally it is yellowish, breaks with a tough fibrous fracture, and exhibits on transverse section a bark of about one-eighth the diameter of the rhizome, and composed of two distinct layers; a woody zone of the same thickness, consisting of short, nearly square porous wood wedges, separated by broad medullary rays, and a large central pith. The rhizome has a slight odor and a bitter taste.

Constituents.—We found (1863) the rhizome to contain a small quantity of berberina and a larger proportion of a white alkaloid, which is soluble in ether, alcohol, and much water, neutralizes acids completely, and yields precipitates with the group reagents for alkaloids. It also contains starch. The other constituents have not been investigated.

Medical Action and Uses.—It has been reputed for many years that moonseed is tonic, alterative, and diuretic, and that its medical qualities resemble those of sarsaparilla. It much more probably resembles colombo, not so much because, like that medicine, it yields berberina, as because it is bitter. We read that it is used in *scrofulous* affections as a substitute for sarsaparilla, but without the assurance that the latter medicine is itself of demonstrable utility in their treatment. Whatever virtues it may possess await the discovery of intelligent investigation.

MENTHA PIPERITA, *U. S.*—PEPPERMINT.

Folia (*Herba*) *menthæ piperitæ*, P. G.; *Menthe poivrée*, Fr.; *Pfefferminze*, G.

The leaves and tops of Mentha piperita, *Lin.* Bentley and Trimen, Med. Plants, 203.

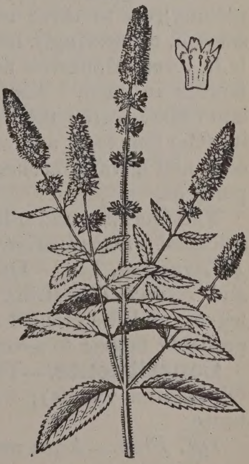
Nat. Ord.—Labiatæ, Satureieæ.

Origin.—Peppermint is a perennial plant, readily multiplying by runners, and with a square frequently purplish stem, about three feet high. Its native country is unknown; it is regarded as a mere variety of *M. hirsuta*, Lin., with which it is connected by many intermediate forms, and from which it was probably produced by cultivation. It is now found wild in wet places in England, in other countries of Europe, and in North America; it is largely cultivated. It flowers in August and September.

Description.—The leaves are 2 to 3 inches long, and all petiolate, the petioles being about half an inch long; they vary in shape between lanceolate and ovate-lanceolate, have a rounded base, an acute apex, and a sharply serrate margin; the upper surface is dark green, and smooth, the lower surface paler, with numerous glands, and upon the nerves sparingly pubescent. The inflorescence is terminal, consists of 12 to 16 whorls, the lowest of which are somewhat distant; it is conical in shape, rounded or acute above, and about 2 inches long; the cymules of each whorl contain about 20 or 30 flowers. The calyx is often purplish, tubular, 5-toothed, 10-ribbed, glabrous, but dotted with yellowish glands. The corolla is pale purplish-red, and smooth, with the tube about as long as the calyx, and the limb nearly equally four lobed. The four short stamens are equal in length, and included in the calyx tube. The fruit consists of four brownish smooth or rugose akenes.

Several varieties are known, differing in the width of the leaves, the amount of pubescence, and the compactness of the flowering spikes.

Fig. 108.



Mentha piperita. *Lin.*

Constituents.—The most important constituent is the volatile oil, of which the dried herb yields in the neighborhood of 1 per cent. (see Ol. menthæ piperitæ). A little tannin and the other constituents are of no medicinal importance.

Off. Prep.—Aqua menthæ piperitæ, Spiritus menthæ piperitæ, *U. S.*

Medical Action and Uses.—The name peppermint denotes the sharp, biting taste of this plant, whose odor, when fresh, is likewise very powerful, but refreshing. In the mouth it produces a pungent sensation, followed by a sense of coolness and numbness, increased by inhaling strongly. The essential oil occasions this feeling more sensibly, as well as a diffusive warmth in the abdomen, when it is swallowed. The action of peppermint is mainly that of a carminative stimulant, with a certain degree of anodyne power, which last is especially recognized by the popular use of the bruised fresh leaves to ally *colic*, *headache*, and other local pains. A hot infusion is commonly employed to relieve *colic*, *flatulence*, *diarrhœa*, *vomiting*, *cholera morbus*, *dysmenorrhœa*, and the associated abdominal pains. Nervous *headaches*, *palpitation of the heart*, *hiccup*, and other phenomena of difficult digestion, are palliated by this medicine. The hot or warm infusion, especially of the fresh herb, is a very excellent preparation; but usually the spirit is more convenient, given in sweetened hot water. The special virtues of the oil are described elsewhere.

MENTHA VIRIDIS, *U. S.*—SPEARMINT.

Herba menthæ acutæ (vel romanæ).—*Menthe verte*, *Menthe romaine*, *Baume vert*, Fr.; *Grüne Minze*, *Römische Minze*, G.

The leaves and tops of Mentha viridis, *Lin.*, s. M. sylvestris var. glabra, *Koch.* Bentley and Trimen, Med. Plants, 202.

Nat. Ord.—Labiatæ, Satureieæ.

Origin.—Spearmint is a perennial herb with a square green or sometimes purplish stem about three feet high, and multiplying extensively by long runners. It is probably a cultivated variety of *M. sylvestris*, Lin., the typical form of which has broader woolly leaves and a cylindrical or subconical inflorescence, and is frequently found in moist and swampy localities throughout the greater portion of Europe. Spearmint appears to be indigenous to England, but it is cultivated, and has been naturalized, in the United States and most civilized countries. It flowers from July to September.

Description.—The leaves are sessile, or only the lowest with a very short petiole, two to three inches long, lanceolate to ovate-lanceolate, acute, serrate, smooth, or sparingly hairy, and densely glandular beneath. The inflorescence is in terminal, narrow acute spikes, with distant whorls of about fifteen to twenty flowers in each. The glandular calyx is tubular bell-shaped, with five sharp and ciliate teeth; the corolla is light-purplish, naked, four-lobed, and bears upon its tube four long and nearly equal stamens. Spearmint has a strong aromatic odor and a warm aromatic taste, which resembles that of peppermint, but is less pungent.

The German and other Pharmacopœias recognize, instead of spearmint, the so-called *crisped mint*, *Mentha crispa*, Lin., which is a cultivated variety of *M. aquatica*, Lin. Other species of mint, like *M. sylvestris*, *viridis*, *sativa*, and *rotundifolia*, Lin., frequently produce in cultivation forms with crisped leaves, and the crisped mints cultivated in different parts of continental Europe probably belong to several of these species.

Constituents.—The principal constituent of spearmint is volatile oil (see Ol. menthæ viridis); the others are of no medicinal or pharmaceutical importance.

Off. Prep.—Aqua menthæ viridis, Spiritus menthæ viridis, *U. S.*

Medical Uses.—Spearmint is generally described as identical in its action with peppermint, but it is really much less intense. Its uses are the same as those of peppermint, but its milder action has led to its being preferred for infantile cases.

MENYANTHES.—BUCKBEAN.

Folia (Herba) trifolii fibrini, P. G.—*Bogbean, Marsh trefoil*, E.; *Ményanthe, Trèfle d'eau (de marais)*, Fr.; *Fieberklee, Bitterklee, Dreiblatt*, G.

The leaves of Menyanthes trifoliata, *Lin.* *Nat. Ord.*—Gentianaceæ.

Origin.—The buckbean is a perennial, indigenous to North America from Pennsylvania northward, to Europe and Northern Asia. It grows in boggy places, has a fleshy rhizome of the thickness of a finger, and sheathed by the remnants of the leaf-stalks, and bears a naked scape with about fifteen rose-colored or whitish flowers. It blooms in May and June.

Description.—The leaves are on petioles, four or six inches long, ternate, the leaflets sessile, about two inches long, obtuse, oblong or obovate, the margin slightly crenate, smooth, and pale green. They are inodorous, and have a very bitter taste free from astringency.

Constituents.—Trommsdorff found in the leaves the principles usually present in herbaceous parts of plants, and obtained the bitter principle in the form of an extract-like mass. Brandes (1830 and 1842) succeeded in gaining it partly as a thick amorphous mass, partly in yellowish-white granules. Landerer (1839) found an ethereal extract of buckbean to contain white bitter needles, which were soluble in water and alcohol, and precipitated by alkalies from their acid solution (?). Kromayer and Ludwig (1861) obtained *menyanthin*, which has probably the composition $C_{33}H_{54}O_{16}$, by several processes. The following is an outline of one of them: The concentrated infusion is precipitated with tannin, the precipitate mixed with litharge, dried, and exhausted with alcohol. The mass left on evaporating the alcohol is washed with cold water and ether, again treated as before with tannin and litharge, the alcoholic solution passed through animal charcoal, mixed with water, and evaporated. It dries over sulphuric acid to an amorphous whitish mass, which, on the application of heat, softens, and at 115° C. (239° F.) is limpid and transparent. It is sparingly soluble in cold water, soluble in alkalies and alcohol, but insoluble in ether. It has a very bitter taste, aud when boiled with dilute acids is resolved into sugar, a brown resin, and *menyanthol*, the latter being oily, volatile, heavier than water, and of an agreeable odor resembling that of bitter almonds.

Pharmaceutical Uses. EXTRACTUM MENYANTHIS S. TRIFOLII FIBRINI.—The French preparation is the inspissated juice. In Germany it is made by hot infusion of the dry leaves with water.

Medical Action and Uses.—Water-shamrock, or marsh trefoil, is a bitter tonic which is reputed to be also antiscorbutic, emmenagogue, and vermifuge. In large doses, like other bitters, it acts as an emetic, and some observers have attributed to it narcotic qualities. It is chiefly used in atonic *dyspepsia* and those hepatic and digestive derangements which are apt to prevail in damp malarial localities. It is a popular remedy in chronic *cutaneous eruptions* both internally and externally. The most efficient form of the medicine is the expressed juice, which is administered in the dose of two or three ounces daily, in whey or thin broth. A decoction is made with half an ounce of the herb in a pint of water, both for internal and external use.

MESEMBRYANTHEMUM.—ICE PLANT.

Diamond fig, E.; *Glaciale*, *Cristalline*, Fr.; *Eiskraut*, G.

Mesembryanthemum crystallinum, *Lin.* *Nat. Ord.*—Mesembryanthemeæ.

Description.—The ice plant is an annual or biennial, growing near the sea-coast of Southern Europe and Southern Africa, and is much cultivated for ornament. It is smooth, but covered with glittering vesicles resembling hoar-frost, about a foot long, decumbent; has the lower leaves opposite, the upper ones alternate, varying between roundish-ovate or obovate to oblong, wavy, amplexicaul, and frequently purplish on the margin and apex. The flowers are nearly sessile, white or reddish, have numerous linear petals and stamens, and produce a five-celled many-seeded capsule. The plant is inodorous, and has an unpleasant saline taste.

Constituents.—John found the expressed juice to contain 3 per cent. of solid matter, consisting of various salts and the ordinary principles of the herb. The liquid of the vesicles, according to Voelcker, contains albumen, oxalic acid, and various salts. The dry plant yielded to Brandenburg 42 per cent. of ash, of which 31 per cent. were sodium salts, the remainder being salts of earths and traces of potassium.

Medical Action and Uses.—This is an obsolete medicine, which once had a certain vogue in Europe, especially for the relief of disorders of the bladder attended with *dysury* or *incontinence* of urine. The expressed juice was used in the *dose* of a tablespoonful daily.

MESENNA.—MUSENNA.

Muséna, *Moucéna*, Fr.; *Musennarinde*, G.

Origin.—The musenna bark has been referred by Brogniart to a papilionaceous tree, *Albizzia anthelmintica*, and by Martius, Hochstetter, and others to *Rottlera Schimperi*, *Nat. Ord.* Euphorbiaceæ. The bark comes from Abyssinia, and was sent to Europe about the year 1838.

Description.—Musenna bark comes in flat or bent pieces, which are one or two inches broad and sometimes twelve inches long. The outer surface is either smooth and brown-gray, or uneven, fissured, and yellowish-brown, followed by a thick pale brownish-yellow granular layer, which covers the very tough and fibrous bast layer. The bark is inodorous, and has, particularly in the liber, a nauseous, sweet, bitterish, and afterwards persistently acrid taste.

Constituents.—Thiel (1862) isolated *musennin*, which is an amorphous acrid principle resembling saponin, but more soluble than this in alcohol; the bitter principle has not yet been obtained pure. Tannin appears to be absent. The bark yields 5½ per cent. of ash, containing much silica.

Medical Action and Uses.—It is alleged that the Abyssinians, to expel the *tænia*, use three or four ounces of the powdered bark of musenna made into an electuary, after fasting for twenty-four hours. The parasite is discharged, neither whole nor in fragments, but reduced to a sort of pulp. The medicine thus administered is apt to occasion nausea, but neither colic nor diarrhœa, and its use is followed after several hours by a purgative, usually of castor oil.

METHYLENI BICHLORIDUM.—BICHLORIDE OF METHYLENE.

Chloro-methyl, E.; *Chlorure de méthyle monochloré, Éther chlorhydrique monochloruré de l'esprit de bois*, Fr.; *Methylenchlorid, Chlormethylchlorür*, G.

Formula CH_2Cl_2. Molecular weight 85.

Preparation.—Methyl chloride (CH_3Cl) is prepared by heating a mixture of one part of methylic alcohol, two parts of common salt, and three parts of sulphuric acid, and passing the gas through water into a glass globe, into which chlorine gas is conducted at the same time; the globe is drawn out below so as to form a thin tube, which passes into one tubulure of a Woulfe's bottle, the second tubulure being connected, by means of a bent glass tube, with a second Woulfe's bottle placed in ice, and this with a flask, cooled by means of a freezing mixture; the liquid condensed in the Woulfe's bottles is chiefly chloroform, while that condensing in the flask will be pure methylene bichloride. This is Regnault's process, by whom the compound was discovered (1840), while methyl chloride was discovered by Dumas and Peligot (1835).

Properties.—Methylene bichloride is a colorless liquid, having at 18° C. (64.4° F.) the spec. grav. 1.344, and boiling at 30.5° C. (87° F.). Its odor resembles that of chloroform. It has no action upon test-paper, is soluble in alcohol and ether, and scarcely affected by alcoholic solution of potassa. Its vapor has the density 3.012, and burns with a bright flame.

In composition it may be regarded as a chloride of methylene (CH_2), or as a derivative of methyl, CH_3; the following shows its relation to allied compounds:—

	Methyl CH_3.	Methylene CH_2.
Marsh gas	$CH_3.H$	——
Methyl chloride	$CH_3.Cl$	——
Methylene bichloride . . .	$CH_2Cl.Cl$	CH_2Cl_2
Chloroform	$CHCl_2.Cl$	$CHCl.Cl_2$
Chloro-carbon	$CCl_3.Cl$	$CCl_2.Cl_2$

Physiological Action. *On Animals.*—Dr. Richardson found that chloride of methylene produced, though in a less intense degree, the same effects as the bichloride, which has the great advantage of being a more stable compound. When pigeons are exposed to the vapor of this latter preparation, it is longer in producing anæsthesia than chloroform, the pulse and respiration are more accelerated, the insensibility more prolonged, and the recovery more sudden. In a rabbit killed by it the heart-beat and the breathing ceased simultaneously; the lungs were not congested, and both sides of the heart contained blood. Blood saturated with this bichloride is of a bright red color, and even when defibrinated forms a clot of albumen and corpuscles.

On Man.—The inhalation of the vapor is described as being very pleasant and but slightly irritating; drowsiness and unconsciousness coming on without any noise in the head or oppression, and recovery taking place at once and completely, without any sense of depression. Like chloroform, it is very apt to occasion vomiting; and like ether, it sometimes causes a stage of excitement and struggling which may be difficult to subdue. Although it does not produce fatal effects as frequently as chloroform, it is not wholly exempt from that danger. Up to 1874 at least four cases had been reported in which death was directly traceable to this anæsthetic, and in the following year a fifth occurred in London. In the last case the breathing became suddenly loud and stertorous, deep, full, and exaggerated; the lips and cheeks retained their color; the pulse at the wrist failed rapidly, and then ceased almost suddenly. A sixth case occurred at Ipswich, England, in which the stertor was preceded by rather violent struggling.

Surgical Uses.—In 1877 Mr. Spencer Wells made the following statement, which, in relation to the particular class of cases referred to, appears conclusive as to the superiority of this anæsthetic: "In 1872 I made known my opinion that all the advantages of complete anæsthesia with fewer drawbacks could be obtained better by the use of bichloride of methylene than by any other known anæsthetic. This was the result of the experience of five years, and of three hundred and fifty serious operations. The experience of the five succeeding years, with more than six hundred additional cases of ovariotomy, and many other cases of surgical operations, has fully confirmed me in this belief. Given properly diluted with air, it has, in my experience of ten years, with more than one thousand operations of a nature unusually severe as tests of an anæsthetic, proved to be, without a single exception, applicable to every patient, perfectly certain to produce complete anæsthesia, relieving the surgeon from all alarm and even anxiety; and its use has never been followed by any dangerous symptoms which could be fairly attributed to it." Other surgeons have testified to its efficiency in a great variety of surgical operations, both capital and trivial; yet, from whatever cause, it does not seem to have supplanted, to any great extent, either chloroform or ether. Perhaps it may be, as Mr. Wells remarks, that the fluid sold as bichloride of methylene may have been only chloroform mixed with some spirit or ether; perhaps the reason may be found in the opinions expressed by Dr. Richardson himself, that "he was not favorably impressed with the application of the bichloride to *quick* general anæsthesia," and that "it belongs to a dangerous family of chemical substances, and cannot therefore be played with without risk."

The deaths above referred to have been attributed to asphyxia, but their symptoms distinctly refute that opinion; yet it is none the less imperative that in administering the vapor a sufficient proportion of atmospheric air should be admitted along with it. For this purpose a hollow cone made of pasteboard, pierced with holes, should contain the cloth or sponge upon which the liquid has been poured. The quantity used should not exceed, for a first inhalation, thirty or forty minims; half that quantity may be used each time that signs of returning consciousness appear.

METHYLI IODIDUM.—IODIDE OF METHYL.

Iodure de methyle, Fr.; *Jodmethyl*, G.
Formula CH_3I. Molecular weight 142.

Preparation.—This compound was first obtained by Dumas and Peligot (1835) by adding very gradually 1 part of phosphorus to a solution of 8 parts of iodine in 12 or 15 parts of methylic alcohol, agitating the distillate with water, and rectifying. According to Wanklyn (1867), iodide of potassium and anhydrous methylic alcohol are mixed in a retort in equivalent proportions; dry chlorine gas is passed into the mixture, which is then distilled, and the distillate purified as before.

Properties.—Iodide of methyl is a colorless liquid of an ethereal odor, and the spec. grav. 2.199 at 0° C. (32° F.). It boils at 43.8° C. (111° F.), and by the aid of a wick burns with difficulty, giving off violet vapors.

Allied Compound.—METHYLENII IODIDUM, s. biniodidum CH_2I_2 (mol. weight 268) was prepared by Butlerow (1859), by acting upon iodoform with sodium ethylate. It is readily formed by heating chloroform with very concentrated hydriodic acid for several hours to near 130° C. (266° F.). It is a yellow liquid, having the spec. grav. 3.34, congealing to glossy scales near the freezing point, and boiling at 180° C. (356° F.), at the same time suffering partial decomposition.

Medical Action and Uses.—Proposed in 1868 by Dr. B. W. Richardson, iodide of methyl was stated to be respirable and anæsthetic when pure; but when decomposed, as it was apt to become, to give rise to the irritating effects of iodine, including lachrymation, salivation, and bronchial secretion. In experiments upon animals inhalation of the vapor produced fatal engorgement of the bronchia. Of it Sir James Y. Simpson wrote: "I found it very powerfully anæsthetic, but dangerously so. After inhaling a very small quantity for two or three minutes, I remained for some seconds without feeling much effect; but objects immediately began to multiply before my eyes, and I fell down in a state of insensibility, which continued for upwards of an hour. I did not completely recover from the effects of it for some days." It was used as a local anæsthetic in cancerous and other cases; but it appears at present to have become obsolete.

MEZEREUM, *U. S.*—MEZEREON.

Mezerei cortex, Br.; *Cortex mezerei*, P. G.; *Cortex thymeleæ (vel coccognidii)*.—*Mezereon bark*, E.; *Écorce de mézéréon, de garou, de lauréole, de thymélée*, Fr.; *Seidelbastrinde, Kellerhalsrinde*, G.

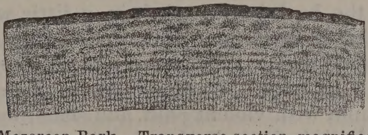
The bark of Daphne mezereum, *Lin.;* Daphne gnidium, *Lin.;* and Daphne laureola, *Lin.* Steph. and Church, Med. Bot., plate 65; Eng. Bot., vol. ii., plate 119; Bentley and Trimen, Med. Plants, 225, 226, 227.

Nat. Ord.—Thymelaceæ.

Origin.—The three plants named above are small shrubs about 2 to 4 feet high. The mezereon has rose-red, sessile, fragrant flowers in small clusters, preceding the deciduous leaves, and is indigenous to hilly and mountainous regions of Europe, extending to the arctic circle, and eastward to Siberia. The other two species are found in Southern Europe; D. laureola, or *spurge laurel*, is also met with eastward to Asia Minor. This species has large evergreen leaves and yellowish-green flowers in axillary clusters, while the *spurge flax* (D. gnidium) has narrow annual leaves and small white flowers in terminal, corymbose racemes. The bark is usually collected during the winter.

Description.—Mezereon bark is in long bands, about ½ inch wide, $\frac{1}{20}$th of an inch and less thick, either folded and tied together in bundles, or rolled up into flat disks, with the inner surface outwards. The outer surface varies in color from pale-yellowish or brownish to brown-yellow, with a coppery lustre, and is marked with numerous minute blackish warts and transversely elongated leaf-scars, in the axils of which is found a cluster of blackish spots. Older bark shows some transverse fissures. The corky layer is easily separated from the pale greenish outer bark. The inner surface is whitish, of a silky lustre, and from loosened bast fibres has a hairy appearance. The bark tears somewhat irregularly in a longitudinal direction, but with difficulty transversely. The fine and tough bast fibres are in tangential rows, and alternate with layers of

Fig. 109.



Mezereon Bark.—Transverse section, magnified.

parenchyma. The dried bark is inodorous, and has a persistently acrid and burning taste.

The bark of the spurge flax is of a darker brown color, and has numerous spirally arranged leaf-scars; that of the spurge laurel is more of a gray or brown-gray color, not prominently marked with leaf-scars, and has a greenish bast; both agree with mezereon bark in acridity. The root bark of the three species is regarded as the strongest, but the stem bark is most generally met with.

Constituents.—Landerer observed (1836) that mezereon bark contains a neutral acrid principle which volatilizes with the vapors of water; a similar observation was made by Squire (1842) with mezereon root; and by Vauquelin (1808) with the distillate from water which had been used for washing the resin. The acrimony is, however, mainly due to a soft resin or oil, which, according to C. G. Gmelin (1822), is not precipitated by lead acetate from its alcoholic solution. This acrid principle deserves further investigation. Vauquelin (1808) discovered *daphnin* in the bark of spurge flax, and the same principle was isolated by Gmelin and Bär (1822) from mezereon bark. Rochleder (1864) obtained it from the aqueous decoction of the alcoholic extract, after precipitating with sugar of lead, by precipitating it with subacetate of lead, decomposing with hydrogen sulphide, washing with ether, and crystallizing from water. It has a persistently bitter, not acrid, taste, dissolves readily in hot water and alcohol, is insoluble in ether, yields with alkalies yellow solutions, and colors ferric chloride blue. Zwenger (1860) ascertained it to be a glucoside of the composition $C_{31}H_{34}O_{19}.4H_2O$, yielding *daphnetin* $C_{19}H_{14}O_9$, which has a coumarin-like odor. On the dry distillation of the alcoholic extract *umbelliferon* is obtained.

Pharmaceutical Uses.—The comminution of the bark requires some precaution to avoid the injurious effects of the dust. The bark may be readily cut into small pieces, and should then be moistened with a little water, which should also be added on bruising the bark in a mortar.

Off. Prep.—Decoct. sarsaparillæ (sarsæ) comp., *U. S.*, *Br.;* Extr. mezerei æthereum, *Br.;* Extr. mezerei fluid., Extr. sarsaparillæ compos. fluid., *U. S.*

Physiological Action.—Ancient and modern authorities agree in describing the various conditions which mezereon is fitted to cure. They all imply the possession by the medicine of irritant qualities; thus we learn that it irritated the fauces, and was capable of reddening, and even of blistering, the skin; that it was used as a gargle in sore-throat, and as an emetic, purgative, cholagogue, emmenagogue, and sudorific. All of these effects agree with the view that it is essentially an irritant. Experiments on animals prove it to be a violent irritant of the gastro-intestinal mucous membrane, and observations upon man lead to the same conclusion. In some of the latter there was narcotism or convulsions, and, in one at least, acrid and blood-red urine. Death has sometimes ensued. When the bark is chewed, it in a little while excites a burning heat in the mouth, which lasts for many hours. In medicinal doses the decoction causes salivation and increased cutaneous and mucous secretions, which are said to acquire a peculiar odor. Excessive doses give rise to symptoms of gastro-intestinal irritation, with violent pain, and sometimes very severe urinary irritation. When the bark is fresh, or has been soaked in water or in vinegar, it reddens the skin, and at length occasions vesicles, followed by moist and painful ulcers which are difficult to heal. A case is recorded of a girl upon whose cheek the fresh juice of mezereon had been rubbed. Extreme swelling, pain, and a vesicular eruption were followed by fever and internal disorders, which are said, after the lapse of nine months, to have ended fatally.

Medical Uses.—At one time mezereon was much in vogue as a remedy for *syphilis*, and to this day it is an ingredient of the compound decoction of sarsaparilla. But the evidence in its favor is not adapted to convince. In chronic, non-syphilitic, *cutaneous diseases*, its reputation was equally ill-founded.

In *chronic rheumatism* it seems to have been more useful; but here, also, its real value in a complex system of treatment is difficult to determine. It is seldom used alone, except as a *local irritant*, in the form of the recent or moistened bark above referred to. In this respect it may more or less take the place of cantharides, or be employed to prolong the action of the latter. It has been applied to improve the condition of foul or indolent *ulcers*, and to maintain the discharge from *issues* and *setons*. For these purposes mezereon ointment is convenient. To excite vesication the bark, prepared as above described, and bound firmly to the skin with a roller, should be freshly applied twice every day, until vesication begins. Mezereon ointment may be used to prolong and renew the suppuration originally produced by cantharides.

When poisoning by mezereon occurs, the stomach should be evacuated by lukewarm, albuminous, or mucilaginous liquids. Milk and fatty oils may also be administered.

MICA PANIS, *Br.*—CRUMB OF BREAD.

Mie du pain, Fr.; *Brodkrumen*, G.

The soft part of bread made with wheat flour.

It is employed as an excipient in the preparation of certain pills, like those of corrosive sublimate, etc., and externally for emollient poultices. It is a constituent of *Cataplasma carbonis*.

Medical Uses.—It is to be presumed that this article was made officinal, in order that only wheaten bread should be used. But in the only article for which it is directed, charcoal poultice, any other form of bread would answer equally well. In this country Indian corn meal is generally employed. Bread crumb is sometimes used for making pills.

MISTURÆ vel MIXTURÆ.

Mixtures, E., Fr.; *Mixturen*, G.

Liquid medicines which contain insoluble substances in suspension, or which are composed of two or more liquids, with or without the addition of saline or other material, are termed mixtures, and in its more limited application the term is restricted to mixtures intended for internal use. They are most frequently prepared extemporaneously and upon the prescriptions of physicians, since even among the officinal ones but few possess sufficient stability to permit them to be kept on hand for a longer period than a few days. Insoluble substances, when light and readily diffusible in water, do not generally require the addition of gum arabic or other mucilaginous body to insure their uniform suspension and the equalization of the dose; such an addition is desirable in all cases where the insoluble bodies are much heavier than water. However, some judicious restrictions are necessary, lest the insoluble compound form a compact deposit which cannot be readily suspended again by agitation. This difficulty may be avoided by reducing the gum to a very small proportion, and increasing the suspending power of the vehicle by the addition of sugar or glycerin. When fats, volatile oils, or resinous substances are to be given in watery liquids, gum or the yolk of egg is requisite as a medium for uniform, and within certain limits permanent suspension; such mixtures are opaque, and are called *emulsions*. Certain drugs, like the gum-resins and some seeds, naturally contain a principle (gum, emulsin, etc.), which is capable of keeping the oil or resin suspended in water, and when triturated with water yield emulsions; in all cases the drug should be rubbed or beaten into a uniform pasty mass, if necessary, with small quantities of water, the trituration being afterwards continued with the gradual addition of water, after which the emulsion may be strained. Unglazed wedgewood or porcelain mortars having a rather flat bottom are very serviceable for this purpose. Under no circumstance should powdered gum resins be employed, unless they have been powdered and sifted in cold weather, without having been previously dried by heat.

Fixed oils, to be emulsified, require as a rule one-half their weight of powdered gum arabic, and the mixture may then be diluted with water to eight or ten times the quantity of oil employed. We have been informed by Mr. Boring that the employment of the officinal infusion or syrup of wild cherry materially facilitates the perfect suspension of oils. To prepare emulsions the powdered gum is triturated with not over 1½ times its weight of water, the oil is gradually added, each portion being completely emulsified before more is added. Or the oil and gum are well mixed together, 1½ parts of water for one of gum is added at once and well triturated; when uniform, the remaining water may be incorporated. Dilg (1878) succeeded in making permanent emulsions by using gum arabic equal to one-eighth the weight of the oil; the powdered gum, one part, is at once made into a thin mucilage, with four parts of water, the oil is then mixed with it gradually, and when these are well combined, four parts of water are added in small portions and with constant trituration, after which the mixture will bear copious dilution with water. If properly made, the oil will not separate, and if, after several days, a cream-like layer should rise to the surface, it may be readily incorporated with the aqueous liquid by agitation. For the proper emulsion of solid fats, and if not inadmissible, also of camphor and resins, the addition of almond or similar fixed oil is advisable, but not indispensable. A yolk will readily emulsionize an ounce of fixed oil, and facilitate the suspension of resins and volatile oils; the latter require a larger amount of gum than the fats, unless the process of J. W. Forbes (1872) be followed, who directs for one ounce of volatile oil, ether, or chloroform, only twenty grains of gum arabic. The liquid to be emulsionized is first introduced into a vial, and then the gum; the two are well mixed by agitation; half an ounce of water is added and thoroughly incorporated by agitation, after which the mixture is diluted with the remaining water or mucilage. On standing, a denser emulsion separates like cream, which is again readily mixed on slight agitation. In applying this process to fixed oils, E. Gregory (1876) found it necessary to increase the powdered acacia to three-eighths the weight of the oil.

Emulsio oleosa of European pharmacy is prepared with two parts of expressed oil of almonds, one part of powdered acacia, and seventeen parts of water.

MISTURA AMMONIACI, *U. S.*, *Br.*—AMMONIAC MIXTURE.

Emulsio ammoniaci, *Lac ammoniaci.*—*Ammoniacum mixture*, *Milk of ammoniac*, E.; *Mixture de gomme ammoniaque*, *Lait ammoniacal*, Fr.; *Ammoniak-Emulsion*, G.

Preparation.—Take of Ammoniac one hundred and twenty grains; Water half a pint. Add the water gradually to the ammoniac, rubbing them together until they are thoroughly mixed, and strain. *U. S.*

Take of Ammoniacum in coarse powder a quarter of an ounce; Distilled Water eight fluidounces. Triturate the ammoniacum with the water, gradually added, until the mixture assumes a milky appearance; then strain through muslin. *Br.*

Medical Uses.—Mixture of ammoniac is employed chiefly in the treatment of *chronic bronchitis* and *bronchorrhœa*. The *dose* is one or two tablespoonfuls.

MISTURA AMYGDALÆ, *U. S.*, *Br.*—ALMOND MIXTURE.

Emulsio amygdalæ, s. amygdalarum; Emulsio simplex.—Milk of almonds, E.; *Emulsion simple, Lait d'amandes,* F.; *Mandelmulsion, Mandelmilch,* G.

Preparation.—Take of Sweet Almond half a troyounce; Gum Arabic in fine powder thirty grains; Sugar one hundred and twenty grains; Distilled Water eight fluidounces. Having blanched the almond, add the gum arabic and sugar, and beat them in a mortar until they are thoroughly mixed; then rub the mixture with the distilled water gradually added, and strain. *U. S.*

Take of Compound Powder of Almonds two and a half ounces; Distilled Water one pint. Rub the powder with a little of the water into a thin paste, then add the remainder of the water, and strain through muslin. *Br.*

The presence of gum arabic in both preparations does not increase the stability of either, or the amount of oil suspended. European physicians sometimes prescribe *compound emulsion of almonds*, for which the German Pharmacopœia gives the following directions:—

Emulsio amygdalarum composita: Take of Sweet Almonds four parts; Hyoscyamus Seed one part; Diluted Bitter Almond Water sixty-four parts. Make an emulsion, and add of white sugar six parts; calcined magnesia one part.

Medical Uses.—Almond mixture is an excellent demulcent in *acute laryngeal* and *bronchial* inflammations, *dysentery*, and irritations of the *urinary passages.* It should be administered freely.

MISTURA ASSAFŒTIDÆ, *U. S.*—ASAFŒTIDA MIXTURE.

Mistura (Lac) asafœtidæ.—Milk of asafœtida, E.; *Mixture (Lait) d'asafœtida,* Fr.; *Asafœtida-Emulsion, Stinkasantmilch,* G.

Preparation.—Take of Asafetida one hundred and twenty grains; Water half a pint. Add the water gradually to the asafetida, and rub them together until they are thoroughly mixed. *U. S.*

A *syrup of asafœtida*, of the same strength as the mixture, may be prepared by triturating one hundred and twenty grains of selected tears with small quantities of water, decanting the concentrated emulsion until four fluidounces are obtained, in which six troyounces of sugar are dissolved by agitation. While at first milk white, it acquires, after exposure, a pinkish color; the resin, which partially separates on standing, is easily incorporated by agitation. If desired, the asafœtida odor may be covered by the addition of a little oil of bitter almonds, or, as suggested by J. J. Rambo (1871), by substituting infusion of wild cherry bark for the water, which changes the white to a brownish color.

A *wine of asafœtida* was recommended by H. N. Rittenhouse (1855) to be made by triturating half a troyounce of the gum resin with sufficient white wine to obtain two fluidounces, one drachm of which, mixed with seven drachms of water, represents approximately the officinal mixture.

Medical Uses.—Asafœtida mixture is the most prompt and decided in its action of all the forms of administering asafœtida by the mouth. It is frequently given as an enema; but for the latter purpose a mixture of an ounce of tincture of asafœtida with half a pint of water, is more convenient and efficient. The *dose* of mixture of asafœtida is one or two tablespoonfuls.

MISTURA CHLOROFORMI, *U. S.*—CHLOROFORM MIXTURE.

Emulsio chloroformi.—*Emulsion de chloroforme*, Fr.; *Chloroform-Emulsion*, G.

Preparation.—Take of Purified Chloroform half a troyounce; Camphor sixty grains; The Yolk of one Egg; Water six fluidounces. Rub the yolk in a mortar, first by itself, then with the camphor, previously dissolved in the chloroform, and, lastly, with the water, gradually added, so as to make a uniform mixture. *U. S.*

Medical Uses.—This mixture forms a stable preparation which may sometimes be convenient for the administration of chloroform in cases of *gastralgia*, *flatulent*, *biliary*, *renal*, and *uterine colic*, and in *nervous* or *hysterical* paroxysms. The *dose* is one or two tablespoonfuls.

MISTURA CREASOTI, *Br.*—CREASOTE MIXTURE.

Mixture de créosote, Fr.; *Kreosot-Mixtur*, G.

Preparation. — Take of Creasote, Glacial Acetic Acid, each sixteen minims; Spirit of Juniper half a fluidrachm; Syrup one fluidounce; Distilled Water fifteen fluidounces. Mix the creasote with the acetic acid, gradually add the water, and lastly the syrup and spirit of juniper. *Br.*

Medical Uses.—Creasote mixture, it is stated, is intended to allay *vomiting;* but the bulk of its dose, and the spirit of juniper and syrup contained in it, render it peculiarly unfit to relieve the cases of vomiting in which creasote is most useful. The purpose of the glacial acetic acid in this mixture is not evident. The officinal *dose* is stated to be from one to two ounces.

MISTURA CRETÆ, *U. S.*, *Br.*—CHALK MIXTURE.

Mixture avec la craie, Fr.; *Kreidemixtur*, G.

Preparation.—Take of Prepared Chalk half a troyounce; Glycerin half a fluidounce; Gum Arabic in fine powder one hundred and twenty grains; Cinnamon Water, Water, each four fluidounces. Rub the chalk and gum arabic with the water, gradually added; then add the other ingredients, and mix the whole together. *U. S.*

Take of Prepared Chalk quarter of an ounce; Gum Acacia in powder quarter of an ounce; Syrup half a fluidounce; Cinnamon Water seven and a half fluidounces. Triturate the chalk and gum acacia with the cinnamon water, then add the syrup, and mix. *Br.*

The substitution of glycerin for sugar in the first process is in accordance with the recommendation of G. W. Kennedy (1872), and it renders the mixture more permanent.

Medical Uses.—Chalk mixture is one of the most convenient forms in which chalk can be administered in the *diarrhœas* both of adults and children, especially when the discharges are yeasty or greenish, and there is flatulent distension of the abdomen, with sour eructations. If there is reason to suspect the presence of undigested food in the bowels, a dose of magnesia should first be given. For the watery diarrhœa which often precedes the attack of *epidemic cholera*, there is no better medicine than this. In most cases laudanum should be added to the mixture, or given along with it; and ordinarily its efficiency is much increased by the addition of kino, krameria, or catechu.

MISTURA FERRI AROMATICA, *Br.*—AROMATIC MIXTURE OF IRON.

Mixture de fer aromatique, Fr.; *Aromatische Eisenmixtur*, G.

Preparation.—Take of Pale Cinchona Bark in powder one ounce; Calumba Root in coarse powder half an ounce; Cloves bruised one-quarter ounce; Fine Iron Wire half an ounce; Compound Tincture of Cardamoms three fluidounces; Tincture of Orange Peel half a fluidounce; Peppermint Water a sufficiency. Macerate the cinchona bark, calumba root, cloves, and iron with twelve fluidounces of the peppermint water in a closed vessel for three days, agitating occasionally; then filter the liquid, adding as much peppermint water to the filter as will make the product measure twelve and a half fluidounces; to this add the tinctures, and preserve the mixture in a well-stopped bottle. *Br.*

This has been introduced into the British from the old Dublin Pharmacopœia. During the maceration a portion of the iron is dissolved by the organic acids contained in the drugs.

Medical Uses.—This is a mixture of bitter tonics and aromatic stimulants with a modicum of iron. Many years ago it was appropriately described by Neligan, who said: "In consequence of its black color it is commonly known as *Heberden's ink*. Notwithstanding its being an unchemical compound, it is a most excellent tonic; it is very generally used in Dublin, in the various states of debility attended with anæmia. *Dose*, from one to two fluidounces."

MISTURA FERRI COMPOSITA, *U. S.*, *Br.*—COMPOUND MIXTURE OF IRON.

Griffith's mixture, E.; *Mixture de Griffith*, Fr.; *Griffith's Eisenmixtur*, G.

Preparation.—Take of Myrrh, Sugar, each sixty grains; Carbonate of Potassium twenty-five grains; Sulphate of Iron in coarse powder twenty grains; Spirit of Lavender half a fluidounce; Rose Water seven fluidounces and a half. Rub the myrrh, sugar, and carbonate of potassium, with the rose water, gradually added, then with the spirit of lavender, and, lastly, with the sulphate of iron; and pour the mixture immediately into a bottle, which must be well stopped. *U. S.*

Take of Sulphate of Iron twenty-five grains; Carbonate of Potash thirty grains; Myrrh, Refined Sugar, each sixty grains; Spirit of Nutmeg four fluidrachms; Rose Water nine and a half fluidounces. Reduce the myrrh to powder, add the carbonate of potash and sugar, and triturate them with a small quantity of the rose water, so as to form a thin paste; then gradually add more rose water and the spirit of nutmeg, continuing the trituration and further addition of rose water until about eight fluidounces of a milky liquid is formed, then add the sulphate of iron dissolved in the remainder of the rose water, mix them together thoroughly, and preserve the mixture as much as possible from contact with the air. *Br.*

The preparation of this mixture presents no difficulty if good tears of myrrh are selected, and the directions are strictly followed. The reaction between the iron and potassium salts, resulting in the formation of ferrous carbonate and potassium sulphate, takes place in the myrrh emulsion, by which the insoluble ferrous carbonate is kept in suspension. Unless in full and well-corked bottles, the mixture, at first of a dirty greenish color, is hardly protected against oxidation by the small quantity of sugar present, and should be freshly made when needed.

Medical Uses.—This preparation has special advantages over other ferruginous medicines in several chronic affections, and especially in *chlorotic anæmia*, *chronic bronchitis*, *albuminuria*, and certain chronic *diseases of the skin* (eczema, psoriasis). These disorders have in common a deteriorated condition of the blood, and a debility of the nervous system, which the iron of the mixture is adapted to correct; and several among them present in addition a relaxed state of the secretory organs, which the myrrh and the sulphuric acid tend to counteract. The two first named are those which usually exhibit the most favorable results. The mixture was originally called *antihectic*, from the utility it manifested in hectical conditions of pulmonary disease; not those, however, as is sometimes erroneously supposed, which belong to tubercular consumption, but those of chronic bronchitis attended with purulent expectoration, and usually associated with dilatation of the bronchia. The *dose* is from half an ounce to an ounce and a half two or three times a day.

MISTURA GENTIANÆ, *Br.* See INFUSUM GENTIANÆ COMPOSITUM.

MISTURA GLYCYRRHIZÆ COMPOSITA, *U. S.*—COMPOUND MIXTURE OF LIQUORICE.

Brown mixture, E.; *Mixture de réglisse*, Fr.; *Lakritzen-Mixtur*, G.

Preparation.—Take of Liquorice in fine powder, Sugar in coarse powder, Gum Arabic in fine powder, each half a troyounce; Camphorated Tincture of Opium two fluidounces; Wine of Antimony a fluidounce; Spirit of Nitrous Ether half a fluidounce; Water twelve fluidounces. Rub the liquorice, sugar, and gum arabic with the water, gradually added; then add the other ingredients, and mix the whole together. *U. S.*

The mixture has a turbid and unsightly appearance, from the presence of the insoluble matters contained in powdered extract of liquorice. An equally efficient and much handsomer mixture is obtained by using *purified* extract of liquorice (see page 571).

Medical Uses.—Compound liquorice mixture, or *brown mixture* as it is frequently called, is an agreeable and efficient remedy in the early stages of *acute bronchitis* and catarrhal *laryngitis*. It hastens and promotes expectoration, chiefly by reducing the febrile tension of the vascular system. The average *dose* for an adult is a tablespoonful.

MISTURA GUAIACI, *Br.*—GUAIACUM MIXTURE.

Emulsio resinæ guaiaci.—*Emulsion de resine de gaïac*, *Lait de gaïac*, Fr.; *Guajak-Emulsion*, G.

Preparation.—Take of Guaiacum Resin in powder, Refined Sugar, each half an ounce; Gum Acacia powdered one-quarter ounce; Cinnamon Water one pint. Triturate the guaiacum with the sugar and the gum, adding gradually the cinnamon water. *Br.*

This is a partial emulsion of guaiac resin, which, on exposure, soon changes in color (see page 684).

Medical Uses.—Although unpleasant to the taste, it is perhaps less repulsive than the tinctures of guaiac. Very probably, also, the guaiacum in it being thoroughly divided by sugar and gum is more readily acted upon and absorbed by the stomach than the solid mass precipitated from a tincture would be. *Dose*, from one to four tablespoonfuls several times a day.

MISTURA POTASSII CITRATIS, *U. S.*—MIXTURE OF CITRATE OF POTASSIUM.

Mistura neutralis.—Neutral mixture, E.

Preparation.—Take of Lemon Juice, fresh, half a pint; Bicarbonate of Potassium a sufficient quantity. Add the bicarbonate of potassium gradually to the lemon juice until the acid is completely neutralized; then strain through muslin. *U. S.*

In composition this mixture is identical with Liquor potassii citratis (p. 849), but being prepared with fresh lemon juice is aromatic and more agreeable. The juice should be strained before the bicarbonate is added, to avoid the expulsion of the carbonic acid gas by subsequent straining.

Medical Uses.—Neutral mixture is diaphoretic and diuretic. It is very generally employed as a febrifuge, either alone or with the addition of antimonial wine, of spirit of nitric ether, of morphia, or of all united. It should be administered diluted with water, or, where no contraindication exists, with lemonade. The *dose* is a tablespoonful.

MISTURA SCAMMONII, *Br.*—SCAMMONY MIXTURE.

Emulsio purgans cum scammonia, Lac scammonii.—Emulsion purgative avec la scammonée, Mixture de scammonée, Fr.; *Scammonium-Emulsion*, G.

Preparation.—Take of Resin of Scammony four grains; Milk two fluidounces. Triturate the resin of scammony with a little of the milk, and continue the trituration, gradually adding the remainder of the milk, until a uniform emulsion is obtained. *Br.*

Scammony resin is readily emulsionized with milk. The French Codex directs 1 part of the resin to be first triturated with 15 parts of sugar, afterwards with 120 parts of milk, and the emulsion to be flavored with 5 parts of cherry laurel water.

Medical Uses.—Scammony forms with unskimmed milk a fine uniform emulsion, which perfectly suspends the drug, and conceals its acrid and nauseous taste. The mixture is intended to be a *dose* for an adult; for a child of five years one-third of the quantity will suffice.

MISTURA SENNÆ COMPOSITA, *Br.*

See Compound mixture of senna, under Infusum sennæ, page 757.

MISTURA SPIRITUS VINI GALLICI, *Br.*

Mixture of spirit of French wine, Brandy mixture, E.; *Mixture de cognac*, Fr.; *Branntwein-Mixtur*, G.

Preparation.—Take of Spirit of French Wine, Cinnamon Water, each four fluidounces; the Yolks of two Eggs; Refined Sugar half an ounce. Rub the yolks and sugar together, then add the cinnamon water and spirit. *Br.*

In our opinion this preparation scarcely deserves a place in a Pharmacopœia.

Medical Uses.—As a nutritious and stimulant draught this preparation is often useful in typhoid states of fever, and in exhaustion from nervous excitement, hemorrhage, and other conditions which do not contraindicate the use of alcohol. "Eggnog" made with milk is much more efficient than this preparation.

MITCHELLA.—MITCHELLA.

Partridgeberry, Checkerberry, Squawvine, Winterclover, E.

Mitchella repens, *Lin.* *Nat. Ord.*—Rubiaceæ, Cinchoneæ.

Description.—This pretty North American evergreen, which is found in woods, has a creeping and branching stem 10 to 12 inches long; opposite petiolate, roundish-ovate, entire leaves, which are about ½ inch long and often marked with white lines. The flowers are in pairs, often diœcious, have a white or pale purplish funnel-shaped corolla, and four exserted or included stamens, and produce a rather dry berry-like scarlet-red fruit, which is composed of two united ovaries, and contains four bony nutlets. The flowers are fragrant, the leaves are inodorous, somewhat astringent, and bitter.

We have no knowledge of any analysis of this plant.

Medical Action and Uses.—The virtues of this plant are exceedingly indefinite, for it is reputed to be diuretic, tonic, and astringent, and capable of facilitating child-birth if taken for several weeks before the close of pregnancy. It very probably may be useful in chronic disorders of the urinary passages, when given in decoction.

MONARDA, *U. S.*—HORSEMINT.

American horsemint, E.; *Menthe de cheval,* Fr.; *Pferdeminze,* G.

The leaves and tops of Monarda punctata, *Lin.* Bentley and Trimen, Med. Plants, 208.

Nat. Ord.—Labiatæ, Monardeæ.

Origin.—Horsemint is a perennial herb, 1 to 2 feet high, which is indigenous to the United States, where it grows in dry sandy fields from New York westward to Illinois, and southward to near the Gulf of Mexico. It flowers in the latter part of summer until September, and should be collected with the flowering tops.

Description.—The leaves are about 2 inches long, lanceolate, somewhat toothed, acute, narrowed at the base into a petiole, smooth above, glandular dotted beneath. The whorls of cymules are about 10 flowered, situated in the axils of the upper leaves, and surrounded by about 8 leafy, sessile, and entire bracts, which are pale yellow and purple in color. The tubular, downy calyx is divided into 5 short and rigid teeth. The corolla is prominent, yellowish, with the large arched upper lip spotted with purple, and a small, three-lobed, somewhat crisped lower lip. The two slender stamens are inserted in the throat above the narrow corolla tube. Horsemint has a strong aromatic odor, and a warm, pungent, somewhat bitterish taste.

Other Species of Monarda.—M. DIDYMA, *Lin.*, or *Oswego tea,* is found in the Alleghanies and northward to Canada and Wisconsin. It has the larger bracts and floral leaves tinged with red, and showy bright red corollas with the stamens exserted beyond the narrow upper lip.

M. FISTULOSA, *Lin.*, or *wild bergamot,* has the larger bracts and floral leaves of a grayish tint, and whitish or pale purplish flowers with exserted stamens; it grows in woodlands, from New England to Wisconsin southward.

Substitutions.—In some counties of Pennsylvania, *Pycnanthemum incanum,* Mich., or *wild basil, Nat. Ord.* Labiatæ, is known and popularly used as horsemint; the plant is downy to hoary, has acute, ovate, or oblong leaves, the upper ones whitened, and the flowers in dense heads with narrow linear bracts, and awned calyx lobes. In Great Britain, *Mentha sylvestris*, Lin., is known as horsemint.

Constituents.—The important constituent is the volatile oil (see Oleum monardæ), which is contained in the leaves and flowers; nothing is known about the other principles, among which are doubtless those commonly met with in herbaceous plants.

Medical Uses.—Horsemint is regarded as being diaphoretic, diuretic, carminative, and emmenagogue, like most other plants of its class containing an acrid essential oil. It may be used in hot infusion to prevent the formation of *catarrhal*, *rheumatic*, and *diarrhœal* affections occasioned by cold. The infusion is usually made with half an ounce of the herb in a pint of hot water, and may be given in wineglassful doses. The volatile oil upon which the virtues of horsemint depend is officinal. (See Oleum monardæ.)

MONESIA.—MONESIA BARK.

The bark of Chrysophyllum glyciphlœum, *Casaretti*.

Nat. Ord.—Sapotaceæ.

Origin.—The tree yielding monesia bark is indigenous to the forests of Brazil, and has alternate, coriaceous and entire leaves. The berry-like fruits of several species of Chrysophyllum are edible.

Description.—The bark is in flat or curved pieces, $\frac{1}{8}$ to nearly $\frac{1}{4}$ inch thick, often 2 or 3 inches broad, externally marked with confluent ridges, forming large irregularly quadrangular or hexagonal meshes, which are covered with a thin smooth whitish tissue while the bark is young. The inner surface is cinnamon-colored and longitudinally striate, otherwise smooth. The bark is very hard, breaks with a granular fracture, and shows in the interior alternate layers of brown and pale reddish tissue. It is inodorous, and has a peculiar taste, which is at first sweet like liquorice, afterwards bitterish, somewhat acrid and astringent.

Constituents.—Monesia bark was examined by Derosne, Henry, and Payen (1840), who announced the presence of *glycyrrhizin*, *monesin*, which appears to be identical with saponin, *tannin*, red coloring matter resembling kinic red, trace of volatile oil, pectin, 3 per cent. of ash, etc. Heydenreich (1839) separated from the aqueous extract 52 per cent. of tannin, and 36 per cent. of a sweet principle, which was not precipitated by sulphuric acid or lead acetate, and was not fermentable.

EXTRACTUM MONESIÆ, *Monesia*, comes from Brazil in irregular dark brown friable angular pieces, destitute of any red hue. It is soluble in water, and has a sweet, afterwards astringent, taste, followed by slight but persistent acridity.

Medical Action and Uses.—Internally, and in small doses, as from four to eight grains, monesia rather gives tone to the stomach, and increases the appetite; but in doses of twenty or thirty grains it occasions gastric oppression and constipation. Upon recent sores it causes a burning and stinging pain of brief duration, lessening their secretions, and promoting granulation and cicatrization. Monesin acts upon such sores as a more active irritant, inducing rapidly a plastic exudation.

The medicinal uses of monesia denote its possession of a stimulant as well as an astringent property. It has been found useful in atonic *dyspepsia*, in *vomiting* produced by atony rather than by active irritation of the stomach, and in all forms of *diarrhœa* unattended with fever. It has been employed with profit in chronic *bronchitis*, and in various forms of hemorrhage, especially *hæmoptysis* and *menorrhagia*, and locally by injection in *epistaxis*. In various ecchymoses depending upon *scurvy* its internal administration is said to have been advantageous. As a topical application it has been recommended in *ulcers* and *pseudo-membranous* exudations of the mouth and fauces, and of many other parts, also in *leucorrhœa* and *diarrhœa*, and especially in *fissures* of the *mouth* and *anus*. Although these virtues of monesia appear to have been demonstrated by clinical observation, the medicine seems to have been neglected and almost fallen into disuse.

The *dose* of monesia is stated at from three to twenty grains, or from ten to sixty grains a day. Monesin has been recommended in the dose of half a grain. For local application the tincture diluted with from ten to twenty parts of water has been used; and also an ointment made with one part of the extract to seven of lard.

MORI SUCCUS, *Br.*—MULBERRY JUICE.

Succus mororum.—*Suc de mûres*, Fr.; *Maulbeersaft*, G.

The juice of the ripe fruit of Morus nigra, *Lin.* Steph. and Church, Med. Bot., plate 39.

Nat. Ord.—Urticaceæ, Artocarpeæ.

Origin.—The black like the white mulberry, *Morus alba*, Lin., is indigenous to the Levant; both are rather small trees, about 30 feet high, and are cultivated and partly naturalized in Europe, where the leaves of both, more generally of the white, are employed for feeding the silkworm. Both species are also occasionally seen in cultivation in the United States; *M. alba*, however, is alone naturalized. The mulberry is usually monœcious; the staminate flowers are in loose catkins, the pistillate flowers in short dense spikes; the latter flowers contain a two-celled ovary, with two thread-like styles; one of the cells disappearing after fructification, while the four-lobed calyx becomes fleshy.

Description.—Through the coalescence of the fleshy calyces, the pistillate spikes of the mulberry ripen into what appears to be a compound berry or drupe, having some resemblance to the blackberry. The mulberry is of an ovate form, about 1 inch long, fleshy and juicy, purplish black, each fruit crowned with the filiform styles. The fruit proper is a lenticular akene inclosed in the fleshy calyx. Mulberries have scarcely any odor, but they possess a very agreeable acidulous taste.

The fruit of *Morus rubra*, Lin., which is common in rich woods in the United States, is oblong, one to near two inches long, and otherwise resembles the preceding.

Constituents.—From comparative experiments made in the laboratory of Fresenius (1857), it appears that mulberries contain more sugar than gooseberries, currants, strawberries, raspberries, blackberries, and huckleberries, while in the free acid they are about intermediate between wild and cultivated raspberries. The analytical results, as obtained by Van Hees, were as follows, calculated for 100 parts of the fruit: sugar 9.192, free acid (estimated as malic acid) 1.860, albuminous compounds 0.394, pectin, gum, and other organic compounds 2.031, ashes 0.566, and water 84.707 parts, the remaining 1.250 parts consisting of the akenes and other tissues, with the insoluble organic compounds and ash.

C. R. A. Wright and G. Patterson (1878) examined the juice expressed from mulberries not quite ripe, and obtained from the liter 26.83 grams of citric acid, 7.82 malic acid, 2.74 glucose, 23.37 other organic constituents, and 9.40 ash; a total of 70.16 grams of solids. This juice had slightly fermented, and contained a trace of volatile probably acetic acid.

Off. Prep.—Syrupus mori, *Br.*

Medical Uses.—Mulberries are refreshing to the taste like all subacid fruits, and slightly laxative. Their fresh juice, or a syrup prepared with it, is frequently employed in Europe for the same purposes to which in this country the juice and jelly of currants are applied, viz., in inflammations with *fever*, and especially in *sore throat.* The bark of the root of morus nigra has been found an efficient substitute for pomegranate root in the treatment of *tænia.*

MORPHIA, *U. S.*—MORPHIA.

Morphinum, P. G.; *Morphium, Morphina.*—*Morphine*, Fr.; *Morphin*, G.
Formula $C_{17}H_{19}NO_3.H_2O$. Molecular weight 303.

Preparation.—Take of Opium sliced twelve troyounces; Water of Ammonia six fluidounces; Animal Charcoal in fine powder, Alcohol, Distilled Water, each a sufficient quantity. Macerate the opium with four pints of distilled water for twenty-four hours, and, having worked it with the hands, again macerate for twenty-four hours, and strain. In like manner, macerate the residue twice successively, with the same quantity of distilled water, and strain. Mix the infusions, evaporate to six pints, and filter; then add five pints of alcohol, and afterwards three fluidounces of the water of ammonia, previously mixed with half a pint of alcohol. After twenty-four hours pour in the remainder of the water of ammonia, mixed, as before, with half a pint of alcohol, and set the liquid aside for twenty-four hours that crystals may form. To purify these, boil them with two pints of alcohol until they are dissolved, filter the solution, while hot, through animal charcoal, and set it aside to crystallize. *U. S.*

This process is essentially that of Dr. E. Staples (1829). On maceration with water, the morphia, minute traces excepted, is readily dissolved together with other constituents. To decompose the morphia salt, ammonia is added; by this process, the morphia is rapidly deposited, together with narcotina, and some of the other alkaloids, and mixed with considerable coloring matter, from which it may be freed by repeatedly recrystallizing from dilute hydrochloric acid and expression, by which the coloring matter and narcotina are removed, while at the same time not an inconsiderable amount of hydrochlorate of morphia enters the mother liquors, from which it may be subsequently recovered. If, however, the concentrated infusion of opium is mixed with not more than an equal bulk of alcohol, and a sufficient amount of ammonia water is added, the morphia will be more slowly precipitated in a crystalline condition, while the great bulk of the coloring matter remains in solution. The slower the separation of the alkaloid, the larger and purer will be its crystals; hence the advantage of adding the ammonia in separate portions. Since morphia is soluble in ammonia, only sufficient of the latter should be added to unite with the acids, and, if in slight excess, it should be allowed to evaporate by exposure. The mother liquid from this evaporation is rejected by the Pharmacopœia, but it contains a small amount of morphia, which, when working on a larger scale, it is important to recover. The alcohol may be distilled off, and, if not otherwise purified, may be reserved for a similar purpose. If the process has been well conducted, the crude morphia has a light-brownish color, which is removed by dissolving in hot alcohol and treating with animal charcoal. The mother liquor from this crystallization retains a portion of the morphia, together with the narcotina, first precipitated. On distilling off the alcohol, the alkaloids are obtained, and may be preserved until sufficiently accumulated for further purification. Narcotina may be removed from morphia by treatment with ether, in which the former is readily soluble, the latter entirely insoluble.

Many other processes have been proposed. As a rule, the treatment of opium with acidulated water or alcohol offers no advantages, since more narcotina and other organic compounds are thereby dissolved. Wittstock proposed to separate the narcotina from the infusion of opium by chloride of sodium, in which the narcotina is insoluble, but some morphia is likewise liable to be deposited. The first precipitation with ammonia is sometimes effected at a boiling temperature; after cooling, the morphia will be granular, and may be more advantageously washed with cold water and expressed. Precipitation with carbonate of sodium does not appear to insure a larger yield. Pelletier observed that when acetic acid is added to crude powdered morphia until the liquid begins to retain an acid reaction, all the morphia will be dissolved, while the narcotina remains behind; and this behavior may be used for separating the two alkaloids; or the impure morphia may be completely dissolved in dilute acetic acid, the solution evaporated to dryness, and the residue treated with water, which leaves narcotina. Gregory has proposed a process which has been adopted by the British Pharmacopœia for preparing hydrochlorate of morphia from opium, and which has the advantage of dispensing with alcohol in the purification of the alkaloid. To obtain this in a pure state, the following directions are given: Take of Opium sliced one pound; Chloride of Calcium three-quarters of an ounce; Purified Animal Charcoal one-quarter of an ounce; Solution of Ammonia, Distilled Water, each a sufficiency. Macerate the opium for twenty-four hours with two pints of the water, and decant. Macerate the residue for twelve hours with two pints of the water, decant, and repeat the process with the same quantity of the water, subjecting the insoluble residue to strong pressure. Unite the liquors, evaporate in a water-bath to the bulk of one pint, and strain through calico. Pour in now the chloride of calcium, previously dissolved in four fluidounces of distilled water, and evaporate until the solution is so far concentrated that upon cooling it becomes solid. Envelop the mass in a double fold of strong calico, and subject it to powerful pressure, preserving the dark fluid which exudes. Triturate the squeezed cake with about half a pint of boiling distilled water, and, the whole being thrown upon a paper filter, wash the residue well with boiling distilled water. The filtered fluids having been evaporated as before, cooled, and solidified, again subject the mass to pressure; and, if it be still much colored, repeat this process a third time, the expressed liquids being always preserved. Dissolve the pressed cake in six fluidounces of boiling distilled water; add the animal charcoal, and digest for twenty minutes; wash the filter and charcoal with boiling distilled water, and to the solution thus obtained add the solution of ammonia in slight excess. Let the pure crystalline morphia which separates as the liquid cools, be collected on a paper filter, and washed with cold distilled water until the washings cease to give a precipitate with solution of nitrate of silver acidulated by nitric acid.

From the dark liquids expressed in the above process an additional product may be obtained by diluting them with distilled water, precipitating with solution of potash added in considerable excess, filtering, and supersaturating the filtrate with hydrochloric acid. This acid liquid, digested with a little animal charcoal and again filtered, gives, upon the addition of ammonia, a small quantity of pure morphia. *Br.*

In this process the morphia salts, as naturally contained in the opium, are decomposed by an excess of calcium chloride with the formation of hydrochlorate of morphia, which, crystallizing on cooling from the sufficiently concentrated solution, produces, with the calcium meconate, a solid mass, from which the mother liquor is removed by strong pressure. The pressed cake, on being treated with boiling water, yields up the morphia (and codeia) hydrochlorate, while the calcium meconate remains upon the filter. The evaporation, expression, and resolution are repeated until most of the coloring matter has entered the mother liquors, and nearly the whole of the calcium meconate remains upon the filter. The removal of the last traces of color is then effected by animal charcoal, and the morphia precipitated in a granular condition by adding a slight excess of ammonia to the boiling solution. The dark-colored mother liquors contain, besides coloring matter and calcium salts, narcotina and morphia, which are precipitated by potassa, an excess of which dissolves the latter readily and completely, but narcotina sparingly and slowly, as observed by Robiquet, Wittstock, and others. The filtration of the strongly alkaline liquid must, therefore, not be long delayed; and when the clear liquid is acidulated with hydrochloric acid it contains morphia hydrochlorate, potassium chloride, and some coloring matter, from the last of which it is freed by animal charcoal; ammonia then precipitates the nearly pure alkaloid. The decoloration of the morphia salt by means of animal charcoal is more readily effected when in aqueous solution, as here directed, than when dissolved in alcohol.

Lime has an action upon morphia and narcotina similar to that of potassa. Couërbe has founded upon this behavior a method for preparing morphia, which was somewhat modified by Mohr (1840), who directs four parts of opium to be exhausted by repeated boiling with water; the strained and expressed decoction is gradually added to boiling milk of lime, made of one part of burned lime and eight parts of water; and after boiling for a few minutes, the mixture is strained, pressed, and the insoluble portion twice boiled with a fresh portion of water. The liquid, containing mainly morphia, lime, and coloring matter, is concentrated to eight parts, filtered, and the filtrate, while boiling, mixed with sufficient powdered sal ammoniac to convert all the lime into calcium chloride, while ammonia is given off, and the morphia, on cooling, separated as a granular mass; this is washed with cold water, dissolved in hydrochloric acid, purified with animal charcoal, and crystallized as hydrochlorate of morphia, or the alkaloid precipitated by ammonia. The morphia precipitated from the lime solution is darker in color than the first morphia precipitate obtained by Staples' process, but much lighter than the corresponding precipitate by Gregory's process.

Properties.—Morphia crystallizes in short, transparent, and colorless or white prisms, which require for solution about 1000 parts of cold and about 500 parts of boiling water, 30 parts of boiling and 50 parts of cold alcohol, 60 parts (175 parts, Pettenkofer) of chloroform and 220 parts of glycerin. It is soluble in fusel oil, also in fixed alkalies and alkaline earths, less so in ammonia and its salts, but insoluble in benzol, fixed oils, and ether; the latter liquid dissolves some morphia in the amorphous state, which crystallizes after awhile. It is inodorous, and at first tasteless, developing, however, a bitter taste. Its solutions have an alkaline reaction upon test-paper, and with acids it yields salts, most of which are crystallizable. Heated to 120° C. (248° F.) it loses 5.95 per cent. of water of crystallization, and fuses to an oily liquid, which crystallizes on cooling; at a higher heat it is decomposed, and burns without leaving any residue.

Tests.—Commercial concentrated sulphuric acid dissolves morphia with a yellowish, afterwards gray color. Pure morphia, heated with pure sulphuric acid to 100° C. (212° F.) for half an hour, is colored pink-red (Prescott, 1877). Concentrated nitric acid imparts a blood-red color, changing to orange and yellow. Dissolved in sulphuric acid, and the solution heated to near 150° C. (302° F.) the addition of little nitric acid colors violet-blue, changing quickly to blood-red, and afterwards to deep orange (Husemann, 1863). *Froehde's reagent* (1866) (0.001 sodium molybdate in 1 c. c. H_2SO_4) acquires a beautiful violet color, changing to blue, olive-green, yellow, and, in twenty-four hours, to purplish-blue. In the reaction of this reagent upon many alkaloids and other organic substances, a light- or dark-blue, or more or less green, color is produced; the changes in color must therefore be noticed, and a larger amount of the molybdate in the test carefully avoided. (See paper by Buckingham in *Amer. Journ. Pharm.*, 1873, p. 150.) Chlorine water added to morphia causes a yellow or orange color, which is deepened by alkalies; chlorinated alkalies or lime at once produce the orange color. Morphia decomposes iodic (Serullas) and periodic (Boedeker) acids, liberating iodine; in dilute solutions the addition of sulphuric acid is advisable; ammonia deepens the yellow color of the solution. Ferric chloride colors morphia and its salts deep blue, the color being destroyed by free acids and alcohol, but not by alkalies (Robinet). Pellagri (1877) recommended a test which depends upon the production of apomorphia (see p. 191), and is applied as follows: the suspected substance is dissolved in concentrated muriatic acid, a little sulphuric acid is added, and the solution evaporated at 100° C.; a purple color will be produced. To the residue is added a little muriatic acid, then bicarbonate of sodium, and, finally, a strong solution of iodine in hydriodic acid, when a green compound is produced, dissolving in ether with a purple color.

The *salts of morphia* are precipitated from their solutions by the alkalies and alkaline earths, the precipitates being soluble in an excess of the precipitant. Similar precipitates are produced by the alkaline carbonates and cyanides, but the alkaline bicarbonates fail to precipitate acid solutions in the cold. Tannin causes a white precipitate soluble in acetic acid and in alcohol. Auric or platinic, but not mercuric, chloride occasions a yellow precipitate. The acidulated solutions of morphia are precipitated by phosphomolybdic acid, potassio-mercuric iodide, potassio-cadmium iodide, and other general reagents for alkaloids. 1 c. c. of Mayer's test solution precipitates 0.020 gram morphia. When a salt of morphia is heated with an excess of sulphuric or hydrochloric acid to near 150° C. (302° F.), the alkaloid parts with H_2O, and is converted into apomorphia, $C_{17}H_{17}NO_2$. (See page 190.)

Pharmaceutical Uses.—The alkaloid is used in preparing the salts of morphia.

Physiological Action. *On Animals.*—As the effects of the several salts of morphia are nearly identical, it will be convenient to study them in connection with the alkaloid itself. The first remark is that birds, in many instances, tolerate the action of morphia, when taken into the stomach, to an almost incredible degree; thus it has been found that of two pigeons, one might survive a dose of twelve grains, while it would prove fatal to the other bird. Even hypodermically, three grains were required to destroy life. In these animals morphia appears to act upon the spinal marrow rather than upon the brain, causing unsteady movements, partial paralysis, and general convulsions. Analogous results have followed experiments upon rabbits, dogs, and horses. Thus six grains of acetate of morphia administered to a dog caused paralysis of the hind legs, salivation, somnolency, and *dilated* pupils; but the animal recovered. A like result followed the administration of twelve grains of morphia to a horse. It should, however, be stated that in exceptional cases morphia has appeared to produce true, and even fatal, narcotism in birds. So, too, in certain experiments upon dogs a true narcotic operation has been observed; on awaking, the animals looked terrified and haggard, dragged their hind legs, failed to recognize their masters, and slunk into a dark corner, where they remained for many hours, and until the intoxication had entirely passed away. The rationale of its action upon animals may, according to Witkowski, be expressed in the following propositions: 1. Morphia paralyzes the cerebral centres of sensation and motion in the brain. 2. The paralysis of these centres is preceded by their excitement. 3. This paralysis precedes that of the respiratory centres. 4. The centres of the inhibitory vagus fibres, the vascular nerves, and those which contract the pupil, are neither depressed nor stimulated by morphia. 5. Spinal reflex excitability is heightened by morphia. 6. The peripheral nerves are in no manner affected by morphia.

On Man.—The general effects of morphia on the system are almost identical with those of opium, but there are some points of difference which call for notice, and some peculiarities depending upon the manner in which morphia is administered. It does not appear to stimulate the nervous system or the circulation as much as opium, nor display so decided a narcotic influence. It has been remarked that although two or even three grains of opium certainly contain less than a grain of morphia, yet their action is more intense, rapidly occasioning a degree of narcotism bordering upon coma, but soon subsiding without leaving decided secondary effects behind; while morphia does not readily produce narcotism, but its after-effects are of longer duration. Opium also increases the temperature as well as the sense of heat, but morphia while agreeing in the latter effect lowers the temperature. So, too, opium primarily increases the frequency of the pulse, but morphia diminishes it. Opium is less apt to excite nausea and vomiting than morphia. Of this operation it has been remarked that women are much more liable to it than men, and especially to vomiting. When morphia is used hypodermically, such effects usually take place immediately, but when given by the stomach they may not appear for several days. A corresponding contrast is presented by its action on the bowels; by the hypodermic method morphia continues to constipate, but by the mouth it tends to occasion diarrhœa after a few days. Under like circumstances, opium does not cause looseness of the bowels, but ceases to confine them. Morphia is very apt to occasion ardor urinæ, with vesical irritation, and diminished secretion of urine. The last symptom may be accounted for, in part, by the profuse sweating that often follows the administration of morphia in full doses. It is said to be more marked in females than in males. Although itching of the skin sometimes attends the action of opium, it is usually insignificant compared with that which morphia frequently causes. It generally begins in the eyes and nose, and often extends to the whole surface of the skin, causing great restlessness and distress. Along with this symptom, or independently of it, various fugitive eruptions appear, of a papular or erythematous description, and especially urticaria. They probably depend upon the same immediate cause that provokes diaphoresis; and they have been oftener noticed after the hypodermic use of morphia than otherwise. Like all narcotics, so with morphia; if it is left off abruptly wakefulness and restlessness, with nervous depression, are very apt to ensue. The fatal dose of morphia cannot be determined; it may not exceed a single grain; and, on the other hand, a case is recorded in which seven grains of morphia were taken in the form of Magendie's solution, and yet, by dint of powerful excitation, chiefly electrical, the patient recovered. (Schweig.)

The influence of morphia used habitually by hypodermic injection is most pernicious. Even in dogs, after a time emaciation sets in and ultimately reaches an extreme degree; the animal is habitually torpid, the skin of the feet grows morbidly sensitive, and the temperature is very low. After death the brain and spinal marrow are anæmic, and the lungs and liver engorged. In man the effects are similar, but those of the intellectual sphere are predominant. They include nervousness, tremor, hyperæsthesia, spasms, neuralgia, insomnia, anxiety, hypochondria alternating with excitement, hallucinations, dryness of the tongue, constipation and scanty urine, with vesical irritation, and sometimes albuminous urine. If the drug is abruptly withdrawn the patients suffer a collapse, with indescribable distress from nervousness and loss of self-control, profuse sweats, and a dusky discoloration of the face.

Many cases occur in which idiosyncrasies modify the usual effects of morphia. In some it causes violent mental excitement, hallucinations, and a total inability to sleep. In others it occasions nervous depression, syncope, pallor of the skin, feebleness of the pulse, dyspnœa, insensibility, urgent vomiting, etc. In others again spasmodic movements, or a fully formed tetanoid paroxysm. No doubt some of the most alarming examples of this nature have followed the hypodermic injection of morphia, either because of the swift absorption of the narcotic, or from its having been thrown into a vein. Hence the wisdom of the rule to introduce morphia hypodermically with great deliberation; and the advice that has been given to associate with each injection one-ninety-sixth of a grain of atropia to counteract the depressing and nauseating effects of the morphia.

Medical Uses.—Although morphia may, in general terms, be used for the same purposes as opium (see Opium), especially as an internal medicine, it is true, nevertheless, that the introduction of the hypodermic method of employing it has shown its fitness for certain special conditions. This method is superior to any other when the prompt action of the medicine is necessary to save life or lessen pain; when the patient is unable or unwilling to swallow; and when a local rather than a general influence is intended. In *sunstroke* attended with convulsions, jactitation, delirium, and general excitement, the hypodermic injection of a salt of morphia, in the dose of a quarter of a grain, affords prompt relief. In *epileptiform convulsions* due to mental excitement, in pregnancy and the *puerperal state*, in *hysteria* and aggravated *chorea*, in various *local spasms*, as of the face, glottis, diaphragm, etc., this remedy should always be borne in mind. Morphia hypodermically employed is perhaps the best remedy in *tetanus*, even of the traumatic form, and a like statement is true of the analogous condition caused by *strychnia* poisoning. It is the proper antidote in poisoning by belladonna or atropia. Of all the remedies for *spasmodic asthma* this one procures incomparably the most speedy relief. The pain of *neuralgia*, especially in its severer forms, such as affect the fifth nerve, the sciatic, and the gastric nerves, is promptly palliated by it. In neuralgia of the superficial nerves rapid vesication of the skin over the painful points, and the application to the cutis of a strong solution or ointment containing a morphia salt, may also be employed; but its effect is less prompt and sure than the hypodermic plan. Of all palliatives employed in that most terrible of pains, *angina pectoris*, none affords more prompt and sure relief, not only subduing the neuralgic anguish, but calming the tumultuous and disordered movements of the heart. It has the advantage over other methods of being almost free from danger. One of the best occasional remedies for *nervous headache* which females are apt to experience during the menstrual periods, is a cup of strong coffee with a fifth of a grain of a morphia salt; but it is a remedy which is not to be recommended for general or frequent use. The use of morphia as an antidote to poisoning by *belladonna*, *atropia*, and *Calabar bean*, is considered under those several titles.

Like all new methods, the hypodermic use of morphia has been greatly perverted; the prompt alleviation of pain and the pleasing intoxication which follows form too strong a temptation to its use for all persons to resist successfully. Like alcohol, its intoxication leaves behind it a sense of debility and depression which nothing but a fresh resort to the medicine relieves. If continuously employed, it creates an artificial necessity for resorting to its powerful and genial support, and the longer it is used the larger is the dose required. A peculiar allurement of the habit as compared with that of taking opiates by the mouth is that in many cases it does not so readily derange the stomach, impair the appetite, or produce constipation. These effects should be borne in mind, but it is equally important to remember that in cases of hopeless disease the duty of the physician is, above everything else, to relieve his patient's suffering.

The average *dose* of morphia or of its salts is about one-fifth of a grain; but morphia, uncombined, is seldom prescribed. For hypodermic uses an officinal solution of morphia has been provided by the British Pharmacopœia. See Injectio morphiæ hypodermica.

MORPHIÆ ACETAS, *U. S.*, *Br.*—ACETATE OF MORPHIA.

Morphinum aceticum, P. G.; *Acetas morphinæ, Acetas morphicus.—Acétate de morphine*, Fr.; *Essigsaures Morphin*, G.

Formula $C_{17}H_{19}NO_3.C_2H_4O_2.H_2O$. Molecular weight 363.

Preparation.—Take of Morphia in fine powder a troyounce; Distilled Water half a pint; Acetic Acid a sufficient quantity. Mix the morphia with the distilled water; then carefully drop acetic acid into the mixture, stirring it constantly, until the morphia is neutralized and dissolved. Evaporate the solution, by means of a water-bath, to the consistence of syrup, and set it aside until it concretes. Lastly, dry the salt with a gentle heat, and rub in into powder. *U. S.*

The British Pharmacopœia, not recognizing morphia as officinal, requires that alkaloid to be prepared from the hydrochlorate; in other respects the manipulation is identical with the foregoing, except that a much smaller quantity of water is very properly directed for effecting the solution of morphia and its neutralization with the acetic acid. A very slight excess of acetic acid is rather of advantage, since the salt begins to decompose during the evaporation by the liberation of a little acid; it is, therefore, advisable to facilitate evaporation at a rather low temperature by means of a current of air. The salt may be crystallized with some difficulty in the form of white silky needles; but is very generally obtained in powder as directed above.

Properties.—Acetate of morphia forms a white powder, which has a slight acetous odor and very bitter taste. It is readily and freely soluble in water, less freely soluble in alcohol, and soluble in 60 parts of chloroform; it is insoluble in ether. Cold strong sulphuric acid dissolves it without color only when recently made. When kept on hand, it slowly loses acetic acid, and becomes incompletely soluble in water unless a little acetic acid be added; it gradually acquires a yellowish-gray and finally brownish color, and should then be redissolved in acetic acid and evaporated or converted into another salt of morphia. Its aqueous solution undergoes similar changes, the acetic acid being slowly decomposed with the separation of brown flocculent compounds, while the morphia crystallizes out, forming long prisms, if the solution is not disturbed. The salt contains 78.5 per cent. of anhydrous or 83.5 per cent. of crystallized morphia.

The salt responds to the morphia tests described above, and leaves no residue when ignited. If its solution is precipitated by tannin, the addition of dilute hydrochloric acid redissolves the precipitate; a remaining turbidity would indicate the presence of narcotina.

Off. Prep.—Liquor morphiæ acetatis, *Br.*

Medical Uses.—The action and uses of the acetate are the same that have been described in the article on Morphia. The *dose* of the acetate is about one-fifth of a grain.

MORPHIÆ MURIAS, *U. S.*—MURIATE OF MORPHIA.

Morphiæ hydrochloras, Br.; *Morphinum hydrochloricum*, P. G.; *Murias (Hydrochloras) morphicus.—Hydrochlorate of morphia*, E.; *Chlorhydrate de morphine*, Fr.; *Salzsaures Morphin*, G.

Formula $C_{17}H_{19}NO_3.HCl.3H_2O$. Molecular weight 375.5.

Preparation.—Take of Morphia in fine powder a troyounce; Distilled Water four fluidounces; Muriatic Acid a sufficient quantity. Mix the morphia with the distilled water, then carefully drop muriatic acid into the mixture, stirring it constantly, until the morphia is neutralized and dissolved. Evaporate the solution, by means of a water-bath, so that on cooling it may crystallize. Lastly, drain the crystals and dry them on bibulous paper. *U. S.*

The British Pharmacopœia has a process for preparing this salt from opium, which was given on page 914, as far as the precipitation of pure morphia. The remaining steps are essentially identical with the above, but are more practical in saving evaporation by employing a smaller quantity of boiling distilled water, in which the morphia is diffused and neutralized by the acid, the hydrochlorate crystallizing out on cooling. If pure morphia has been used and an excess of hydrochloric acid avoided, the salt may be wholly obtained in crystals by judicious evaporation of the mother-liquor.

Properties.—Hydrochlorate of morphia crystallizes in white silky needles, or transparent prisms having a bitter taste. It is soluble in 20 parts of cold, and in less than its own weight of boiling water, in 60 parts of cold, and in 10 parts of boiling 80 per cent. alcohol, in 19 parts of glycerin, and in 800 parts of olive oil; it is insoluble in ether. Heated to 130° C. (266° F.), it loses 14.38 per cent. of water of crystallization. It yields 75.9 per cent. of anhydrous, and 80.7 per cent. of crystallized morphia.

The salt answers to all the morphia tests described before; its aqueous solution yields, with nitrate of silver, a white precipitate, which is insoluble in nitric acid, but dissolves in ammonia.

Off. Prep.—Liquor morphiæ hydrochlor., Supposit. morphiæ, Suppos. morphiæ cum sapone, Trochisci morphiæ, Troch. morphiæ et ipecacuanhæ, *Br.*

Medical Uses.—Its operation is identical with that of the acetate, and its *dose* is the same, or about one-fifth of a grain.

MORPHIÆ SULPHAS, *U. S.*—SULPHATE OF MORPHIA.

Morphinum sulfuricum, P. G.; *Sulfas morphicus.*—*Sulfate de morphine*, Fr.; *Schwefelsaures Morphin*, G.

Formula $(C_{17}H_{19}NO_3)_2H_2SO_4.5H_2O$. Molecular weight 758.

Preparation.—Take of Morphia in fine powder a troyounce; Distilled Water half a pint; Diluted Sulphuric Acid a sufficient quantity. Mix the morphia with the distilled water; then carefully drop diluted sulphuric acid into the mixture, stirring it constantly, until the morphia is neutralized and dissolved. Evaporate the solution, by means of a water-bath, so that on cooling it may crystallize. Lastly, drain the crystals, and dry them on bibulous paper. *U. S.*

This process involves the neutralization of pure morphia with dilute sulphuric acid and the subsequent crystallization of the salt. If about two, instead of eight, fluidounces of water are used at the boiling temperature, the solution will crystallize on cooling. The mother-liquor, on further concentration, will yield more of the salt.

Properties.—It crystallizes in white fascicles of transparent needles, which, on being heated to 130° C. (266° F.), lose 11.8 per cent. of water of crystallization. It is soluble in two parts of water, less freely so in alcohol, and in five parts of glycerin (Adolphus, 1867). It is insoluble in ether. The salt yields 75.2 per cent. of anhydrous, and 79.94 per cent. of crystallized morphia, and when ignited leaves no residue. Its aqueous solution yields a white precipitate with chloride of barium, insoluble in nitric acid. To the reagents for morphia it has the behavior described on page 915. Dott (1877) noticed an article sold in England which was adulterated with 34.63 per cent. of anhydrous sodium sulphate.

Off. Prep.—Liquor morphiæ sulphat., Suppos. morphiæ, Trochisci morphiæ et ipecacuanhæ, *U. S.*

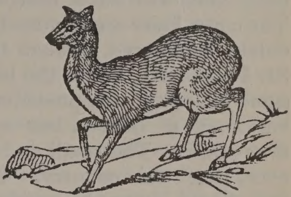
Medical Uses.—Sulphate of morphia is more generally used than any of the other salts of this alkaloid. Its *dose* is about one-fifth of a grain.

MOSCHUS, *U. S.*, *Br.*—Musk.

Musc, Fr.; *Moschus*, G.

The dried secretion from the preputial follicles of Moschus moschiferus, *Lin.* *Class* Mammalia. *Ord.* Ruminantia.

Fig. 110.



Musk-deer.

Origin.—The musk-deer resembles the deer (*Cervus*), but differs from it in the want of horns and in the canines, which are lóng and project considerably downwards from the lips of the male. It inhabits chiefly the mountainous regions and elevated tablelands of Central Asia, and is met with from Anam, in Further India, northwestward to Thibet and northward in China and Tartary to Mantchooria and Southern Siberia. It lives in pine forests in the Himalayas, frequently at an altitude of 10,000 to 14,000 feet. The musk-sac is found in the male only, and is located on the abdomen, immediately before the preputial orifice and to the rear of the umbilicus. The animal has nocturnal habits, and is taken by snares and pitfalls, or sometimes by shooting; the sac is cut off as soon as possible, and rapidly dried by pressing it against heated stones.

Description.—The musk-bag (called sac, pod, or pouch) is oval in shape, about 2 inches long and 1½ inch wide, with a thickness of about half an inch. The upper surface is smooth and flat, the lower surface convex and hairy. The hairs are grayish and brown, rather stiff and appressed, and arranged in a circle towards the aperture near the centre of the bag, and in the form of a pencil towards the preputial orifice, which is about one-fourth inch in the rear of the former. From this orifice underneath the hairy skin between the strata of the muscular coat and towards the posterior end of the sac is a canal containing the front portion of the thin penis. Following the muscular coat is the musk-pouch proper, with an external fibrous coat, having on the inner surface numerous depressions resembling meshes and surrounded by folds, and covered by two coats, the one soft and pearly, and the other very delicate, silvery-white on the outside, and yellowish or brownish on the inside. The musk is supposed to be separated by a number of glands, of which two or more are situated in each depression. In the young animal, the secretion is slight and of a milky appearance; but after

Fig. 111.

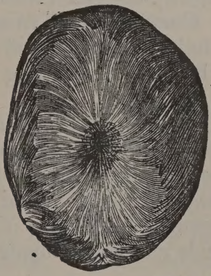
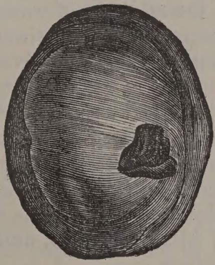


Fig. 112.



Chinese Musk-sac.

Lower surface. Upper surface.

it has passed its third year, the musk is of better quality; in the fresh state it is of an unctuous consistence.

From a record kept by Messrs. Cramer and Small (*Amer. Journ. Pharm.*, 1872, p. 565), the average weight of Chinese musk-bags was found to be 394 grains, and of the musk in each 157 grains.

Musk is of a crummy appearance, near the musk orifice mixed with grayish hairs, of a reddish-brown color, or darker brown and irregularly granular, of a strong diffusible and persistent odor and bitterish taste. When entirely exsiccated, it is almost inodorous, but the odor reappears on moistening and is increased by the addition of a little alkali. Musk should be kept in not too warm and dry a place where the air has some access to it.

Varieties.—Several varieties are known in commerce, the best being the *Chinese*, *Thibet*, or *Tonquin* musk. It is usually imported in small boxes, internally lined with sheet lead and containing about 25 sacs, each wrapped in paper. The outer hairs are trimmed short, and are of a yellowish or grayish color. Musk enters commerce through the Chinese ports. *Siberian musk* comes by way of St. Petersburg, hence the name *Russian musk;* it often resembles and has the same quality as the preceding; when in flatter ovate sacs with thinner and paler hairs, and of fainter, less aromatic, and more urinous odor, it is called *Cabardine musk.* The small and inferior *Bucharian* and *Assam musk* sacs rarely, if ever, reach this country. Chinese musk only should be employed in medicine, and should always be purchased in sacs.

Substitutions and Adulterations.—The substitution of artificial musk-bags, made from a piece of the hide stitched to a membrane, is readily recognized by the absence of the circular arrangement of the hairs and of the central aperture. Genuine sacs are sometimes slit open, the musk partly removed, and other substances introduced in place thereof. They may usually be detected by being stitched together on the edge of the hide and inside membrane. There is no means of detecting the fraudulent introduction through the orifice of pieces of lead, etc., until after the bags have been opened.

Tests.—Cold water dissolves about one-half the weight of the musk; the solution is deep brown, faintly acid, and scarcely disturbed by solution of corrosive sublimate. Weak alcohol yields a similar solution. Absolute alcohol dissolves about 10 per cent., yielding a slightly colored tincture, which scarcely becomes turbid on the addition of water. Carefully freed from fragments of skin and hairs and heated upon platinum foil, musk gives off an odor which is slightly urinous, but very distinct from the odor of burning blood, and leaves about 6 to 8 per cent. of a gray, not red, ash.

Constituents.—Musk, treated with potassa, gives off ammonia; it contains cholesterin, various fatty and waxy substances, gelatinous and albuminous compounds, and salts. The odorous principle volatilizes partly with the vapors of water, but is not a volatile oil; it is most probably formed in the presence of moisture, by the slow and continuous decomposition of one of the constituents.

Camphor, oil of bitter almonds, and acids generally impair the odor of musk, or destroy it altogether.

Pharmaceutical Uses.—TINCTURA MOSCHI, *P. G.;* Tincture of musk, *E.;* Teinture de musc, *Fr.;* Moschustinktur, *G.* Two parts of musk are triturated with 50 parts of water; 50 parts of alcohol, specific gravity 0.892, are added, and the whole macerated for eight days. *P. G.* The tincture has a reddish-brown color, which is darker than that of the tincture made by macerating 10 parts of musk in 100 parts of 80 per cent. alcohol, as directed by the French Codex.

Tincture of musk is employed in perfumery for rendering delicate odors more permanent.

Physiological Action.—Injected into the veins of animals musk has produced a degree of narcotism with muscular spasms, followed by bloody stools, exhaustion, and death; after which cadaveric rigidity and mucous injection were found. In man it produces an effect comparable to that of alcohol, since, after stimulating the brain and heart and raising the temperature, it occasions, according to some, drowsiness and thoracic oppression; but, according to others, leaves no reactionary effects behind. Its odor continues for several days to impregnate the breath and all the secretions.

Medical Uses.—The scarcity, high price, and falsification of musk have caused its use to be comparatively restricted, and explain the varying and often contradictory estimates of its value as a medicine. Yet, on the whole, the conditions it is adapted to remedy are pretty well defined. They include all those nervous phenomena which are represented by the term *ataxia*, and among them subsultus tendinum, mild muttering delirium, floccitation, muscæ volitantes, and hiccup, with a small, frequent, tremulous or irregular pulse, without coma and without collapse. Under these circumstances musk tends to produce refreshing sleep, while it calms muscular spasm and favors perspiration, and the pulse grows fuller, more regular, and less frequent. These are the phenomena which may occur in all febrile diseases originally of a typhoid type or tending to assume it, and notably in *typhus*, *typhoid fever*, the *eruptive fevers*, and certain inflammations also, but particularly *pneumonia*. In proportion as ataxic prevail over adynamic phenomena is musk advantageous. Ataxic phenomena are often met with in the advanced stages of *cholera infantum*, besides others that indicate serous effusion upon the brain; and they are sometimes dissipated by the administration of musk.

Its fitness to combat the special phenomena above indicated is illustrated by its efficacy in purely nervous and non-febrile affections. There can be no doubt of its having repeatedly effected a cure in cases of *hiccup*, *pharyngeal spasm*, *laryngismus stridulus*, *spasmodic croup* (spasmodic laryngitis), *spasmodic cough*, *whooping cough*, *vomiting*, and *colic*. Even *chorea*, *hysterical convulsions*, and *tetanus* have occasionally been cured by its means. Its power as a nervine is also shown by its relieving *wakefulness* resulting from combined mental and bodily fatigue; such cases, in fact, as are benefited by valerian, camphor, asafœtida, and ammonia.

Musk is usually administered in pill or emulsion, and in *doses* of ten grains or upwards, every two or three hours. It may also be employed in suppositories. To children it may be given in doses of one or more grains in the above-mentioned forms, or in a small enema.

MOXA.—Moxa.

Moxa, Fr.; *Brenncylinder*, G.

Moxas are vegetable substances, either cut or formed into short cylinders, and which when ignited will burn without fusing. In China and Japan moxas are made of the felt-like down covering the leaves of Artemisia chinensis, *Lin.*, and perhaps of other plants. In other countries paper, cotton, or hemp impregnated with a weak solution of nitrate of potassium have been employed for the purpose; or the pith of some plants containing sufficient nitrates to sustain an even combustion, like that of the sunflower (see p. 693). Occasionally mixtures have been made of potassium nitrate with substances like lycopodium, beaten together with some adhesive material, and rolled into cylinders of convenient size. Instead of nitrate, chlorate or chromate of potassium has been employed.

Medical Action and Uses.—The moxa is said to have been employed as a form of cautery from time immemorial by oriental nations, particularly the Chinese and Japanese, from whom it was introduced into Europe by the Portuguese; but it was also used by the Egyptians, the Persians, and the Laplanders. The moxa cylinder should be about an inch long and from a quarter to half an inch in diameter. One end of it is applied to the skin and held in its place by a pair of forceps or a *porte-moxa*, while the opposite end is lighted, and the surrounding skin protected by a damp rag, a piece of sticking plaster, or of paper saturated with a solution of alum and dried, and having an aperture in its centre. Combustion is maintained by the breath, or a pair of bellows, until the whole cylinder is consumed. To prevent deep cauterization liquor ammoniæ is applied immediately after the burning. Sometimes the cylinder is moved about within a small area, without permitting any one spot to be deeply involved; or it may be held very near, but without touching the skin; or, finally, it may be removed when the combustion of the moxa has reached to within a line or two of the skin. It should not usually be applied where the skin is the only covering of bone, tendon, ligament, or cartilage; nor to the mammæ, genital organs, or abdomen. The first sensation of heat is apt to be considered agreeable rather than painful, but it increases and grows tolerably severe. Yet we are assured that it causes less pain than either blisters or caustic issues.

In regard to the modus operandi of the moxa, those who have most employed it consider that its action differs from that of hot iron. Some have suggested that a very volatile (anæsthetic) principle is given off by the burning fibres, and in point of fact an empyreumatic oil must in this way be formed upon or near the skin; others consider that the operation is most efficient when there is really no burning of the integument or any serous or purulent discharge.

The remedial uses of moxa are those of counter-irritant agents in general. It seems to have been most efficient in affections of the superficial joints, as the *knee* and the *wrist;* in *white swelling* and *coxalgia;* in diseases of the *vertebræ* and their ligaments, and in *lumbar abscess;* in *neuralgia* and especially in *sciatica;* in *lumbago*, *rheumatic gout*, and *paralysis;* and finally in *chronic bronchitis.*

MUCILAGINES.—MUCILAGES.

Mucilages, Fr.; *Schleime*, G.

These preparations consist of viscid, more or less tenacious and adhesive liquids, or of opaque semi-liquid jellies; in all cases the solvent vehicle is water. All mucilages as directed by the Pharmacopœias are prone to change, and gradually acquire an acid reaction and offensive odor, at the same time becoming more liquid. If not intended for medicinal use, the change may be retarded or prevented by the addition of alum, creasote, or glycerin.

MUCILAGO ACACIÆ, *U. S.*, *Br.*—MUCILAGE OF GUM ARABIC.

Mucilago gummi arabici, P. G.—*Mucilage de gomme arabique*, *Mucilage arabique*, Fr.; *Gummischleim*, G.

Preparation.—Take of Gum Arabic in small fragments four troyounces; Water half a pint. Add the gum arabic to the water, agitate occasionally until it is dissolved, and strain. *U. S.*

Take of Gum Acacia in small pieces four ounces; Distilled Water six fluidounces. Put the gum and water into an earthen jar, and stir them frequently until the gum is dissolved. If necessary, strain the solution through muslin. *Br.*

White and clear pieces of gum arabic should be selected for preparing this mucilage. The impurities which necessitate the subsequent straining are generally accidental admixtures of the gum, and may mostly be removed by rapid washing with cold water before dissolving it. The solution may be effected in a corked bottle by placing it on its side, whereby a more extended surface of the gum is exposed to the solvent action of water, and by agitating it occasionally so as to mix the heavy solution with the lighter liquid. It is a nearly transparent, colorless or scarcely yellowish, viscid liquid, having a faint rather agreeable odor and an insipid taste. To prevent its decomposition, Archer & Co. (1874) employed *tolu water* instead of distilled water, using one fluidrachm of tincture of tolu, rubbed up with carbonate of magnesium, to one pint of water.

Pharmaceutical Uses.—This mucilage serves for the suspension of insoluble substances in mixtures and to impart adhesiveness to pill masses. The British Pharmacopœia directs it to be used as an excipient in the preparation of troches.

Medical Uses.—This mucilage, diluted according to the taste or condition of the patient, sweetened and flavored, forms a customary drink in *fevers*, and in inflammatory affections of the *respiratory* and *digestive* organs. It is probably not directly nutritive, but it very possibly retards tissue waste.

MUCILAGO AMYLI, *Br.*—MUCILAGE OF STARCH.

Mucilage d'amidon, Fr.; *Stärkeschleim*, G.

Preparation.—Take of Starch one hundred and twenty grains; Distilled Water ten fluidounces. Triturate the starch with the water gradually added, then boil for a few minutes, constantly stirring. *Br.*

It should always be made fresh when needed.

Off. Prep.—Enema aloes, Enema magnes. sulphat., Enema opii, Enema terebinthinæ, *Br.*

Medical Uses.—Mucilage of starch is generally intrusted to domestic manufacture; but it may be worth while for physicians to know that one hundred and twenty grains of starch should be mixed with about half a pint of water to procure a liquid of the proper density for an enema such as may be used in *dysentery*. But in that disease if opiates, or any other medicines intended to be retained, are to be added to the mucilage, the quantity of it injected should not exceed three ounces.

MUCILAGO SASSAFRAS MEDULLÆ, *U. S.*—MUCILAGE OF SASSAFRAS PITH.

Mucilage de moelle de sassafras, Fr.; *Sassafrasmark-Schleim*, G.

Preparation.—Take of Sassafras Pith one hundred and twenty grains; Water a pint. Macerate for three hours, and strain. *U. S.*

It is a colorless, thickish, transparent liquid of a bland taste.

Medical Uses.—The mucilage of sassafras pith is a refreshing and useful application to the eye in *acute conjunctivitis*, and may serve as a vehicle for more active agents. It is equally appropriate as a soothing lotion in erythematous and other *inflammations of the skin*. Internally, it may be freely used as a drink in *dysentery* and other bowel complaints, and in *febrile affections* generally.

MUCILAGO TRAGACANTHÆ, *U. S.*, *Br.*—MUCILAGE OF TRAGACANTH.

Mucilage de gomme adragante, *Mucilage adragant*, Fr.; *Traganthschleim*, G.

Preparation.—Take of Tragacanth a troyounce; Boiling Water a pint. Macerate the tragacanth with the water for twenty-four hours, occasionally stirring; then beat the mixture so as to render it of uniform consistency, and strain forcibly through muslin. *U. S.*

Take of Tragacanth in powder sixty grains; Distilled Water ten fluidounces. To the water contained in a pint bottle add the tragacanth, agitate briskly for a few minutes, and again at short intervals, until the tragacanth is perfectly diffused and finally has formed a mucilage. *Br.*

The first formula yields a thick jelly-like mass; the second a more fluid preparation. The former is better adapted as an excipient for troches (U. S.) and many pill masses, but has the disadvantage of drying out and rendering the pills very slowly soluble, a fault which may be corrected by substituting for this purpose, for one-fourth or one-half the quantity of water, an equal bulk of glycerin. Thus prepared it may be readily mixed with aqueous liquids, and serves also a good purpose for suspending insoluble substances.

Medical Uses.—Tragacanth mucilage has scarcely any medicinal qualities peculiar to itself. It is seldom used unless as an excipient in lenitive mixtures, and in troches and lozenges which are intended to dissolve slowly in the mouth. Its tenaciousness has led to its occasional use as a protective for *burns* and *ulcers*.

MUCILAGO ULMI, *U. S.*—MUCILAGE OF SLIPPERY ELM BARK.

Mucilage d'écorce d'orme fauve, Fr.; *Ulmenrinden-Schleim*, G.

Preparation.—Take of Slippery Elm Bark sliced and bruised a troyounce; Boiling Water a pint. Macerate for two hours in a covered vessel, and strain. *U. S.*

Slicing the elm bark will yield a more acceptable preparation, since the mucilage cannot be strained without pressure; and by bruising, the tissues are ruptured and partly forced through the strainer. (See also page 498.)

Medical Uses.—As a demulcent, mucilage of slippery elm is employed in acute affections of the respiratory, digestive, and urinary organs. As a lenitive for external use, it is frequently applied to *erysipelatous* and other acute *cutaneous eruptions*, *abscesses*, *rheumatic joints*, etc. It is very apt to grow sour, and, if allowed to get dry, renders the skin painfully hard and stiff.

MUCUNA, *U. S.*—COWAGE.

Setæ siliquæ hirsutæ.—Cowhage, E.; *Pois velus*, *Pois à gratter*, Fr.; *Kratzbohnen*, *Kuhkrätze*, G.

The hairs of the pods of Mucuna pruriens, *De Candolle*, s. Dolichos (Stizolobium, *Pers.*, Carpopagon, *Roxb.*) pruriens, *Lin.* Woodville, Med. Bot., t. 153; Bentley and Trimen, Med. Plants, 78.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This is a long, slender, twining plant, with large trifoliate, nearly smooth leaves, and showy dark-purple and greenish flowers in pendulous axillary racemes, producing flattish, hairy, *S*-shaped legumes, with about four brownish seeds mottled with black. It is cultivated and wild, both in the East and West Indies.

Description.—The hairs covering the legumes are the officinal portion. They are about one-eighth inch long, of a glossy-brown color, straight, quadrangular prismatic, sharply pointed at the apex, somewhat retrorsely serrate on the upper half, and partly empty, partly filled with a brown granular matter. They easily penetrate the skin, and occasion an intolerable itching, which is greatly increased by washing and rubbing.

The fruits of *Stizolobium* (*Mucuna*, D. C., *Dolichos*, Lin.) *urens*, Pers., are shorter, less bent, and covered with shorter and darker hairs, which are used like the preceding. An emulsion of the seeds is used in the West Indies in dysuria; and an infusion of the root of the first species is considered to possess diuretic properties, and in India is employed as a remedy in cholera.

Constituents.—Nothing is known of the composition of cowhage, except that it contains a little tannin and resin (Martius, 1827).

Medical Action and Uses.—Cowhage was originally employed as a *vermifuge*, under the idea that its prickly setæ, which irritate the skin so severely and are so difficult to detach, would wound and injure the worms, and either kill them or promote their expulsion. Observation showed, however, that when the spiculæ are moistened they are quite innocuous, and there is much reason for believing that the supposed vermicide virtues of this substance are imaginary. It is difficult to imagine that an agent which has actually been employed to produce a painful irritation and eruption upon *paralyzed limbs* for the purpose of arousing their dormant functions, should cripple or destroy intestinal worms and leave the intestine itself uninjured. As a vermifuge the setæ are mixed with honey or molasses by dipping the pods in the liquid, and when it has reached the consistence of an electuary it may be given, fasting, in doses of one or more teaspoonfuls for several successive days. Subsequently a purge of calomel and jalap may be prescribed; and this is, doubtless, the most efficient part of the treatment. When formerly used to relieve paralysis, it was applied in a layer upon the affected part, supported by thin paper or similar substance, or else incorporated in simple ointment or lard.

MYRICA.—WAX-MYRTLE.

Bayberry, Candleberry, E.; *Arbre à suif*, Fr.; *Wachsbaum, Wachsgagel*, G.

Myrica cerifera, *Lin.* *Nat. Ord.*—Myricaceæ.

Origin.—The wax-myrtle is shrubby, or sometimes arborescent, usually from four to eight feet high, and grows near Lake Erie, but chiefly along the Atlantic coast of North America. It has alternate, oblong-lanceolate, entire or near the apex sparingly toothed leaves, which are nearly smooth, about two inches long, on both sides covered with resinous dots, and fragrant when bruised. The flowers are diœcious, the staminate ones in nearly cylindrical catkins about three-quarter inch long, the pistillate ones shorter, and producing globular one-seeded nuts, which are of the size of a pea, blackish, and covered with a white waxy incrustation.

The bark and waxy incrustation of the fruit have been employed.

Description.—1. The bark is in quills or curved pieces about one-sixteenth inch thick, externally covered with a whitish, slightly wrinkled, thin, corky layer which separates in small fragments, underneath which the bark is dark reddish-brown and nearly smooth, resembling the inner surface, except that the latter is slightly striate. The fracture is granular, of a pale-reddish color, and scarcely fibrous in the inner layer. The bark yields a light reddish-brown irritating powder, having a peculiar aromatic odor, and an astringent, somewhat bitter and pungently acrid taste.

2. Myrtle-wax, or *bayberry tallow*, is prepared by boiling the fruit with water until the fat collects on the surface. It has a balsamic odor, is harder and more brittle than beeswax, varies in color between green, yellowish, and gray, and breaks with a shallow conchoidal fracture. G. E. Moore (1862) found its specific gravity to range from 1.004 to 1.006, its fusing point from 47° to 49° C. (116.6° to 120.2° F.), and its proximate composition to be about one-fifth *palmitin*, the remainder being *palmitic acid* with a small quantity of *lauric acid*. Four-fifths of the myrtle-wax are soluble in hot alcohol.

Constituents.—The constituents of bayberry bark, as determined by G. M. Hambright (1863), are, besides those more generally met with, a trace of volatile oil, tannin, an acrid resin soluble in alcohol and ether, an astringent resin insoluble in ether, and *myricinic acid*, the latter obtained from the alcoholic extract after having been treated with ether, by exhausting it with hot absolute alcohol. It forms small granules, which produce a thick froth on being agitated with water, and on the addition of ammonia a deep-green color rapidly changing to red and yellow. It has a lastingly acrid taste.

Allied Plants.—Myrica gale, *Lin.;* Sweet gale, Dutch myrtle, *E.;* Piment royal, Galé odorant, *Fr.;* Gagel, Brabanter Myrte, *G.*—This is a smaller shrub than the preceding, growing in swampy places from the mountains of North Carolina northward to Canada, and in the northern part of Europe. The leaves are on short petioles, one and a half inch long, obovate-lanceolate, wedge-shaped at the base, serrate near the apex, subcoriaceous, softly pubescent beneath, and on both sides with yellow resinous dots. The fruit is likewise resinous dotted. The leaves and brown branches have a strong balsamic odor, and an aromatic, astringent, and bitterish taste. Rabenhorst (1836) obtained from 3000 parts of fresh leaves one part of a thickish volatile oil, containing 70 per cent. of stearopten.

A solid fat very similar to myrtle-wax is obtained from the fruit of other species of myrica indigenous to different countries.

Medical Action and Uses.—The bark of the root is acrid and stimulant, and in doses of a drachm causes a sensation of heat in the stomach, followed by vomiting, and sometimes diuresis. When chewed it acts as a sialagogue, and has proved useful in toothache. The powder is an active errhine. The leaves have some celebrity in domestic practice as an antispasmodic, antiscorbutic, and astringent medicine. The other native species are very similar in their properties. The "myrtle-wax" which covers the berries appears to have astringent and slightly narcotic properties, and was used with alleged success in an epidemic of typhoid dysentery, when it was administered in the dose of one or two drachms. (Griffith.)

MYRISTICA, *U. S.*, *Br.*—NUTMEG.

Semen myristicæ, P. G.; *Nux moschata*, *Muscade*, *Noix de muscade*, Fr.; *Muskatnuss*, G.

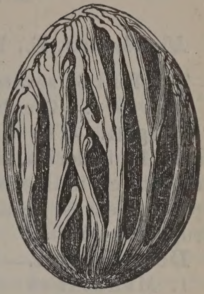
The kernel of the seed of Myristica fragrans, *Houttuyn*, s. M. moschata, *Thunb.*, M. aromatica, *Lam.*, M. officinalis, *Lin. f.* Suppl. Steph. and Church, Med. Bot., plate 104; Bentley and Trimen, Med. Plants, 218.

Nat. Ord.—Myristicaceæ.

Origin.—The nutmeg tree is indigenous to the Molucca Islands, but is at present cultivated in various parts of India, in the Philippines, West Indies, and South America. It attains a height of 30 to 40 feet; has alternate, smooth, entire, and prominently veined leaves, and small, yellowish, diœcious flowers, with the stamens united into a fleshy column, and a superior ovary, ripening into a dehiscent, pear-shaped, tough, one-seeded berry.

Collection.—The fruit is gathered, when split on one side, by means of a long hook fastened to a long stick; the pericarp is removed, and the arillus detached from the nut-like seed (see *Macis*, p. 868), which is carefully dried, on the Banda Islands, first by solar heat for a few days, or in Bencoolen at once on frames over a slow wood fire at a temperature of about 140° F. This requires about two months, during which time the seeds are frequently turned, and when the kernels rattle in the shell they are packed for the Chinese market. The entire seeds do not enter the European and American commerce, but only the kernels, which are removed from the shell by cracking the latter with a wooden mallet, carefully garbled and packed (*unlimed nutmegs*), sometimes mixed with cloves, in casks which have been smoked and whitewashed on the inside. In the Dutch colonies the kernels are dipped in a thick milk of lime (*limed nutmegs*), a custom which originated in the desire to destroy the vitality of the embryo, and thus limit this culture to their own possessions. Small and worm-eaten nutmegs are usually used for obtaining the fixed oil. About 800,000 pounds of nutmegs are annually consumed in the United States.

Fig. 113.



Nutmeg with Mace.

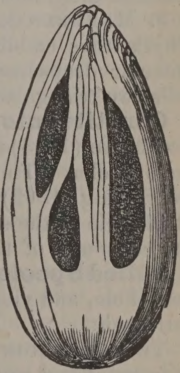
Description.—Nutmeg in the shell is an oval or elliptical seed, about an inch or more in length, with a brown, somewhat glossy, woody testa, light-brown raphe, and bearing the shallow impressions of the mace. The nutmegs of our commerce are deprived of the testa or shell, oval or ovate in shape, an inch or less in length, and marked on the broad end with a circular scar, from which proceeds a shallow furrow to a deeper depression near the upper end. The entire surface is reticulately furrowed, and of a light-brown color, or covered, particularly in the furrows, with a white powder (lime). The embryo is located near the base in a small conical cavity of the albumen or endopleura, which constitutes the remainder of the commercial article, is of a pale brownish-yellow color, has a fatty lustre, and is dissected by numerous curved channels filled with brown tissue and penetrated by the inner seed coat (tegmen). Nutmegs have a strong and pleasant aromatic odor, and a warm, aromatic, somewhat bitter taste.

The Penang and Singapore nutmegs are unlimed; the Dutch are limed.

False Nutmegs.—The *long*, *wild*, or *male* nutmeg resembles the foregoing, but is oblong, about 1½ inch long; the mace inodorous, less deeply lobed, the kernel of a paler color than nutmeg, and scarcely aromatic. It is obtained from *Myristica fatua*, Houtt., and is rarely seen in our commerce.

The so-called *California nutmeg* is the seed of *Torreya californica*, Torr., s. *T. myristica*, Hook. *Nat. Ord.* Coniferæ, *subord.* Taxineæ. It is oblong, with a smooth, brownish, thin testa, inclosing a kernel of the same shape, which has upon cross section a marbled appearance similar to that of the nutmeg, but has a terebinthinate odor and taste.

Fig. 114.



Wild Nutmeg with Mace.

Constituents.—Nutmegs contain about 2 to 3 per cent. of volatile oil (see Oleum myristicæ), between 25 and 30 per cent. of fat (see Oleum myristicæ expressum), some starch, protein compounds, and other principles of no medicinal importance.

Off. Prep.—Acetum opii, Pulv. aromaticus, *U. S.;* Pulv. catechu comp., Pulv. cretæ aromaticus, Spiritus armoraciæ comp., *Br.;* Spiritus (tinctura) lavandulæ comp., *U. S.*, *Br.;* Syrupus rhei aromat., Trochisci magnesiæ, Troch. sodii bicarbonatis, *U. S.*

Medical Action and Uses.—Observations and experiments upon man and animals agree in showing that nutmeg has a narcotic and intoxicating power. It is but little used as a medicine, except for flavoring purposes, but extensively as a condiment to qualify the action of oleraceous vegetables, soups, and pastry. It may be given in cases of simple debility of the stomach in *doses* of from five to twenty grains.

MYROBALANUS.—MYROBALAN.

Myrobalans, E., Fr.; *Myrobalanen*, G.

The fruit of several species of Terminalia, *Lin.* (Myrobalanus, *Gaertn.*).
Nat. Ord.—Combretaceæ.

Origin.—The following species yield myrobalans: Terminalia chebula, *Retz*, T. bellerica, *Roxb.*, T. citrina, *Roxb.*, and perhaps others. They are large trees, indigenous to India, with coriaceous entire and alternate or nearly opposite leaves, decandrous whitish or yellowish racemose flowers and one-seeded drupaceous fruits.

Description.—The following varieties have been distinguished:—

1. MYROBALANI CHEBULÆ.—They are nearly 1½ inch long and 1 inch thick, oblong or pyriform in shape, obtusely 5-angled and 5-ribbed, blackish-brown, the endocarp pale brown and resinous dotted, and contain a white seed.

2. M. BELLERICÆ.—They are roundish-oval, of about the size of a nutmeg, narrowed below, indistinctly 5-angled, reddish-brown, covered with a soft brownish tomentum, and contain a pale brown endocarp, inclosing the ovate and obtusely triangular seed.

3. M. CITRINÆ.—These are 1½ inch long, oblong, obtusely 5-angled, ribbed, orange- or ochrey-yellow, smooth, with a pale brown acutely angular endocarp, and a cylindrical seed.

4. M. NIGRÆ, s. INDICÆ.—These are unripe fruits, varying in size and shape, blackish-gray, and with an undeveloped seed.

5. M. EMBLICÆ.—These are obtained from Emblica officinalis, *Gaertn.*, s. Phyllanthus emblica, *Lin.*, a euphorbiaceous tree of India, and consist of subglobular drupaceous six-grooved capsules, which contain in each of the three cells two triangular red-brown seeds.

Constituents.—The astringent taste of myrobalans is due to tannin; Stenhouse (1843) found in the first variety also gallic acid, mucilage, and brown-yellow color. The last variety contains notable quantities of sugar. According to Hennig (1869), myrobalans yield about 45 per cent. of tannin, which is obtainable in the same manner as from nutgalls and at a lower price, owing to the cheapness of the drug.

Allied Species. TERMINALIA CATAPPA, *Lin.*—Its seeds resemble almonds, are edible, and yield about 50 per cent. of a bland fixed oil. The bark is very astringent.

TERM. BENZOIN, *Lin. fil.*, s. T. angustifolia, *Jacq.*—The resinous exudation is fragrant and resembles benzoin in properties.

Medical Action and Uses.—These fruits are now wholly disused in medicine, although they were once held in high esteem. Pliny speaks of one species as an astringent in diarrhœa and menorrhagia, and as a vulnerary. The Arabian physicians abound in their praise. Some species appear to have been cholagogue and others astringent. Rhazes declares that they act as emetics and cathartics, purge away the excrement, remove humidity, strengthen the senses and the understanding, are useful in cutaneous eruptions, colic, mental debility, obstinate fevers, headache, dropsy, and splenic disorders. Mesue embellishes this statement by adding, among other things, "that they restore youth, improve the complexion, the breath, and the perspiration, impart joy and hilarity," etc. They continued to be used by European physicians as late as the last century

MYRRHA, *U. S.*, *Br.*—MYRRH.

Gummi-resina myrrha.—*Myrrhe*, Fr., G.

A gum-resinous exudation from Balsamodendron Ehrenbergianum, *Berg*, perhaps, also, from Balsamodendron myrrha, *Nees.* Plant. Med., plate 357; Berg and Schmidt, Off. Gew., t. 29; Bentley and Trimen, Med. Plants, 59.

Origin.—Myrrh is collected from large shrubs or small trees, growing in Southern Arabia, by the Somalis, who cross the Gulf of Aden for the purpose. It is likely that it is obtained from both species mentioned above, which were collected by Ehrenberg (1820–1826) on the eastern side of the Red Sea, and on the first mentioned of which he observed the exudation of myrrh. But the principal supply of myrrh comes from Eastern Africa from the country of the Somalis, and is probably obtained from *B. opobalsamum*, Kunth, which grows northward into Abyssinia, and by Oliver and Bentley is considered identical with Berg's plant. Formerly, myrrh entered commerce through Egypt and the ports of the Levant, hence the term *Turkey myrrh;* at present, it is taken from Aden and Berbera to Bombay, where it is assorted before being shipped to Europe and America. From the observations of Marchand (1866), it seems to be chiefly produced in the bark, and to a small extent in the pith.

Description.—Myrrh is in roundish or irregular tears, or in larger masses having an uneven surface of a lighter or darker reddish-brown color and dull dusty appearance. These break readily with an uneven somewhat splintery fracture, which is of a waxy lustre, apparently fatty to the touch, often marked with semicircular whitish lines, of a brownish-yellow or reddish color, and translucent, at least when in thin layers. In cold weather, myrrh may be readily powdered, but in warm weather, it cannot be reduced to a fine powder until after it has been well dried and deprived of some volatile oil. When triturated with water, it yields a brown-yellow emulsion. Alcohol dissolves it partly, leaving the gum behind and yielding a brownish orange-colored tincture. It has a peculiar rather agreeable odor, and an aromatic, acrid, and bitter taste.

Other Varieties of Myrrh.—According to Vaughan (1853), there are two other varieties of myrrh found in the Arabian commerce at Aden; one called by the Arabs *mur*, or by the Somalis *heera bôl*, by which names African myrrh is likewise known, resembles the latter in all sensible properties, but upon the fractured surface is destitute of the whitish lines and dissolves in alcohol only to the extent of 25 per cent. (*Pharmacographia.*) The other variety is known as *bissa bôl*, or by the Somalis as *hebbakhade.* Hanbury (1853) states that it is the *Myrrha indica* of Martiny, and was formerly, but is not now, distinguished in commerce as *Indian myrrh;* it has the appearance of an inferior dark-colored myrrh, and is chiefly distinguishable by its different odor, which is likened to that of mushrooms.

Admixtures.—Myrrh is not unfrequently mixed with dark-colored pieces of various gums, some of which merely swell with water, and with *East India bdellium.* The latter is referred to *Balsamodendron mukul*, Hook., and, according to Dymock (1876), a similar exudation is yielded by *B. Roxburghii*, both species indigenous to India, but perhaps also growing in Southern Arabia. It is in large pieces, rounded and dusty on the surface, breaks with a flat conchoidal fracture, has a dark, sometimes blackish-brown color, is translucent in thin layers, and has an odor somewhat resembling myrrh; its tincture does not acquire a purplish color on the addition of nitric acid.

Constituents and Tests.—Myrrh contains a small quantity of volatile oil which may reach 2 or $2\frac{1}{2}$ per cent., from 25 to 40 per cent. of resin, 40 to 65 (or, in Arabian myrrh, 75) per cent. of gum, and yields about $3\frac{1}{2}$ per cent. of ash, mostly $CaCO_3$. *Oil of myrrh* is a pale yellow, thick liquid, of specific gravity 0.98, but, according to Brandes (1819), sometimes heavier than water.

The variable yield is explained by Bley and Diesel (1845) by oxidation, whereby formic acid is formed. For the same cause, probably, the composition may vary; Ruickholdt (1845) obtained results leading to the formula $C_{10}H_{14}O$, which would make it isomeric with thymol and carvol; Heldt (1847) found $C_{22}H_{32}O_2$; Buri (*Pharmacographia*) obtained $C_{22}H_{32}O$. Dissolved in bisulphide of carbon, the oil gradually assumes a permanent violet or blue color after the addition of nitric acid or bromine. The *resin* is entirely soluble in alcohol, ether, and chloroform. Hager (1865) found it only partly soluble in bisulphide of carbon, the soluble portion acquiring a violet color with nitric acid. Muriatic acid produces the same color with the resin, after previously moistening it with alcohol. The *gum* consists, according to Hekemeijer (1858), of two kinds, one being precipitated by neutral, the other by basic acetate of lead. Shuttleworth (1871) recommends it as making a good paste of unlimited keeping qualities; its adhesiveness is increased by the addition of a little molasses.

Allied Drugs.—BALSAMUM GILEADENSE, *Balm of Gilead, Mecca balsam,* or *Opobalsamum,* though differing greatly from myrrh, is referred to Balsamodendron opobalsamum, *Kth.* It is said to exude spontaneously, and is an opaque yellowish or whitish, fragrant, viscid liquid, in which Trommsdorff found 30 per cent. of volatile oil and 64 per cent. of hard resin, while Bonastre obtained only 10 per cent. of volatile oil, 70 per cent. of adhesive, and 12 of hard resin. It is at present rarely, if ever, met with in our commerce.

BDELLIUM.—Indian bdellium is described above. African bdellium is the exudation of Balsamodendron Africanum, *Arn.*, a shrub indigenous to West Africa, and is used in France chiefly as an addition to some plasters. It is met with in irregular roundish or oval tears, about an inch in diameter, and varying in color from pale yellowish to brown-red. It is translucent, breaks with a waxy fracture, and resembles myrrh in odor and taste, but its tincture does not become purple on the addition of nitric acid.

Off. Prep.—Decoct. aloes comp., *Br.;* Mistura ferri comp., Pilulæ aloes et myrrha, *U. S., Br.;* Pil. ferri comp., *U. S.;* Pil. galbani (assafœtidæ) comp., Pil. rhei comp., Tinct. myrrhæ, *U. S., Br.;* Tinct. aloes et myrrhæ, *U. S.*

Medical Action and Uses.—Myrrh is both stimulant and tonic. In small doses it appears to quicken the appetite and digestion; in larger doses it irritates the stomach, occasioning nausea and even vomiting and diarrhœa, quickening the pulse, stimulating the bronchial mucous membrane, and probably exerting a special influence of the same sort upon the uterine system. It has been found useful in *atonic dyspepsia* with flatulence, mucous evacuations, constipation, and associated nervous disorders of an hysterical or hypochondriacal description. In such affections it is profitably associated with vegetable bitters and iron. The compound iron mixture is a valuable preparation of this nature, which is extensively employed in *amenorrhœa* connected with anemia and general torpor of the functions. Myrrh is especially useful in *chronic bronchitis* with profuse expectoration, but if fever is present its dose should at first be small. In like manner it may be employed in chronic uterine and vaginal *leucorrhœa.* In ancient times it was much used as a vulnerary to promote the healing of *wounds, ulcers,* etc., of an indolent type. Its stimulant and astringent qualities are manifested in cases of *spongy* and *ulcerated gums.* Its *dose* is from five to thirty grains; but it is seldom used in substance. It may be prescribed in emulsion as an enema.

NAPHTHALINUM.—NAPHTHALIN.

Naphthalene, E.; *Naphtaline, Naphtalène,* Fr.; *Naphtalin, Naphtalen,* G.
Formula $C_{10}H_8$. Molecular weight 128.

Origin.—Naphthalin was discovered by Garden (1820) in coal-tar oil, and recognized by Reichenbach as resulting from the decomposition of the products of distillation of coal. It has since been obtained from a large number of organic bodies, particularly if the distillation products are conducted through a red-hot tube.

Preparation.—Coal-tar oil is distilled, and that portion collected by itself which passes over between 170° and 200° C. (338° and 392° F.), or the distillation is continued until the contents of the retort begin to char. The dark-colored product is purified by resubliming it two or three times.

Properties.—Naphthalin forms large, colorless and transparent, glossy laminæ, which have a faint and peculiar odor. According to Kopp (1855) it fuses at 79.2° C. (174.6° F.), forming a colorless liquid, and crystallizes again on cooling. It volatilizes slowly at the ordinary temperature, and boils at 218° C. (424.4° F.). When heated in the air, its vapors are ignited with difficulty, and burn rapidly with a red and sooty flame. It is insoluble in water, freely soluble in hot alcohol, in ether, bisulphide of carbon, chloroform, and in warm fixed and volatile oils. On dissolving it together with picric acid in hot alcohol, the two compounds unite, forming, on cooling, golden-yellow needles, having the composition $C_{10}H_8.C_6H_3(NO_2)_3O$, and yielding all the picric acid to ammonia. Naphthalin yields with chlorine and bromine numerous products of addition and substitution. When treated with strong nitric acid, *nitronaphthalins* are generated, which, by the action of reducing agents, are converted into *naphthylamina* $C_{10}H_7.NH_2$, which is crystallizable, turns red in the air, and the salts of which yield blue, and finally purple-colored precipitates with ferric chloride, chromic acid, and other oxidizing agents.

Medical Action and Uses.—Upon the tongue it gradually develops a strong, acrid, burning taste in the whole mouth and throat, and the expectoration of ropy or frothy sputa. It has been employed with reputed advantage in *chronic bronchitis* and *bronchorrhœa*, particularly as they occur in advanced life. In other words, its operation in these affections is the same as that of terebinthinate and balsamic medicines. Externally, dissolved in alcohol, it has been applied as a substitute for tincture of camphor in *sprains*, *contusions*, etc., and in the treatment of scaly *eruptions of the skin*. It is a valuable agent in preventing the ravages of moths, book-worms, etc., and has been administered internally for *intestinal worms*. The *dose* is from eight to thirty grains, given in some aromatic and alcoholic vehicle. An ointment is made with thirty grains of naphthalin to an ounce of lard.

NARCISSUS.—DAFFODIL.

Narcisse des près, *Porrillon*, Fr.; *Gelbe Narcisse*, G.

Narcissus pseudonarcissus, *Lin.* *Nat. Ord.*—Amaryllidaceæ.

Description.—Daffodil is found wild in moist and shady places in Southern Europe, and is frequently cultivated in gardens. It has an ovate, tunicated, whitish *bulb*, which is covered by brown leaf-scales, and has a mucilaginous and bitter taste. The *leaves* are flat, linear, erect, a foot long, and one-third of an inch broad. The *flowers* are single on the scape, nodding, large, yellow, with a top-shaped tube, and a large, bell-shaped cup, wavy or crisped at the margin, and equal to the six spreading divisions of the perianth; they have an unpleasant odor, and a nauseous, bitter, and acrid taste.

Constituents.—The acrid and bitter principles of daffodil have not been investigated. Caventou obtained from the flowers, by ether, a yellow, and, by alcohol, a brown-yellow coloring matter.

NARCISSUS JONQUILLA, *Lin.*, *Jonquil.*—The scape bears two to five small, yellow, fragrant flowers, from which ether takes up a yellow, butyraceous, volatile oil of a very agreeable odor; afterwards alcohol dissolves a brown, viscid oil of an unpleasant odor. (Robiquet, 1835.)

Medical Action and Uses.—The several species of narcissus appear to possess almost identical qualities. Pliny describes their emetic, purgative, maturative, and cicatrizing powers, and refers also to their soporific virtue, saying that the plant was called narcissus, because it was narcotic, and not after the fabled boy: "et a narce narcissum dictum, non a fabuloso puero." The Arabian writers dwell especially upon its emetic properties and its stimulant virtues exhibited in curing alopecia, producing abortion, and exciting genital erections by its local irritation. According to Orfila's experiments upon dogs, the flowers and the bulb are local irritants, internally causing vomiting, purging, and inflammatory gastro-intestinal lesions. Applied to wounds the extract inflames them, and produces all of the above effects, besides affecting the brain and the whole nervous system, causing staggering, anæsthesia, paralysis, and death by paralysis of the lungs and heart. In man the most noticeable effect of narcissus is vomiting. From fifteen to thirty grains of wild narcissus flowers are said to act as an emetic, especially if given in a decoction prepared from the flowers dried slowly in the sun. Quite recently (1876) the infusion has been strongly recommended for children when prepared in the following manner: From thirty to fifty grains of narcissus flowers are infused for fifteen or twenty minutes in five or six ounces of hot water, and strained. When slightly sweetened, children take it without repugnance, and vomit within ten or twelve minutes. The emetic action of narcissus has been used to break up *intermittent fever*, and relieve *bronchial catarrh*, with congestion or obstruction of the air-tubes. Like ipecacuanha, it has also been used in *dysentery*, especially of the epidemic form. Its influence on the nervous system is attested by the vogue it has enjoyed in *hysteria*, *chorea*, *whooping-cough*, and even *epilepsy*. The *dose* of the powdered flowers is from fifteen to thirty grains; of the powdered bulb from thirty grains to two drachms may be given as an emetic.

NASTURTIUM.—WATER-CRESS.

Cresson de fontaine, Fr.; *Brunnenkresse*, G.

Nasturtium officinale, *R. Br.*, s. Sisymbrium nasturtium, *Lin.*, s. Cardamine fontana, *Lam.*

Nat. Ord.—Cruciferæ, Siliquosæ.

Description.—The true water-cress is a perennial herb, growing in springs, brooks, ponds, and ditches in Europe, Asia, Africa, and North America. The ascending and spreading stem is 1 or 2 feet long, angular, and hollow. The leaves are petiolate, 2 or 3 inches long, dark green, pinnate, with from 5 to 15 obliquely ovate or roundish oblong leaflets, about $\frac{3}{4}$ inch long, or sometimes much smaller, the terminal one being largest, ovate-cordate or oblong, and rather wedge-shaped at the base. The flowers are in loose corymbose racemes, white, and produce linear ascending pods, about $\frac{1}{2}$ inch long. The fresh plant bruised has a pungent odor, and a bitterish somewhat biting taste.

Constituents.—On distilling the fresh plant with water a volatile oil is obtained, which contains sulphur, and is probably identical with oil of mustard.

NASTURTIUM SYLVESTRE, *R. Br.*, with narrow linear pods, and

NAST. PALUSTRE, *D. C.*, with oblong or ovoid pods, have similar properties. Both species grow in North America (the former one as an introduced plant), have pinnatifid toothed leaves, and small yellow flowers.

Medical Action and Uses.—Like several other plants that have a pungent taste, as scurvy-grass (Cochlearia officinalis) and horse-radish (C. armoracia), water-cress has long been celebrated as a purifier of the blood, and was and is used in the spring to eliminate the crude humors accumulated during the winter. That it increases the appetite, renders the bowels freer, and the urine more abundant, is familiarly known. It is a favorite and efficient domestic remedy in many cases of glandular *scrofula* in children, and applied in a poultice to *eczematous* eruptions it sometimes effects a cure. It is also reputed to do good in chronic *bronchitis*. It is best eaten fresh as a salad; but it may be given in decoction or infusion, or its expressed juice may be taken in milk.

NECTANDRA, *U. S.*—BEBEERU BARK.

Nectandræ cortex, Br.; *Cortex beberu, s. bibiru.—Greenheart bark*, E.; *Écorce de bébéeru*, Fr.; *Bibirurinde*, G.

The bark of Nectandra Rodiæi, *Schomburgk*. Hooker's Jour. Bot., 2d ser.; Bentley and Trimen, Med. Plants, 219.

Nat. Ord.—Lauraceæ.

Origin.—The greenheart is a tree about 30 feet high, growing in British Guiana on hillsides a short distance from the sea, and disappearing further inland. The small compound racemes of white flowers are situated in the axils of the coriaceous oblong elliptical and acuminate leaves, and produce a subglobular berry about 2 inches in diameter, supported by the enlarged cup-shaped tube of the calyx, and containing a single seed, nearly the size of the fruit. The wood is very durable and useful in shipbuilding.

Description.—The bark is in flat or somewhat curved pieces, sometimes 1 or 2 feet long, and 4 or 6 inches wide, by $\frac{1}{4}$ inch thick, is heavy, hard, and brittle, and consists of liber only. The outer surface is gray-brown, with numerous irregular conchoidal depressions, the ridges between consisting of soft cork, sometimes with light reddish-gray patches, containing small suberous warts. The inner surface is cinnamon brown, and rather coarsely striate. The bark breaks with a short and rough granular fracture, which is somewhat fibrous in the inner layer. It has no odor; its taste is astringent and persistently bitter.

Constituents.—Besides tannin, producing green precipitates with iron salts, some starch and other common constituents; the bark contains an alkaloid, *beberina*, $C_{18}H_{21}NO_3$, discovered by Rodie (1834). In its pure state it is a white bitter fusible powder, soluble in alcohol and ether, according to Walz (1860), identical with *buxina*, the alkaloid of *Buxus sempervirens*, Lin., and according to Flückiger (1869), also with *pelosina*, the alkaloid of pareira brava. The commercial sulphate of beberina (see page 270) was found by Maclagan (1843) to contain another alkaloid, *sipirina*, which is red-brown, resin-like, and insoluble in ether. Maclagan obtained the alkaloid also from the fruit, which in addition contains *bebiric acid*, forming white deliquescent crystals, fusible at 150° C., and sublimable at 200° C. Together with Gamgee (1870), he examined the wood, and obtained several alkaloids, one of which, *nectandria*, $C_{20}H_{23}NO_4$, fuses in boiling water, is very soluble in chloroform, little so in ether. The others have not been further examined.

Pharmaceutical Uses.—For the preparation of Beberiæ sulphas, *Br.*

Medical Action and Uses.—The bitterness and astringency of nectandra are due in a great measure to its alkaloid, *beberia* or *bébéerine*. According to its original promoters, beberia had all the virtues without the objectionable qualities of quinia, such as the production of tinnitus, headache, etc. In small doses it appeared to be a stomachic tonic. Experiments upon the frog, in which the alkaloid was used hypodermically, produced tetanic retraction of the limbs in the same manner as quinia; but these effects were not produced by either substance when given by the stomach. Nor did the tetanism resemble that of strychnia, since it was not intensified by external excitation.

The treatment of *periodical fevers* by this substance proves it to be a very imperfect substitute for quinia, since it fails in at least one-half of the cases. It has also been vaunted in the treatment of periodical *headaches* and *neuralgias*, as an anti-hectic remedy in *consumption*, as a tonic in *atonic dyspepsia*, in *menorrhagia*, *leucorrhœa*, etc. It may, on the whole, be regarded as an imperfect substitute for quinia. The *dose* of beberia is from one to three grains as a tonic, and from five to ten grains as an antiperiodic medicine. (See Beberia sulphas.)

NIGELLA.—FENNEL FLOWER.

Faux cumin, Fr.; *Schwarzkümmel*, G.

The seeds of Nigella sativa, *Lin.*, and of Nig. damascena, *Lin.*
Nat. Ord.—Ranunculaceæ, Helleboreæ.

Origin.—Both plants are annuals, indigenous to Southern Europe and the Levant. They have finely divided leaves like fennel; the second species also a similar involucre. The fruit consists of 5 united follicles, which contain numerous seeds. Both plants are cultivated in gardens, and are known respectively as *nutmeg flower* and *ragged-lady*.

Description.—The seeds are about $\frac{1}{10}$ inch long, triangular-ovate, netted-wrinkled, of a dull black color, internally white, contain a fleshy albumen enclosing a small straight embryo, and have a somewhat acrid taste. When rubbed, the seeds exhale a peculiar odor; that of the first species being camphoraceous, and resembling cajuput, while that of the second species resembles the odor of strawberries. The latter are sometimes sold as *magnolia seeds.*

Constituents.—Reinsch obtained 35 per. cent. of fixed oil, which, according to Lepine, is orange-yellow, and solidifies at 2° C. (35.6° F.). The volatile oil is lighter than water, colorless, and shows a blue fluorescence. Reinsch's *nigellin* is an extract-like yellow mass, having the consistence of turpentine and a bitter taste.

Medical Action and Uses.—Nigella is closely analogous in its properties to coriander, anise, and cumin, and like them is used in the East as a condiment for food, and medicinally as a carminative, aphrodisiac, emmenagogue, galactogogue, diuretic, and expectorant.

NITROBENZOLUM.—NITROBENZOL.

Nitrobenzol, Fr., G.; *Essence de mirbane*, Fr.
Formula $C_6H_5NO_2$. Molecular weight 123.

Preparation.—Benzol is added in small portions to warm fuming nitric acid, when a violent action takes place, and a dark-red liquid is formed, which is mixed with water, and the oily precipitate washed with the same liquid.

Properties.—Nitrobenzol is a yellowish, oily liquid, having the spec. grav. 1.209, crystallizing in needles at 3° C. (37.4° F.), and boiling at 213° C. (415.4° F.). It has a strong odor of bitter almonds—hence the incorrect name *artificial oil of bitter almonds*—a sweet taste, and dissolves in concentrated sulphuric and nitric acid, and in all proportions in alcohol and ether. In its alcoholic solution it is readily converted into anilina through the influence of nascent hydrogen.

Pharmaceutical Uses.—Nitrobenzol is often used for scenting soaps and in various perfumes as a tolerably good substitute for the more costly oil of bitter almonds, which is sometimes adulterated with it (see Ol. amygd. amaræ); but its most important use is in the manufacture of anilina (see page 175).

Physiological Action. *On Animals.*—The experiments of Dr. Letheby and others show that the toxical phenomena vary not only with the dose of this poison, but very singularly in the time of their coming on, so that several or even many hours may elapse before they appear. When the poison is speedily fatal, the animal is affected with giddiness, inability to walk, complete loss of voluntary power, occasional spasms of the dorsal muscles, or general epileptiform convulsions; the pupils are widely dilated, the heart's action tumultuous or irregular, and the breathing difficult. The animals retain consciousness until life is extinct. When the action of poison is slower its visible effects may be delayed even for days, and then suddenly there is observed a look of distress, perhaps vomiting, and a fit of epilepsy, followed by exhaustion and then by renewed fits, which occur at irregular intervals for several days; between them the limbs are in constant motion. Consciousness is unimpaired. Death takes place through exhaustion, or gradually voluntary power is restored, and the animal recovers. The post-mortem appearances consist of extreme congestion of the bloodvessels of the brain and its membranes; the cavities of the heart and the veins being full of black, coagulated blood; the lungs are congested in a less degree; but there is no sign of gastric lesions.

On Man.—Numerous cases have been published of poisoning by nitrobenzole, sometimes by its being swallowed, sometimes by the inhalation of its fumes, and sometimes by its application to the skin. A remarkable illustration of the potency of this poison is furnished by several cases of females affected by the odor of the so-called "almond glycerin soap," and by that of a person who, while using such a soap in a warm bath, fainted from the effects of nitrobenzole set free by the heat, and was ill for some time afterwards. A case is also recorded of a man who, having used a liniment containing this product in the treatment of scabies, became partially paralyzed, while his head was drawn back, and his face, hands, mouth, and pharynx were all cyanosed, and the breath and matters vomited smelled of bitter almonds. In this case, as in some others, the blue tint remained for at least a week. The symptoms produced in man are identical with those observed in animals, except the purple color of the skin, which appears to be due in part to venous congestion, but in part also to the presence of aniline derived from the decomposition of nitrobenzole in the body. The mode of death and the lesions found *post-mortem* are also essentially the same as in animals: the tarry dark blood, congested lungs, heart, and brain, etc. In one case the liver is described as being of a deep-purple color. Whether recovery or death occur, the peculiar odor of nitrobenzole persists for many days. The probable fatal dose of nitrobenzole may be stated to be between a few drops and two drachms.

Medical Uses.—The only disease, so far as we are informed, in which the preparation has been used is *scabies*, but its dangerous effects from accidental conditions, and the case of poisoning by it in this very disease, and to which reference has been made, ought to exclude it altogether from medical practice.

In poisoning by nitrobenzole the proper remedies consist of stimulants, internally and externally; carbonate of ammonia rather than alcohol, electricity, the hot bath, and a simultaneous cold douche upon the head and spine, frictions of the skin, etc.

NITROGENII MONOXIDUM.—NITROUS OXIDE.

Laughing gas, E.; *Oxyde nitreux*, *Protoxyde d'azote*, Fr.; *Stickstoffoxydul*, *Lachgas*, G.

Formula N_2O. Molecular weight 44.

Preparation.—Nitrate of ammonium, which is absolutely free from chloride, is gradually heated to about 200° C. (392° F.), when the decomposition commences and the heat may be slowly increased. The salt yields then water and nitrous oxide without other products of decomposition; NH_4NO_3 yields $2H_2O$

$+N_2O$. The gas is passed through a little warm water, which will retain any undecomposed salt or other product, without retaining much of the gas. For other precautions in the preparation of this gas, refer to the decomposition of Ammonii nitras, on page 159.

Properties.—Nitrous oxide is a colorless gas, of a very slight agreeable odor and a sweetish taste. It has the specific gravity 1.6 (Dalton), and a liter of it at 0° C. (32° F.) weighs 1.97 grams. It is not inflammable, but supports the combustion of ignited bodies, which burn more vigorously than in the open air. By the aid of pressure and cold, it may be condensed into a thin, very mobile, colorless liquid, which, at a temperature of about —100° C. (—148° F.), congeals to colorless crystals. The gas is soluble in water, alcohol, ether, volatile and fixed oils.

Nitrous Oxide Water.—The solubility of nitrous oxide in water has been determined by Carius (1855) as follows: Water absorbs at a barometric pressure of .76 meter and at a temperature of

0°	5°	10°	15°	20°	25° C.
1.3052	1.0954	.9196	.7778	.6700	.5962 measures of the gas.

Such an aqueous solution, prepared under a pressure of about five atmospheres, has been employed under the name of *oxygenous aërated water.*

Physiological Action.—The primary action of nitrous oxide gas is to stimulate the whole system; a tingling sensation is felt all over the body, the senses seem unnaturally acute, the pulse becomes stronger and more frequent, the breathing more rapid and shallow, and the face grows pale. If the inhalation is interrupted at this period, a lively intoxication is developed. It was formerly the custom to have semi-public exhibitions of this appropriately called "laughing gas," in which one of the most familiar phenomena was a high degree of mental excitement, generally exhibited in rhapsodical declamation or singing, but sometimes, also, in a sudden fit of violent pugnacity, which subsided abruptly when the vapor was exhaled. But if the inspiration is not interrupted, the breathing, in about a minute and a half, begins to be stertorous; at the same time, the pallor of the face is replaced by a cyanotic hue, and complete unconsciousness and anæsthesia. Without a renewal of the inhalation, it does not last more than a minute or two. Unlike ether or chloroform, it is apt to occasion muscular twitching or even rigidity. In general, feeble persons are more quickly affected than the strong; children, females, and the aged more speedily than adult males.

The number of deaths due to the administration of this gas is surprisingly small when compared with those following chloroform and even ether, and, as in the case of the latter agent, they may always, or nearly so, be demonstrably ascribed to the special condition of the patient or the mode of administration, and not to the anæsthetic itself. According to the statistics of Darin, 53 deaths occurred in 152,260 administrations of chloroform, or 1 : 2872; 4 in 92,815 of ether, or 1 : 23,203; and 3 in 300,000 of gas, or 1 : 100,000, one of which was due to an accident, namely, the falling of a cork into the air-passages. Other ill effects have occasionally been noticed, *e. g.*, coma of several days' duration, hemiplegia, temporary catalepsy or hysteria, clonic convulsions, etc.

The mode in which nitrous oxide gas acts has been variously explained, and while it remains as difficult as ever to understand its soporific and anæsthetic power, it is very easy to refute the principal error in regard to it, which is that it is merely an asphyxiating agent whose action consists in excluding the atmosphere from the lungs. This simple, but very absurd, hypothesis would liken the presence of the gas in the air-passages to that of a foreign body, or, more precisely, to that of an unirritating but irrespirable gas. But carbonic acid is such a gas, and, although it may prove fatal, it does not produce the discoloration of the skin which is characteristic of nitrous oxide. Besides, nitrous oxide is not irrespirable. The experiments of Zimmermann show that rabbits and pigeons may be confined in it not only for minutes, but for hours, and yet return to active life. It must not be forgotten that it not only contains oxygen, but a far larger proportion of it than exists in atmospheric air; and that very possibly a portion of the gas is decomposed, furnishing an amount of oxygen necessary to maintain life, while the bulk of it remains unchanged and induces cyanosis, unconsciousness, and anæsthesia. This conjecture is not a mere hypothesis, for it is established by experiment that venous blood introduced into an atmosphere of nitrous oxide assumes the arterial color; that phosphorus undergoes oxidation in it; that seeds germinate and grow in it; and, above all, that it does not put out the light of a burning taper. Finally, a most important, and, indeed, capital fact is, that in the series of phenomena which it produces in animals immersed in it, the organ which remains longest in action is the heart; and as the gas is very rapidly eliminated from the system, the brain and the lungs are soon relieved from its influence, while the heart continues to pulsate, and repair whatever temporary damage may have been produced.

Surgical Uses.—Nitrous oxide has been used in surgical operations, but chiefly in those requiring a comparatively short time for their performance. *Teeth* have been extracted with its aid in cases innumerable in this country and in Europe; and whoever has experienced its effects must be satisfied with the efficiency and convenience of its use. All surgical operations which can be quickly completed, from the opening of *abscesses* to the operation for *cataract*, have been successfully performed with its aid; and in numerous instances it has sufficed for operations lasting from fifteen to twenty minutes.

Administration.—The nostrils being closed, the gas may be inspired from the reservoir in which it is collected, or from caoutchouc bags, through a tube and mouth-piece furnished with valves opening outwards, to permit the breathed air to escape during expiration. It is also kept in wrought-iron vessels in a highly condensed or even a liquid state, and may thus be conveniently transported from place to place.

NITROGLYCERINUM.—NITROGLYCERIN.

Trinitroglycerin, Glonoin.

Formula $C_3H_5(NO_2)_3O_3$. Molecular weight 227.

Preparation.—Nitroglycerin was discovered by Sobrero (1847), and is at the present time prepared on a large scale by slight modifications of the process proposed by the discoverer and by E. Kopp. To about seven pounds of a mixture, composed of one part of nitric acid, sp. gr. 1.47, and two parts of strong sulphuric acid, one pound of glycerin is slowly added, with frequent stirring, and with the precaution of preventing the temperature from rising above 26.6° C. (80° F.). The mixture is then poured into a large quantity of water, and the oily sediment well washed with a diluted solution of alkali and of water.

Properties.—Nitroglycerin is a colorless or pale-yellowish oily liquid, having the density 1.60 at 15° C. (59° F.), and, when exposed to a low temperature, crystallizes in long needles. It is without odor, but its vapors produce intense headache; its taste is sweet, and pungently aromatic. When ignited in the open air it burns quietly and incompletely; but when heated in closed vessels, or by percussion, it explodes with great violence. On keeping it is gradually decomposed, oxalic acid being formed, besides nitrous acid and other gases, from the pressure of which explosions are apt to occur. Nitroglycerin forms the basis of various blasting compounds known as *dynamite*, *glyoxylin*, *dualin*, etc. It is nearly insoluble in water, but dissolves freely in ether, alcohol, and methylic alcohol; these solutions will likewise explode by percussion with a wet hammer.

Physiological Action.—Nitroglycerin is a powerful poison, and exerts a marked effect upon the nervous system even when given in minute doses. Its general effects may be summarily described as "accelerated respiration, paralysis, loss of reflex action, and apparently to a great degree of sensation, and death from stoppage of the respiration." (Brunton and Tait.) In frogs it induces lethargy and paralysis, alternating with clonic and tonic convulsions; in cats and rabbits convulsions, tetanus, paralysis, spasmodic breathing; frequent and feeble pulse, general anæsthesia, and death; and in dogs the same effects, besides salivation and vomiting. On dissection the brain may be either pale or congested, and the lungs are engorged with blood, but the heart is empty.

Medical Uses.—When this preparation was first known it was for a short time employed in the treatment of certain functional nervous disorders, such as *asthma*, *epilepsy*, *headache*, etc., but it appears to be now entirely disused.

NUX VOMICA, *U. S.*, *Br.*—NUX VOMICA.

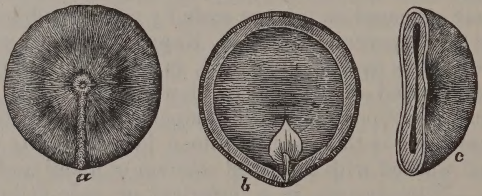
Semen strychni, P. G.; *Semen nucis vomicæ.—Poison nut*, *Quaker buttons*, E.; *Noix vomiques*, Fr.; *Krähenaugen*, *Brechnuss*, G.

The seeds of Strychnos nux vomica, *Lin.* Steph. and Church, Med. Bot., plate 52; Bentley and Trimen, Med. Plants, 178.

Nat. Ord.—Loganiaceæ.

Origin.—The tree has a short, thick, often crooked trunk, opposite, oval, glossy, 3- to 5-nerved leaves, and small, funnel-shaped, whitish flowers in small, terminal, paniculate cymes; the smooth, orange-colored berry is globular, about two inches in diameter, and contains about five seeds. The tree is common in many parts of Hindoostan, Farther India, some of the East India Islands, and as *St. lucida*, R. Br., is also found in Northern Australia. All parts of the plant possess a bitter taste, and are probably poisonous; the bark has at one time been sold in place of angustura bark (see page 174). The white, gelatinous pulp of the fruit, it has been stated, is eaten in India by birds; it, however, contains strychnia (*Pharmacographia*). The seed is the only officinal portion. The quantity imported into the United States amounts to about 450,000 pounds per year.

Fig. 115.



Nux Vomica.—*a.* Surface with raphe; *b.* Longitudinal section showing albumen and embryo; *c.* Transverse section showing central cavity.

Description.—Nux vomica is in the form of an orbicular disk, nearly an inch in diameter, and almost a quarter of an inch thick, nearly flat, or convex on one side and concave on the other, with the margin frequently thickened. The surface is of a grayish or greenish-gray color, and has a slight silky lustre from the closely appressed soft hairs, directed towards the circumference, and forming a soft ridge on the edge. Where the hairs have been rubbed off, the dull, brownish testa becomes visible. In the centre of the concave side is the hilum, connected by a slightly elevated raphe with the chalaza, which forms a small protuberance on the edge in the immediate vicinity of the radicle.

Schleiden, Berg, and others regard the latter as the hilum, and the central scar as the chalaza. The thin testa incloses a yellowish-gray, somewhat translucent, horny, and very hard albumen (endosperm), which is of the same form as the seed, but has within it a large, flat, circular cavity. After softening the seed in hot water, the edge may be readily trimmed down with a knife, and the albumen split into two disks, which were united with each other merely on the margin to the width of less than one-eighth of an inch. The embryo is over one-quarter of an inch long, has a thick, club-shaped radicle, and a pair of pale-greenish, delicately 7-nerved, heart-shaped cotyledons projecting into the circular cavity. The seed is inodorous, but possesses a persistently bitter taste.

Nux vomica is very difficult to powder, owing to the horny condition of the albumen. The powdering is considerably facilitated by drying the entire seeds for two or three days, and breaking them up into several pieces, which are again dried for several days by means of warm air, and then reduced to powder of the desired fineness. If a drug-mill, with chilled iron grinding plates, admitting of regulation as to different degrees of fineness, be used, much labor may be saved in the final powdering in an iron mortar, provided with a heavy iron pestle. Powdered nux vomica is of a light gray-greenish color.

Constituents.—The horny nature of nux vomica is probably due to protein compounds, of which it contains about 11.3 per cent. (*Pharmacographia*). Gummy matter, fat, sugar, and *igasuric acid*, besides the alkaloids, are also contained in it. The acid was discovered by Pelletier and Caventou (1819), and by Höhn (1873) was regarded as a kind of tannin; the latter obtained it as an amorphous, yellowish-white mass, of a strongly acid and somewhat astringent taste; its solution is colored dark green by ferric salts, precipitated yellow by acetate of lead, and rapidly reduces an ammoniacal solution of silver.

The alkaloids *strychnia*, *brucia*, and *igasuria*, are the medicinally important constituents of nux vomica. For an account of the first of these, which is present to the amount of $\frac{1}{4}$ or $\frac{1}{2}$ per cent., see the article Strychnia in this work.

Brucia, $C_{23}H_{26}N_2O_4$, seems likewise to vary in quantity; Merck obtained only 0.12, Wittstein 0.5, Mayer 1.10 per cent.; by the latter it was estimated by means of potassio-mercuric iodide, and the presence of igasuria was not taken into account. The alkaloid was discovered by Pelletier and Caventou (1819), in the false angustura bark, which was then supposed to be derived from *Brucea antidysenterica*, Mill., an Abyssinian shrub. It is one of the by-products of the manufacture of strychnia, and in the officinal process for this alkaloid, is obtained from the mother-liquor and alcoholic washings, by neutralizing them with sulphuric acid, evaporating to crystallization, removing the mother-liquor, purifying the crystals by treatment with animal charcoal, precipitating with ammonia, and recrystallizing from boiling 80 per cent. alcohol; it contains then $4H_2O$. It is soluble in 850 parts of cold water, 1.5 parts of alcohol, 7 parts of chloroform, and 70 parts of glycerin. It is soluble also in ammonia, creasote, very slightly so in volatile and fixed oils, and is insoluble in ether. It fuses without decomposition a little above 100° C., and at a higher heat burns, leaving voluminous charcoal. In contact with strong nitric acid, brucia acquires a blood-red color, which changes to orange, and finally yellow; if now stannous chloride be added a beautiful violet red is produced. The compound thus produced, according to Roehre (1878), may be obtained in crystals, which dissolve in water and mineral acids with a violet color. A compound of a similar color is obtained by using sulphurous acid, and lustrous brick-red needles are obtained by using ammonium sulphide in place of stannous chloride. These reactions are not interfered with by the presence of a little strychnia. Commercial brucia generally contains traces of strychnia, as proven by Cownley (1876), and Shenstone (1877), and according to the latter, may be completely freed from it by partial precipitation, brucia being precipitated from its solutions by strychnia.

Igasuria was discovered by Desnoix (1854) by concentrating the filtrate and washings of the lime precipitate in the decoction of nux vomica. The crystals thus obtained are stated by Schützenberger (1858) to be a mixture of not less than 9 different alkaloids, which he distinguished by prefixing to igasuria the letters *a*, *b*, *c*, etc. This subject requires further investigation. Igasuria has a bitter taste, and is poisonous.

Other Species of Strychnos.—The seeds of Str. tieute, *Lech.*, indigenous in Java, closely resemble nux vomica, but are smaller and whiter in color. The decoction of the root bark, evaporated to an extract, is the principal ingredient of the arrow poison, *upas-tieute.* It contains strychnia.

The seeds of Str. potatorum, *Lin.*, indigenous to India, are subglobose, ½ inch or less in diameter, brownish-gray in color, and of an insipid, not bitter taste. They do not contain strychnia, and are used in India as *clearing nuts*, for cleansing muddy water, also in diabetes, and as an emetic. In 1871 they were sent to the United States as *Indian gum nuts.*

See Ignatia, page 739.

Off. Prep.—Extract. nucis vomicæ, Tinct. nucis vomicæ, Strychnia, *U. S.*, *Br.*

Medical Action and Uses.—The action and uses of nux vomica being identical with those of strychnia, they will be treated of in connection with the latter. It may be mentioned in this place, however, that the activity of nux vomica is too variable to render it eligible as a medicine. It may be prescribed in the *dose* of from one to five grains three times a day, and gradually increased from the minimum quantity until its characteristic effects begin to be manifested. The pilular form is the best adapted for its administration.

NYMPHÆA.—WATER-LILY.

Pond-lily, E.; *Nénuphar*, *Lune d'eau*, Fr.; *Seerose*, *Wasserlilie*, G.

Nat Ord.—Nymphæaceæ.

Description.—The following species, of which two belong to North America, have been employed.

NYMPHÆA ODORATA, *Ait.* *Sweet scented water-lily.*—It has a horizontal immersed rhizome, which is 2 or 3 inches thick, verrucose and brown externally, yellowish-white internally, fleshy, after drying deeply wrinkled, spongy and light. It is without odor, and has a bitter mucilaginous, somewhat astringent taste. The leaves are large orbicular-cordate and entire; the flowers are 4 or 5 inches broad, many-petalous, white, and very fragrant.

NYMPHÆA ALBA, *Lin.*—The European water-lily resembles the preceding, the chief differences being found in the shape of the fruit and the greater number of its stigmas.

NUPHAR ADVENA, *Ait.* (Nymphæa, *Mich.*) *Yellow pond-lily*, *Spatter-dock.*—The rhizome resembles the above, and is nearly of the same dimensions. The leaves are heart-shaped at the base, with rather divergent lobes, and vary between ovate and roundish in outline. The flowers have 6 yellow sepals, and numerous small yellow petals, which resemble the stamens.

Constituents.—The rhizome of Nymphæa alba was examined by Morin (1819), and Carminati, and that of N. odorata by Bigelow. Tannin, mucilage, etc., were found, but the bitter principle has not been isolated.

Medical Action and Uses.—The root of our native pond-lily is astringent and demulcent, and is used internally for the cure of *bowel complaints*, and topically in cataplasm for ulcers, and in decoction for *leucorrhœa* and *dysentery.* The European species, N. alba, was once reputed to be anaphrodisiac, and the juice of the fresh root is said to be acrid, and even capable of reddening the skin. An ointment is prepared with it to stimulate the scalp when the hair tends to fall out.

ŒNOTHERA.—EVENING PRIMROSE.

Onagre, Fr.; *Nachtkerze*, G.

Œnothera biennis, *Lin.* *Nat. Ord.*—Onagraceæ.

Description.—This very variable plant is common throughout North America, in fields and waste places, and has been naturalized in Europe. It has a conical *root*, which is ½ to 1 inch thick at the base, 4 to 6 inches long, with spreading branches, externally pale brown or sometimes reddish, with a thin bark, internally white, fleshy, inodorous, of a sweetish taste, and in the second year woody and tough. The *stem* is from 3 to 6 inches high, rough, hairy, often purplish. The *leaves* are ovate-oblong or oblong-lanceolate, 3 to 5 inches long, somewhat petiolate, acute, nearly entire, and short-hairy. The *flowers* are in terminal leafy spikes, have a sessile cylindrical ovary united with the long tubular calyx, 4 obcordate yellow petals, and 8 stamens, and produce a four-valved capsule, containing numerous seeds. The herb is inodorous, and has a mucilaginous and mild astringent taste. The root and the flowering plant are used.

Constituents.—Diot Chicoisneau (1834) found the plant to contain much mucilage; his *œnotherin* was a mixture of several bodies, which have not been separated from one another.

Medical Action and Uses.—The late Dr. R. E. Griffith, in his Medical Botany, after speaking of the mucilaginous and acrid qualities of the herbs and leaves, states that he made use of it in several cases of infantile eruptions which had resisted other modes of treatment, and became satisfied that it was highly beneficial, a judgment which his subsequent experience confirmed. It is advised that about the flowering season, the small twigs with the bark of the large branches and stem, retaining their leaves, should be dried in the shade. Of these a strong decoction is made, with which the eruptions should be bathed several times a day. We are not acquainted with any later and confirmatory reports upon this plant. It has also been used in *diarrhœa* and in *asthma*.

OLEA DESTILLATA.—VOLATILE OILS.

Olea ætherea s. volatilia, Ætherolea.—Essential (ethereal or distilled) oils, E.; *Huiles volatiles (éthérées, essentielles, distillées), Essences*, Fr.; *Flüchtige (Ætherische) Oele*, G.

Characters.—Volatile oils are those proximate principles to which in the majority of cases the odor of plants is due. They have no chemical, and but few physical, properties in common with the fixed oils, but, like the latter, they are generally soluble in ether, chloroform, bisulphide of carbon, etc., and, when dropped upon paper, leave a stain resembling that produced by fat, but which, unlike the latter, disappears upon the application of heat. Their specific gravity usually ranges between 0.85 and 0.99; a few are still lighter, and some are heavier than water, one reaching the specific gravity 1.17. All are inflammable, and burn with a bright but very sooty flame. They possess the odor of the plants from which they have been obtained, but are usually less fragrant, which is probably due to the presence in the plants of other odoriferous compounds, perhaps compound ethers, which, being more soluble in water, are removed during the distillation; it is on this account that medicated waters distilled from the drug, almost without exception, possess a more agreeable odor and taste than when prepared from the volatile oil.

When exposed to the air, volatile oils become ozonized, and are more or less rapidly converted into a viscid oil or even solid resin; to the presence of ozone is due their bleaching effect upon corks, indigo solution, etc. (See a paper by Dr. J. L. Plummer in *Amer. Journ. Pharm.*, 1853, p. 398 and 508; also, 1860, p. 46.)

Origin.—Volatile oils are met with in a large number of plants, and may exist in every part thereof, from the root to the seed. If found in several parts of the same plant, the volatile oils obtained from them generally differ more or less, not only in odor and other physical properties, but frequently also in chemical composition. They are often separated in the plant in distinct cells, appearing as glands in the herbaceous portion, or distributed throughout the interior tissue, or forming tubes as in the fruits of the Umbelliferæ. Very frequently they are associated with resins, and even exude, either naturally or from incisions, holding resins in solution (oleoresins and many gum resins). In a number of plants they are known to be produced under the action of a ferment, like emulsin and myrosin, upon other compounds, such as amygdalin and myronic acid; but in most cases it has been impossible to demonstrate either the precise tissue where they are produced, or the compounds which yield them. There is, however, reason to believe that, at least in some cases, they result from the splitting of glucosides, resins, and similar principles. All volatile oils yield by spontaneous oxidation resinous compounds, which, however, have thus far been found to be entirely distinct from the resins with which the former have been naturally associated.

Among the products of the destructive distillation of organic bodies, compounds are often found which possess the general characters of volatile oils, but usually have an empyreumatic odor persistently adhering to them; they are called *empyreumatic volatile oils.* Odorous compounds, sometimes known as *ferment oils* (*fermentolea*), are also produced during the fermentation of bruised vegetables or their expressed juice; they are probably alcohols or compound ethers.

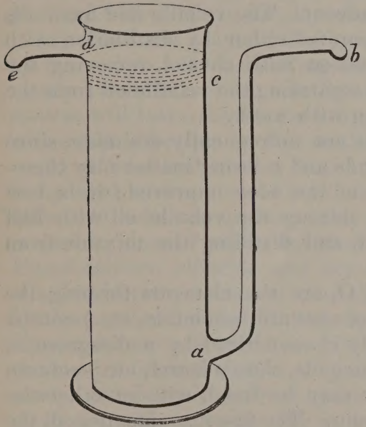
Preparation.—In a few instances, where the volatile oils are separated in cells of the epidermal tissue and not associated with resinous or fatty matters, as in the fruits of many Aurantiaceæ, they may be prepared by expressing that tissue after removing it by grating. By far the largest number, however, require to be distilled with water. Herbaceous plants, flowers, and leaves which are not of a leathery nature usually need no previous comminution; but firmer parts of plants, and those containing the volatile oil in the inner tissues, must be more or less ground or broken. Though fresh plants are usually readily softened and permeated by water, a short maceration before the distillation begins is rather advantageous, and may be regarded as very desirable if dried plants are employed; it is unnecessary in case the volatile oils are to be distilled off from resinous compounds, but whenever the volatile oil does not pre-exist, but is produced by the reaction of two principles in the presence of water, a prolonged maceration in cool or lukewarm water is required.

The *distillation* is accomplished in stills made of copper or iron, a sufficient quantity of water being introduced to cover the material and prevent empyreuma; the latter object is more completely attained if a perforated false bottom is placed a few inches above the bottom of the still and the material packed upon it. Direct heat is then applied until the water boils briskly, and is maintained at this temperature until the distillate is no longer charged with volatile oil. Some volatile oils are obtained of better quality and greater fragrance if the direct application of fire to the still is avoided and the volatilization is accomplished by the introduction, near the bottom, of steam under pressure; a wooden tank may then be converted into a still by cutting a suitable aperture into the top and surmounting it with a still-head. Steam distillation is particularly applicable for flowers like those of the orange, lavender, chamomile, etc., and for the labiate and other herbs.

Although volatile oils have a higher boiling point than water, the majority boiling above 140° C. (284° F.), their vapors diffuse readily in the vapors of water at the boiling temperature of the latter, and are thus easily carried over. Greater difficulty, however, is experienced with those volatile oils which have either an exceptionally high boiling point or a specific gravity near or exceeding that of water; the addition to the water of about 3 per cent. of table salt is then advisable, whereby the boiling point is somewhat raised, and, as the water distils over, it may be gradually increased to about 109.5° C. (229° F.). The volatile oils of cloves, cinnamon, santal wood, etc. are thus more readily obtained than with water alone.

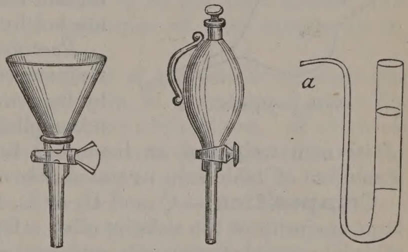
Cohobation is the returning of the aqueous distillate from which the volatile oil has been separated, either upon the same or upon fresh portions of material, and distilling again. The process is rendered necessary with cloves, santal wood, etc., the firm tissue of which containing the volatile oils is not easily ruptured or thoroughly permeated by water, and with the petals of rose and similar articles which contain only a minute proportion of volatile oil.

Fig. 116.



Separator for Heavy or Light Oils.

Fig. 117.



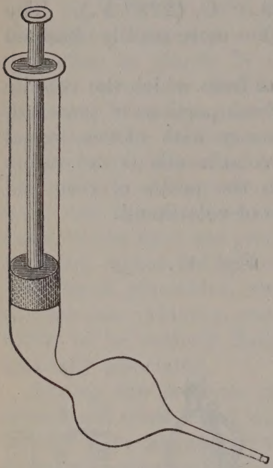
Separating Funnels and Tube-separator.

Separation.—On cooling, the distillate separates into two layers, one being a solution of the volatile oil in water, the other the pure oil. A tall cylinder or flask is used, which, near the bottom, has a glass or other tube inserted and curved upward to a short distance below the top. The heavier water separating at the bottom will commence to discharge through the lateral tube *b*, as soon as the vessel is nearly filled with the distillate, upon which will float a layer of volatile oil; this layer may be withdrawn by means of a small siphon, or, better still, through a lateral tube *e*, inserted near the top of the vessel. If the volatile oil, however, is heavier than water, the conditions will be reversed, and the oil will flow through *a* and run off at *b*. The last portions of volatile oil are removed from the water by means of a separating funnel (Fig. 117), the separation being effected with a perforated glass stopper inserted in the neck or by inclining the vessel (Fig. 117) through the tube *a*. For very small quantities a bulb-pipette will be found useful, the longer tube of which is drawn out to a fine point. By a suitable arrangement, the separated odorous water may be returned to the still while the distillation is progressing.

If volatile oils are present only in minute quantities, frequent cohobation is required, but even then too much is often lost by being retained in the water, as in the case of violets, tuberoses, etc. To obtain these delicate perfumes, Millon and Commaille (1868) employed purified bisulphide of carbon, with which the material is exhausted, and on the spontaneous evaporation of which all the odoriferous compounds are left behind.

The process of *enfleurage* is likewise adapted for obtaining delicate perfumes. A number of trays or frames are covered with a layer of purified tallow or other inodorous fat, and then with flowers, the latter, if necessary, being replaced by fresh flowers in a few days. When the fat is sufficiently charged with the perfume, it constitutes the *pommades* used by perfumers, from which the *extracts* are obtained by digestion with pure alcohol; the small *portion of fat* entering solution separates on exposure to a low temperature.

Fig. 118.



Syringe-pipette.

L. Wolff (1877) proposed a process for preparing volatile oils whereby distillation may either be entirely avoided or materially shortened. Petroleum benzin dissolves from plants chiefly the volatile and fixed oils and wax which are left after evaporating the solvent. The volatile and fixed oils may then be separated either by distillation with water, or by agitation with alcohol, removing the fat and wax, and separating the volatile oil from the alcohol by mixing with water.

Rectification is not unfrequently desirable, since resinous compounds and coloring matter may thereby be removed and the odor improved; it is best accomplished by mixing the volatile oil with half of its own weight of an inodorous liquid fat, and distilling the mixture from a solution of table salt, as stated above.

Composition.—C and H, or C, H, and O, are the elements forming the large majority of the volatile oils; a few (oil of mustard, asafœtida, etc.) consist of sulphuretted compounds, and are generally characterized by a disagreeable penetrating odor; some others (oil of bitter almonds, cherry laurel, etc.) contain hydrocyanic acid, from which, however, they may be freed, without otherwise altering their composition or modifying their odor. The first class mentioned, the hydrocarbons, are mostly *terpenes*, consisting of two or more isomeric modifications, having the composition $C_{10}H_{16}$, or a multiple thereof. The oxygenated volatile oils likewise consist proximately of at least two principles, boiling at different temperatures. The one having the lowest boiling point is called *elæopten*, and very often is a hydrocarbon of the composition $C_{10}H_{16}$ or $C_{10}H_{14}$. *Stearopten* is that portion which volatilizes last and congeals at about the ordinary temperature; in composition it is not unfrequently an oxide or hydrate of the hydrocarbon. The stearopten of oil of rose is a hydrocarbon C_nH_{2n}, and has a lower boiling point than the fragrant oxygenated portion. Stearoptens, or *camphors*, as they are sometimes called, crystallize from the volatile oils on exposure to a low temperature, the crystallizing point depending partly on the fusing point of the stearopten, and partly on the amount of the solvent elæopten. The variation in the proportion of the two proximate constituents is due to the influence of climate, soil, and cultivation, and modifies to some extent the effect upon polarized light.

The *color* of volatile oils appears to be due to distinct compounds. Piesse (1863) separated from oil of wormwood, patchouly, etc., a volatile dark-blue body, *azulene* (according to Gladstone [1863] *cærulein*) of the composition $C_{16}H_{26}O$, which he stated to be present in all blue-colored volatile oils, while those having a different color are free from it or contain it in smaller proportion mixed with more or less of yellow or brown resin.

Preservation.—Since volatile oils oxidize when in contact with air, and the oxidation is accelerated in the light, they should be kept in well-stoppered vessels protected against the light. Various contrivances, which readily suggest themselves, have been recommended. Bottles of amber-colored glass, which excludes the actinic rays, are very suitable; and the addition of a small quantity of alcohol, which in our experience need not exceed three per cent., will prevent for a long time, if not the oxidation, at least the marked change of odor which oils of orange, lemon, peppermint, and others undergo. Menigaut, as early as 1835, proposed for the same purpose the addition of an equal weight of alcohol.

Restoration.—Resinified volatile oils, the flavor of which has not been impaired, may be restored to their former limpidity by rectification (see above). Small quantities of such volatile oils Curieux (1858) recommended to be agitated for fifteen or twenty minutes with a magma formed by mixing solution of borax with animal charcoal, when the resinified portion will unite with the borax, leaving the oil limpid and the odor restored.

Adulterations.—Among the numerous methods which have been recommended for detecting the principal adulterations to which volatile oils are subject, the following are simple, reliable, and easily executed:—

(a) *Fixed oils* are indicated by the permanent greasy stain left upon paper, or by the residue left on distilling the suspected oil with water. Since the fats are mostly insoluble and the volatile oils mostly soluble in 85 per cent. alcohol, this solvent will leave the former behind; minute quantities of fixed oils, however, will escape detection by this method.

(b) *Alcohol* will cause a diminution of the volume of the volatile oil when this is agitated with an equal bulk of water or glycerin in a graduated tube; the difference indicates approximately the amount of the adulteration. If olive oil is used in place of water, the alcohol, unless in very small quantity, will separate. Fused calcium chloride and dry acetate of potassium are insoluble in volatile oils, but in the presence of alcohol become either soft or liquid. Tannin, which has been recommended for the same purpose, is soluble in oil of bitter almonds, cinnamon, and a few others. Dragendorff recommends metallic sodium, which produces a brisk evolution of gas in the presence of even 5 or 10 per cent. of alcohol, while hydrocarbons are not at all, and oxygenated oils but slightly acted on in the cold. Anilin red is soluble in alcohol and insoluble in volatile oils; but if the oils contain alcohol they are colored red by the dry anilin color.

(c) *Cheap volatile oils* are often difficult to detect. On rubbing a few drops of the volatile oil between the hands, or heating them gradually in a dish, or evaporating them from bibulous paper, and observing the odor from time to time, a marked difference of it is indicative of such adulteration. The hydrocarbons being mostly cheaper and less freely soluble in 85 per cent. alcohol than the oxygenated oils, an adulteration with the former will generally be recognized by the solvent mentioned.

The solubility of santal red in some volatile oils (Voget), the different reaction of these oils with iodine (Tuchen), the change of color produced on heating oxygenated volatile oils with a little nitroprusside of copper, and the prevention of this reaction by oil of turpentine and other hydrocarbons (Heppe, 1856), and the behavior of the volatile oils towards strong mineral acids, potassa, bromine, sulphide of lead, and other chemicals, may, at least occasionally, be utilized for the purpose of detecting adulterations. (See *Proceedings Amer. Pharm. Assoc.*, 1858, p. 344, and 1859, p. 338.)

OLEA PINGUIA.—Fixed Oils.

Fats, E.; *Huiles grasses*, *Huiles fixes*, Fr.; *Fette*, *Fette Œle*, G.

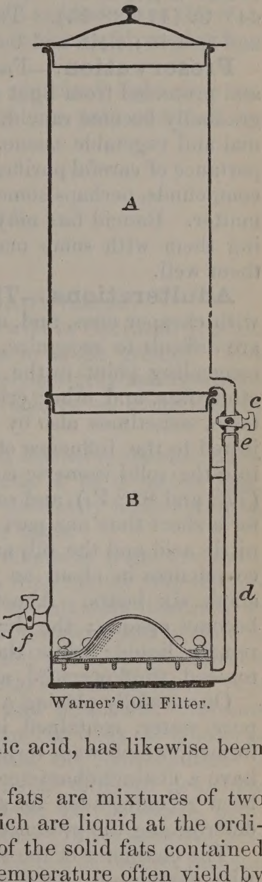
Characters.—Fats are peculiar compounds obtained both from the animal and the vegetable kingdom. In their pure state they are often colorless, inodorous, and tasteless. Many are liquid at the ordinary temperature (*oils* or *fixed oils* proper), but by cautious cooling may generally be separated into fats of different fusibility. Others have a soft consistence (*fats* proper, or *butters*), and mostly yield liquid fats when subjected to a gradually increased pressure, while a fat of a higher fusing point remains in the press-cloth. Those of a firmer consistence are sometimes termed *tallows;* and when hard, and more or less brittle at the common temperature, they are often popularly and commercially known as *waxes.* They are all lighter than water, and vary in specific gravity generally between .913 and .956, though some are as light as .860. They are insoluble in water, sparingly soluble in cold alcohol, but generally freely soluble in ether, chloroform, carbon bisulphide, benzol, and light petroleum oils. The hot alcoholic solution of the solid fats separates them on cooling generally in a crystalline form. When heated, the solid fats fuse to transparent oils and solidify again on cooling. Heintz observed that by raising the heat very slowly, some fats show two fusing points, which for pure stearin were found at 55° C. (131° F.) and 71.6° C. (160.9° F.), and also two congealing points, the latter depending upon the temperature to which the fat had been heated and upon the rapidity with which it had cooled. After having been heated considerably beyond the fusing point some solid fats remain liquid for a long time after cooling; at a higher temperature, usually in the neighborhood of 300° C. (572° F.), an ebullition is observed, accompanied by decomposition, the boiling point gradually rises, and extremely acrid and irritating vapors are evolved, causing a copious flow of tears, and containing *acrolein.* (See Glycerin, p. 671.)

Fats are more or less unctuous to the touch, and when in a liquid condition dropped upon paper leave a permanent grease spot, unless they are crystalline and so hard that they may be rubbed off. They are not inflammable at the ordinary temperature, but when heated to incipient decomposition, burn more or less readily by the aid of wick and with a sooty flame. When their surface is considerably increased by being spread over porous bodies, they are rapidly oxidized, whereby the heat may be increased to such an extent as to ignite the entire mass.

Origin.—All plants, and perhaps all parts of plants, contain fat, though often in minute quantity. The liquid and solid fats are most likely generated from starch and other carbohydrates and allied compounds; De Luca (1862) proved that the fixed oil of olives increases in quantity as the mannite of the green olives disappears, and that the access of air and light facilitates the conversion. It is not unlikely that certain protein compounds may likewise be the source of fats. In the animal economy fats are, at least partly, produced in a similar manner.

Preparation.—From animal tissues rich in fat, the latter is obtained by fusion either by itself or in the presence of water, and removal of the tissue by skimming or straining. Vegetable tissues containing notable quantities of fat yield it on being subjected to powerful pressure, either at the ordinary temperature or between plates which are heated to a little beyond the fusing point of the fat; but since a certain quantity of the fat is mechanically retained by the tissues, a larger yield is had by the use of a solvent, such as carbon bisulphide or petroleum benzin, which, on being distilled off, leaves the fat behind. When the bruised or cut vegetables are boiled with water, the fused fat rises to the surface, and may either be skimmed off, or obtained by straining, expression, and subsequent separation from the water; such fats are usually inferior to those obtained from the dried article by pressure alone.

Fig. 119.



Warner's Oil Filter.

Purification.—The impurities contained in fats are protein and mucilaginous compounds derived from the vegetable tissue, and may be removed through a well-dried filter; the filtration is facilitated by a somewhat elevated temperature. An apparatus suitable for this purpose, and for filtering through flannel in an upward direction and under pressure of a column of the oil, was constructed by W. R. Warner (1861); A, is the reservoir containing the oil; B, the recipient of the filtered oil. On the large scale the purification is effected by the gradual addition to the oil of about 2 per cent. of sulphuric acid, whereby the impurities are carbonized; the oil is then agitated with water to remove adhering acid, decanted and often filtered through charcoal. Barreswil (1858) recommended for the same purpose the saponification of a small proportion of the fat by means of a weak alkali. The loss sustained in purification varies with the nature and amount of the impurities, and in some cases reaches 15 or 20 per cent. of the crude oil.

Bleaching.—The treatment of fats with sulphuric acid usually destroys also the coloring matter wholly or in part; treatment with animal charcoal renders the fats lighter, and many are bleached (and often become rancid) by exposure to the direct sunlight, a strip of lead being sometimes introduced into the fat if liquid, or this is occasionally agitated with an aqueous solution of ferrous sulphate. Palm oil is bleached by being rapidly heated to 240° C. (464° F.), and keeping it at this temperature for ten minutes. The same effect is produced upon oil of poppy-seed by heating it for five hours to between 90° and 95° C. (194° and 203° F.). Oxidation of the coloring principle, by means of permanganic or chromic acid, has likewise been recommended.

Composition.—Nearly all animal and vegetable fats are mixtures of two or more fats having a different fusing point; those which are liquid at the ordidary temperature separate in the cold granular masses of the solid fats contained in them; while those which are solid at the common temperature often yield by expression a liquid oil. With comparatively few exceptions, fats are compound ethers of the triatomic alcohol glycerin (see page 671), and the acids contained in them belong to two series, the fatty acid group of the general formula $C_nH_{2n}O_2$ and the oleic acid group of the formula $C_nH_{2n-2}O_2$. The most important members of the first group are stearic ($C_{18}H_{36}O_2$), palmitic ($C_{16}H_{32}O_2$), myristic ($C_{14}H_{28}O_2$), lauric ($C_{12}H_{24}O_2$), and butyric ($C_4H_8O_2$) acids. To the second group belong, besides oleic acid ($C_{18}H_{34}O_2$), erucic ($C_{22}H_{42}O_2$) and hypogæic ($C_{16}H_{30}O_2$) acids; the former being found in oil of mustard, the latter in oil of groundnut. All these acids are monobasic, and the neutral fats therefore contain three molecules of the acid to one of the ether, $C_3H_5O_3$, which is sometimes called *oxide of glyceryl* or *of lipyl;* these compounds are conveniently named from the acid by changing the termination to *in;* thus *stearin* or *tristearin* is $C_3H_5O_3.3C_{18}H_{36}O_2$, and *olein* or *triolein* has the formula $C_3H_5O_3.3C_{18}H_{34}O_2$. The fats most widely distributed are olein, stearin, palmitin, myristin, and laurin, which are inodorous when pure, while the fats of the volatile acids have a distinct odor, the most important being *butyrin.* Fats which, on exposure to air, gradually solidify through the absorption of oxygen, the so-called *drying oils*, are supposed to contain *olin*, the composition of which is not known; the drying fat of linseed oil has been named *linolein.*

The fusing points of the above-named pure fats are as follows: Stearin 55° C. (131° F.), palmitin 48° C. (118.4° F.), myristin 31° C. (87.8° F.), laurin 44° C. (111.2° F.). The margarin of older chemists is a mixture of palmitin and stearin; olein and butyrin are liquid at common temperatures.

Preservation.—Fats should be kept in a dry place, at a low temperature, and protected from light and air. On being exposed to the atmosphere the fats gradually become rancid, and this change is accelerated by the presence of animal and vegetable tissue, protein and mucilaginous compounds; hence the importance of careful purification. The rancidity is due to the generation of odorous compounds, perhaps some acrolein and volatile fatty acids, besides some coloring matter. Rancid fats may be restored by washing with warm water, or by treating them with some magnesia or other weak alkali, and afterwards washing them well.

Adulterations.—The higher priced fats are not unfrequently adulterated with cheaper ones, and, owing to the similarity of composition, such admixtures are difficult to recognize. A change of the fusing point in the solid and of the congealing point in the liquid fats is not unfrequently produced by addition of other fats, and other criteria are afforded by the color, consistence, odor, and taste, sometimes also by the specific gravity. The non-drying oils when subjected to the influence of nitrous acid become solid, the olein being converted into the solid isomeric compound *elaidin*, which fuses between 25° and 28° C. (77° and 82° F.), and solidifies again on cooling. The test is made by agitating for a short time one part of copper in small pieces with about five parts each of nitric acid and the oil, and setting the mixture aside; the separation of elaidin commences in about an hour, and the solidification is generally completed in about six hours. Almond oil and olive oil are scarcely colored thereby, but become opaque; the drying oils (linseed, poppyseed, hempseed and nut-oils) remain liquid; while the following become thicker, but not solid: Castor, cottonseed, sunflowerseed, and benneseed-oil, the latter acquiring also a red color.

On carefully placing a drop of oil or oleoresin upon the surface of chemically pure water, contained in a perfectly clean glass vessel, distinct figures are formed, which were termed *cohesion figures* by C. Tomlinson (1864), and which have a distinct character for the different liquids. These cohesion figures have been recommended as a means of identifying the liquids and possibly also of determining the presence of admixtures.

The character of the soda soap may likewise serve to indicate an adulteration with drying oils; for this purpose the oil is agitated with one-third of its weight or more of soda solution, specific gravity 1.33 (containing 30 per cent. NaHO), and the mixture boiled until saponification has been effected; after cooling, the soap of the drying oils will be soft, and should oils of cruciferæ (mustard, etc.) have been present, the aqueous filtrate will impart a black color to paper moistened with solution of lead acetate, owing to the sulphur present in the oil.

Concentrated sulphuric acid produces with different fixed oils mixtures varying in color; 8 or 10 drops of the oil are placed upon a china plate, 3 drops of sulphuric acid are added, and after a few seconds mixed by stirring; the color of the mixture will be as follows: with *almond oil* yellow changing to pale brownish-yellow; with *olive oil* yellow turning brown; with *benne oil* brown-red becoming gelatinous; with *linseed oil* brown-red to blackish-brown; with *rapeseed oil* greenish-blue or brownish-green; with *poppy-seed oil* yellow to brownish-green; with *castor oil* brownish to gray-brown. When larger quantities of oil are mixed with sulphuric acid, a rise of temperature takes place, which is not alike for different oils. According to Behrens (1852) when a cold mixture of equal parts of nitric and sulphuric acid is added to an equal weight of oil, *benne oil* acquires a green, *ground-nut oil* a red, and *olive oil* a yellow color. (See also Ol. amygdal. express.)

Lipowitz (1868) observed that the admixture of drying in non-drying oils may be detected, by triturating 8 parts of the oil with 1 part of chlorinated lime; in the course of a few hours the mixture, if made with non-drying oils, will separate a layer of limpid oil, while no oily layer will separate from the mixture containing a drying oil. This appears to be due to the rapid oxidation of the latter.

Since most of the fats are without action upon it, polarized light does not afford a means of distinguishing them; of the officinal oils, only castor oil has a decided rotation to the right.

OLEANDER.—OLEANDER.

Laurier rose, Laurose, Fr.; *Oleander*, G.

The leaves of Nerium oleander, *Lin.* *Nat. Ord.*—Apocynaceæ.

Origin.—This well-known ornamental shrub grows wild in Southern Europe, Northern Africa, and Western Asia, and thrives best in moist ground. It is 10 to 15 feet high, often arborescent, with a gray or greenish-gray nearly smooth bark, ternately divided branches and showy dark-rose colored or white flowers. All parts are reputed to possess poisonous properties.

Description.—The leaves are whorled in threes, leathery, smooth, dark-green and glossy above, nearly sessile, linear-lanceolate, 4 to 6 inches long, finely pointed at the apex, entire on the margin, and delicately feather-veined. They are without odor, and have a nauseous and bitter taste.

Constituents.—Lukomski (1861) obtained two alkaloids from the leaves and branches by carefully precipitating their decoction with tannin; the tannate of pseudocuraria is soluble in an excess of tannin and the alkaloid liberated by oxide of lead. *Pseudocuraria* is amorphous, yellowish, tasteless, and inodorous, insoluble in ether, freely soluble in water and alcohol, and yields uncrystallizable salts. *Oleandria* is a yellowish resinous body, slightly soluble in water, very soluble in alcohol and ether, of a strongly bitter taste and poisonous. Its salts are uncrystallizable. Bitteli (1875) observed that oleandria loses its poisonous properties when heated to 240° C. (464° F.), and that the hydrochlorate is crystalline; he regards the pseudocuraria as a mixture of different principles containing a little oleandria. Pelikan (1866) considered the poisonous principle to be a yellow acrid resin, which according to Latour (1857) possesses acid properties. The latter chemist determined also the presence of tannin, fat, and other common principles.

Medical Action and Uses.—This is one of the plants whose flowers are said to render honey poisonous; and the experiments of Pelikan seem to show that its active principle is a heart poison. It has been used in epilepsy, but fruitlessly.

OLEATA.—OLEATES.

Oléates, Fr.; *Oleate*, G.

This class of preparations was introduced by Professor John Marshall (1872). They are made from oleic acid, by combining with it metallic bases and alkaloids, nearly all of which dissolve easily in the acid on trituration in a mortar. The application of heat should be avoided, since oleic acid is very readily altered by it, and some of the metallic oxides are reduced.

Oleic acid is obtained as a secondary product at the stearin candle factories, and may be prepared, according to Bromeis (1842), by saponifying almond or olive oil with potassa, decomposing the soap with hydrochloric acid, combining the fatty acids with lead, by digesting with oxide of lead, dissolving the oleate of lead in ether, and agitating the ethereal solution with hydrochloric acid. On evaporating the ether, oleic acid remains behind, which requires to be washed with water. In its pure state it is a colorless oily liquid, which congeals to a white crystalline mass at 4° C. (39.2° F.), and fuses again at 14° C. (57.2° F.). When heated to a little above the boiling point of water, it rapidly acquires a dark brown color. Its composition is $C_{18}H_{34}O_2$. As found in commerce, oleic acid is of a yellow color. Should it contain notable quantities of the solid fatty acids, it may be deprived of the greater part of them, according to Ch. Rice (1873), by exposing it to a temperature of 4.5° C. (40° F.), and expressing the liquid portion.

Oleate of mercury has been used containing different amounts of mercury the most serviceable of which seems to be that containing 20 per cent. of the oxide. One part of dry precipitated oxide of mercury is triturated at a slightly elevated temperature with four parts of oleic acid. It is of a soft solid consistence, and may be readily reduced to any desired strength by the addition of the requisite amount of oleic acid.

Oleate of lead, containing 20 per cent. of oxide of lead, is a tenacious mass.

Oleate of zinc, of the same strength, according to A. W. Gerrard (1872), is hard and friable, but transparent when melted.

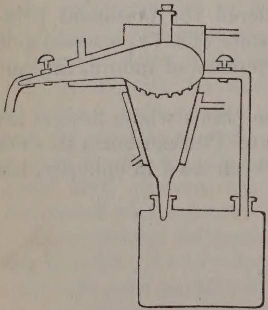
The *Oleates of morphia*, *atropia*, *aconitia*, and other alkaloids are made by dissolving two grains of the alkaloid in 98 grains of oleic acid. The preparation will then contain 2 per cent. of the alkaloid.

OLEORESINÆ.—Oleoresins.

Oléo-résines, *Extraits éthérés*, Fr.; *Œlharze*, *Ætherische Extracte*, G.

These preparations consist mainly of fixed or volatile oils associated with resin and some other constituents, and are directed to be prepared by exhausting the powdered drug with ether. The great volatility of this solvent renders it necessary to percolate in a well-closed apparatus, in which the pressure is equalized by connecting the receiving vessel with the top of the percolator by means of a tube (see page 589). The ethereal tincture is afterwards transferred to a suitable still, and the ether distilled off with a moderate heat. Various apparatuses have been constructed to accomplish the exhaustion with the smallest possible quantity of ether, by using the same liquid over again until the material has been exhausted; for this purpose the recipient is placed in hot water, the ether vapors ascending through the connecting tube mentioned above are condensed in a suitable refrigerator, and the ether is again passed into the percolator, the operation being repeated as often as required. The annexed cut, taken from Parrish's Pharmacy, represents such an apparatus, which is best made of tinned sheet-iron, or preferably of copper well tinned on the inside; it explains itself, and it is merely necessary to state that the head is perforated at the bottom for the equal distribution of

Fig. 120.



Percolator with still and condenser for preparing oleoresins.

the menstruum, and jacketed above for the condensation of the ether. The percolator being likewise jacketed, it may be immersed in hot water, and the ether recovered, which remains in the powder after the exhaustion of the powder.

If the operation has been carefully conducted, the ether thus regained is not at all or but very slightly impregnated with volatile oil; nevertheless, it must be regarded as unfit for internal use, and should be reserved for a similar subsequent operation.

OLEORESINA CAPSICI, *U. S.*—Oleoresin of Capsicum.

Oléorésine (Extrait éthérée) de capsique, Fr.; *Spanischpfeffer-Oelharz*, G.

Preparation.—Take of Capsicum in fine powder twelve troyounces; Ether a sufficient quantity. Put the capsicum into a cylindrical percolator, provided with a cork, and arranged with cover and receptacle suitable for volatile liquids, press it firmly, and gradually pour ether upon it, until twenty-four fluidounces of liquid have slowly passed. Recover the greater part of the ether, by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Lastly, remove, by straining, the fatty matter which separates on standing, and keep the oleoresin in a well-stopped bottle. *U. S.*

It is a dark brown-red rather thick liquid, separating on standing a granular deposit of fat, which mechanically incloses a portion of the oleoresin, that may be recovered by washing several times with small quantities of ether. Instead of removing the fat by straining, we prefer to decant the clear oleoresin, and treat the remainder as stated. The yield is about 4 per cent. The oleoresin has but little odor, but possesses an extremely hot and fiery taste.

Medical Uses.—This preparation appears to be nearly superfluous as an internal medicine, since all the virtues it can exert in that manner are sufficiently exhibited by capsicum. It is occasionally added to liniments to increase their rubefacient action, but is more beneficially incorporated in plasters, such as soap or lead plaster, for a similar purpose.

OLEORESINA CUBEBÆ, *U. S.*—Oleoresin of Cubeb.

Extractum cubebarum, P. G.; *Extractum cubebæ æthereum.*—*Oléorésine de cubébe*, Fr.; *Kubebenextrakt*, G.

Preparation.—Take of Cubeb in fine powder twelve troyounces; Ether a sufficient quantity. Put the cubeb into a cylindrical percolator, provided with a cork and arranged with cover and receptacle suitable for volatile liquids, press it moderately, and gradually pour ether upon it until twenty-four fluidounces of liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue, in a capsule, until the remaining ether has evaporated. When, after standing in a close vessel, waxy and crystalline matter has been deposited, decant the oleoresin and keep it in a well-stopped bottle. *U. S.*

The German Pharmacopœia has a similar preparation, made, however, by extracting the cubebs with a mixture of equal weights of ether and alcohol; it probably contains less volatile oil, a portion of which must volatilize with the last portions of alcohol. The oleoresin, as prepared by the above formula, is of a brown-green, or sometimes of a grass-green color, the difference being due to the presence of more or less chlorophyll. On standing, it deposits some waxy matter and cubebin, which are removed by decantation. The remaining liquid, amounting to between 20 and 25 per cent. of the cubebs used, consists mainly of fixed and volatile oils, the active resins, and chlorophyll. An alcoholic ether dissolves more brown coloring matter.

Off. Prep.—Trochischi cubebæ, *U. S.*

Medical Uses.—Investigations for the purpose of discovering upon which of the constituents of cubeb its medicinal value depends, have not reached a perfectly definite conclusion; but it may be considered that its most active element is cubebic acid, which, when taken in doses of from seventy to ninety grains, produces a lively sensation of heat in the stomach, increases the urine, and renders it hot and irritating. In the dose of 150 grains, it occasions also eructation, flatulence, a pervading sense of warmth, and some quickening of the pulse. The *dose* of the oleoresin is stated to be from five to thirty minims, which may be given on sugar, or preferably inclosed in gelatin capsules.

OLEORESINA FILICIS, *U. S.*—OLEORESIN OF MALE FERN.

Extractum filicis æthereum, Br.; *Extractum filicis*, P. G.; *Oleum filicis maris.*—*Liquid extract of male fern*, E.; *Huile* (*Extrait éthéré*) *de fougère mâle*, Fr.; *Wurmfarnextrakt*, *Wurmfarnöl*, G.

Preparation.—Take of Male Fern in fine powder twelve troyounces; Ether a sufficient quantity. Put the male fern into a cylindrical glass percolator, provided with a cork and arranged with cover and receptacle suitable for volatile liquids, press it firmly, and gradually pour ether upon it until twenty-four fluidounces of liquid have slowly passed. Recover the greater part of the ether, by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Lastly, keep the oleoresin in a well-stopped bottle. *U. S.*

The processes of the British and German Pharmacopœias are essentially identical with the above, except that the latter directs maceration instead of percolation. It should be remembered that only that portion of the rhizome is to be used which has still a greenish color; the oleoresin will then have a greenish or brownish-green color, while the entire rhizome with the stipes yields a brown preparation, which not unfrequently forms a jelly, probably from the separation of pectin compounds. The officinal oleoresin separates a granular depositof filicic acid, which must be well mixed with the liquid portion on dispensing. The yield is about 10 or 12 per cent.

Medical Action and Uses.—Since the introduction into practice of this preparation, whose activity depends upon the filicic acid it contains, the treatment of *tænia* has been rendered prompt and certain, at least so far as relates to the armed tænia and bothriocephalus. It appears to act as a poison to the parasites, which are discharged dead. The medicine may occasion nausea, griping, and even vomiting, but usually without either pain or uneasiness. It is well to prepare the patient by administering a purgative dose of castor oil or of calomel a day before the oleoresin, and to restrict his diet to milk and light broths. The oleoresin is best prescribed in capsules each containing six or seven grains. Some advise that an equal quantity of ether should be contained in every one. Of these capsules two should be taken every fifteen minutes until one and a half or two fluidrachms of the oleoresin shall have been used. In the course of two or three hours, purging begins, and after several stools the worm is generally expelled, dead. It has been suggested that the patient should evacuate the bowel in a vessel nearly full of water, so that the parasite need not break, and that its parts may be readily distinguished.

OLEORESINA LUPULINÆ, *U. S.*—OLEORESIN OF LUPULIN.

Extractum lupulini æthereum.—Oléorésine de lupuline, Fr.; *Ätherisches Lupulinextrakt*, G.

Preparation.—Take of Lupulin twelve troyounces; Ether a sufficient quantity. Put the lupulin into a narrow cylindrical percolator, provided with a cork and arranged with cover and receptacle suitable for volatile liquids, press it firmly, and gradually pour ether upon it, until twenty fluidounces of liquid have slowly passed. Recover the greater part of the ether, by distillation on a water-bath, and expose the residue, in a capsule, until the remaining ether has evaporated. Lastly, keep the oleoresin in a wide-mouthed bottle, well stopped. *U. S.*

The yield is variable, often about 50 per cent. It is of a dark reddish-brown color, and semifluid in consistence, and has the odor and taste of the drug.

Medical Uses.—This preparation probably contains all the medicinal virtues of hop. It is, however, seldom used. It may be prescribed in *doses* of from two to five grains, in pill or capsule.

OLEORESINA PIPERIS, *U. S.*—OLEORESIN OF PEPPER.

Oléorésine de poivre noir, Fr.; *Ätherisches Pfefferextrakt*, G.

Preparation.—Take of Black Pepper in fine powder twelve troyounces; Ether a sufficient quantity. Put the black pepper into a cylindrical percolator, provided with a cork and arranged with cover and receptacle suitable for volatile liquids, press it firmly, and gradually pour ether upon it until twenty fluidounces of liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue, in a capsule, until the remaining ether has evaporated, and the deposition of piperin in crystals has ceased. Lastly, separate the oleoresin from the piperin by expression through a muslin strainer, and keep it in a well-stopped bottle. *U. S.*

The officinal process yields about 5 per cent. of a greenish-black oleoresin, consisting of a mixture of volatile and fixed oil holding the pungent resin and some piperina in solution. It is an officinal substitute for the so-called *oil of black pepper*, which is obtained as a by-product in the manufacture of piperina, and has essentially the same composition, except that the volatile oil is present in small quantity only.

Medical Uses.—The medical uses of this oleoresin are probably few and unimportant, since it contains but a small proportion of piperin, which is of some value as a medicine. Its *dose* is one or two minims.

OLEORESINA ZINGIBERIS, *U. S.*—OLEORESIN OF GINGER.

Extractum zingiberis æthereum.—Oléorésine (Piperoide) de gingembre, Fr.; *Ätherisches Ingwerextrakt*, G.

Preparation.—Take of Ginger in fine powder twelve troyounces; Stronger Ether twelve fluidounces; Alcohol a sufficient quantity. Put the ginger into a cylindrical percolator, provided with a cork and arranged with cover and receptacle suitable for volatile liquids, press it firmly, and pour upon it the stronger ether. When this has been absorbed by the powder, add alcohol until twelve fluidounces of liquid have slowly passed. Recover from this the greater part of the ether, by distillation on a water-bath, and expose the residue, in a capsule, until the volatile part has evaporated. Lastly, keep the oleoresin in a well-stopped bottle. *U. S.*

In this process the alcohol is employed for the purpose of displacing the ether, an exception for which there is no good reason, and which might as well be extended to all officinal processes for oleoresins, unless an apparatus, as above described, be used alike for all. Coated ginger yields between 9 and 10 per cent. of the oleoresin; the uncoated (Jamaica) ginger, only between 6 and 7 per cent.; the latter is lighter in color, rather more limpid, and perhaps more agreeable in flavor. The appellation *piperoid* originated with Béral.

Medical Uses.—This oleoresin may possibly fulfil some useful purpose for which ginger in substance and its tincture are inadequate. The oleoresin is, in fact, only a concentrated ethereal tincture. The *dose* is one minim, largely diluted.

OLEUM ÆTHEREUM, *U. S.*—ETHEREAL OIL.

Oleum vini.—Heavy oil of wine, E.; *Huile d'éther, Huile de vin pésante, Huile volatile éthérée*, Fr.; *Schweres Weinöl*, G.

Formula $(C_2H_5)_2SO_4.(C_2H_4)_2SO_3$.

Preparation.—Take of Stronger Alcohol two pints; Sulphuric Acid fifty-five troyounces; Distilled Water a fluidounce; Stronger Ether a sufficient quantity. Add the acid slowly to the alcohol, mix them thoroughly, and allow the mixture to stand for twelve hours. Decant the clear liquid from the sediment into a tubulated retort, of such capacity that the mixture shall nearly fill it. Adapt a thermometer tube to the tubulure by means of a cork, so that the bulb shall be deeply immersed in the liquid, and, having attached a Liebig's condenser, distil, by means of a sand-bath, at a temperature between 302° and 315° F., until the liquid ceases to come over, or until a black froth begins to rise in the retort. Separate the yellow ethereal liquid from the distillate, and expose it for twenty-four hours, in a shallow capsule, to evaporate spontaneously. Then transfer the remaining liquid to a wet filter; and, when the watery portion has drained off, wash the oil which is left, while on the filter, with the distilled water. When this also has drained off, transfer the oil to a graduated measure, by perforating the point of the filter, and add to it an equal volume of stronger ether. The ethereal oil, obtained by this formula, measures about six fluidrachms. *U. S.*

The reaction upon each other of alcohol and sulphuric acid in the production of ether is explained under Æther, page 104, sulphovinic acid, $HC_2H_5SO_4$, being first formed. When this acid is heated with a further supply of alcohol, ether distils over; if water instead of alcohol be added and then heat applied, alcohol distils over, and sulphuric acid is set free; on heating the sulphovinic acid by itself, gas is copiously given off consisting chiefly of *ethylene* (*æthene, elayl, olefiant gas*) C_2H_4, sulphuric acid being regenerated; $HC_2H_5SO_4$ yields C_2H_4 and H_2SO_4, while the free sulphuric acid determines further decomposition, the mass becomes charred, and sulphurous and carbonic acids are met with among the gaseous products. On heating sulphuric acid to about 150° C. (302° F.) and adding slowly sulphovinic acid, heavy oil of wine is produced besides other gaseous compounds and carbonaceous matter.

Instead of operating with pure sulphovinic acid, alcohol and sulphuric acid may be allowed to react upon each other, whereby the products must necessarily be still more complicated, owing to the presence of uncombined alcohol and sulphuric acid, together with water and sulphovinic acid which have resulted from the reaction of the two former; in all cases the temperature to which such mixtures are heated exerts an important influence, determining, as it rises, further decomposition. On keeping sulphuric acid at a temperature of 160° C. (320° F.) and passing the vapors of absolute alcohol into it, Lose obtained ethylene, sulphurous acid, water, and heavy oil of wine, while the retort contained sulphuric, isæthionic, and thiomelanic acids; but on previously diluting the acid with water to the amount of 30 per cent., and using 80 per cent. alcohol, Mitscherlich obtained in the distillate only water and ethylene, with traces of alcohol and ether. The carbonaceous mass mentioned before, has been named *thiomelanic acid;* it is a black, rather dense, glossy mass, forming with bases insoluble compounds, and having a complex composition, approaching the empirical formula $C_{28}H_{16}SO_7$. *Isæthionic acid*, $C_2H_5HSO_4$, is syrupy, and isomeric with sulphovinic acid.

The production of heavy oil of wine evidently depends upon the absence of water and the generation of sulphurous acid, the latter being accompanied by the production of thiomelanic acid. An excess of sulphuric acid is required for this purpose, and this is directed in the above formula, the quantity of acid being about four times greater than is necessary for the production of sulphovinic acid. On mixing the acid and alcohol, a turbidity is seen, and subsequently a white precipitate takes place, consisting of sulphate of lead, which was dissolved in the sulphuric acid; this should be removed to avoid the concussions which would endanger the safety of the retort. When distillation begins, ether and water come over, which are followed by sulphurous acid gas, ethylene, and heavy oil of wine, and the distillate finally consists of an aqueous solution of sulphurous acid and a yellowish ethereal solution of the oil. The gaseous acid should be conducted into the open air, or may be utilized for the preparation of sulphites. By exposing the ethereal portion of the distillate to the air, the ether evaporates, leaving the oil contaminated with some acid watery liquid, which is removed by draining upon a wet filter and washing, after which it is measured and dissolved in an equal volume of ether. This has been found necessary to avoid the spontaneous decomposition and separation into two liquids which would otherwise take place.

The process now officinal is essentially that devised by Squibb (1858), with some modifications suggested by C. L. Diehl (1864). The proper management of the heat influences the yield very considerably; to reduce the formation of ether to its smallest quantity, the mixture should be rapidly heated to near the lowest temperature mentioned in the directions (302° F.), and should never be permitted to fall much below it; if it should rise above 160° C. (320° F.), there is great danger of foaming to such an extent that the mixture will run over and the charge be lost. Diehl found it of advantage to let the temperature rise to 157° or 158° C. (314.6° or 316.4° F.), then to dampen the fire and allow the distillation to proceed spontaneously until the temperature is reduced to 150° C., when heat is again cautiously applied as before, and then heating repeated four or five times until the charge is nearly exhausted, which requires from 10 to 12 hours, when working with 5 to 7 gallons of the mixture. The attention required for smaller quantities is nearly the same. With good management the yield varies between about 1.6 and 2.3 per cent., and averages about 2 per cent. of the weight of the alcohol employed. (See also a paper in *Amer. Journ. Pharm.*, 1865, p. 100.)

Properties.—Pure heavy oil of wine is a yellowish, thickish oily liquid of a peculiar aromatic odor, and pungent, refreshing, bitterish taste, somewhat like that of mint. It is neutral to test-paper, has the specific gravity 1.09, or, according to Serullas 1.133, when quite pure. It is very slightly soluble in water, but dissolves readily in alcohol and ether. On being kept for some time, crystals of *etherin* are separated which have the same elementary composition as ethylene, are nearly tasteless, and on warming have an odor similar to that of oil of wine. In contact with cold water, the oil of wine is slowly, with warm water rapidly decomposed into sulphovinic acid and light oil of wine containing etherin in solution. This *light oil of wine* or *etherol* has likewise the elementary composition of ethylene, but its formula is probably C_8H_{16}; it is yellowish, of a peculiar odor, specific gravity 0.921, insoluble in water, soluble in alcohol. It boils at 280° C. (536° F.), is tough like turpentine at —25° C. (—13° F.), and solid at —35° C. (—31° F.).

Diluted with ether, as directed by the Pharmacopœia, oil of wine has the specific gravity 0.91, a pale-yellowish color, and an ethereal odor, besides that peculiar to the pure oil.

Composition.—Serullas regarded heavy oil of wine as the double sulphate of ether and ethylene, Liebig as ethylsulphate (sulphovinate) of etherol; the latter view appears to be the more correct one if the decomposition with water is taken into consideration. Alkalies also decompose it into sulphovinate of the alkali, liberating etherol. Or it may be related to *sulphuric ether* or *ethylic sulphate*, discovered by Wetherill (1848), which is a yellowish oil of the specific gravity 1.120, has a peppermint-like odor and pungent taste, and the composition of which is expressed by the formula $(C_2H_5)_2SO_4$.

Medical Uses.—It is not used as a medicine except as an ingredient of the compound spirit of ether.

OLEUM AMYGDALÆ AMARÆ, *U. S.*—OIL OF BITTER ALMOND.

Oleum amygdalarum (amararum) æthereum.—Essence d'amandes amères, Fr.; *Bittermandelöl*, G.

Preparation.—Bitter almonds are deprived of most of their fixed oil by pressure between warm plates; the press-cake is powdered, mixed with about six times its weight of water, the mixture digested for a day or two at a temperature of about 50° C. (122° F.), and then distilled.

The oil does not pre-exist in the almonds, but is produced through the decomposition of amygdalin by emulsin, hydrocyanic acid and sugar being at the same time formed; $C_{20}H_{27}NO_{11}$ (amygdalin) and $2H_2O$ yield $C_{12}H_{24}O_{12}$ (glucose), C_7H_6O (oil of bitter almond), and HCN (hydrocyanic acid). This decomposition must first be effected before distillation is resorted to; but while digesting the mixture too high a heat must be avoided, which would coagulate the emulsin and render it ineffective. Distillation by superheated steam is preferable to the use of the naked fire, in order to avoid empyreuma. The water from which the volatile oil has been separated still retains notable quantities of it in solution, which may be recovered by fractional distillation. The yield varies considerably, but is usually in the neighborhood of 1 per cent. The importation of the oil into the United States usually amounts, annually, to 1500 or 2000 pounds.

Properties.—Oil of bitter almond is colorless or yellowish, limpid, has a peculiar aromatic odor, reminding us of that of hydrocyanic acid, and a bitter and burning taste. It varies in spec. grav. between 1.06 and 1.075, and boils at about 180° C. (356° F.). When freed from hydrocyanic acid and rectified, its spec. grav. is lowered to 1.043 or 1.049; but it retains the aromatic almond odor. It is soluble in 300 parts of water, and in all proportions of alcohol and ether.

Composition.—Pure oil of bitter almond was formerly regarded as the hydride of the radical benzoyl (C_7H_5O), but in its chemical relation it is the aldehyd of *benzalcohol*, C_7H_8O, which was discovered by Cannizaro (1853), is a colorless, faintly aromatic oil, and, by careful oxidation, yields *benzaldehyd*, or bitter almond oil, C_7H_6O; and this, by further oxidation on exposure to the air, or by means of oxidizing agents, is converted into benzoic acid, $C_7H_6O_2$. It is this latter compound which crystallizes from old oil of bitter almonds.

Pure benzaldehyd (*artificial oil of bitter almond*) is now largely made in Europe from *toluol*, C_7H_8, a liquid hydrocarbon contained among the products of the destructive distillation of coal.

The crude oil contains variable quantities of *benzimid*, *benzoin*, and *hydrocyanic acid*, from the latter of which it may be freed by agitation with mercuric oxide, or, preferably, ferrous hydrate (a mixture of lime with solution of ferrous sulphate), and subsequent distillation. Potassa and other alkalies may likewise be employed, but an excess is apt to decompose the oil with the production of benzoic acid and benzalcohol. According to Völkel, hydrocyanic acid is contained in the crude oil in the form of a compound, $C_7H_6O.HCN$, which is a yellowish, nearly inodorous bitter oil, of spec. grav. 1.124, and boiling at 170° C. (338° F.). *Benzimid* has the composition $2C_7H_6O.C_7H_6(CN)_2$, and forms, in the pure state, colorless, pearly, inodorous crystals, which, on being boiled with water and hydrochloric acid, are decomposed into oil of bitter almond, formic acid, and ammonia. *Benzoin*, $C_{14}H_{12}O_2$, crystallizes in inodorous and tasteless, colorless prisms, which are polymeric with oil of bitter almond, and are converted into the latter by passing their vapor through a red-hot tube.

Adulterations.—The principal adulterations are nitrobenzol, alcohol, and chloroform, the last two being sometimes used together to leave the specific gravity unchanged. The chloroform is readily detected by distilling a little of the suspected oil from a test-tube placed in a water-bath kept at a temperature not exceeding 65° C. (149° F.), when the chloroform will distil over. *Nitrobenzol* is largely prepared for use in the arts (see page 936), and is met with in the market under the name of *essence de mirbane;* it has an odor similar to that of bitter-almond oil, and a sweet taste, and is nearly insoluble in water. We found it convenient (1857) to test for it by dissolving 15 grains of the oil in 2 drachms of alcohol, adding 15 grains of caustic potassa, heating for a few minutes, evaporating to one-third, and cooling. The pure oil will leave a brownish-yellow liquid, soluble in water, with but slight turbidity; while if nitrobenzol be present, the residue will be dark-brown, sometimes crystalline, and not dissolve clear in water, depositing a brown-yellow sediment in proportion to the amount of the adulterant. The test depends upon the conversion of nitrobenzol, $C_6H_5NO_2$, into *azoxybenzid*, $C_{12}H_{10}N_2O$, which dissolves in alcohol and ether, but is insoluble in water. Wagner (1866) proposed to agitate 5 c. c. of the suspected oil with 10 c. c. of solution of sodium bisulphite, spec. grav. 1.225, and diluting with water to 50 c. c. in a graduated tube; pure bitter-almond oil will dissolve, while the nitrobenzol (spec. grav. 1.20) will separate as an oily layer. More delicate tests for this substance depend upon its reduction to *anilin*. According to Hoffmann (1845) the oil is diluted with ether and some alcohol, after which some zinc and hydrochloric acid are added; after the evolution of hydrogen has ceased, the ethereal layer is evaporated spontaneously, and the residue mixed with a few drops of solution of chlorinated lime, when a purplish-blue color will be produced. Jacquemin (1876) recommended adding a few drops of the oil to a solution of stannous chloride in caustic soda, and afterwards a drop of carbolic acid and some solution of chlorinated soda, when the blue color of erythrophenylate of sodium will appear.

Off. Prep.—Aqua amygdalæ amaræ, *U. S.*

Medical Action and Uses.—The oil of bitter almonds is hardly inferior to dilute hydrocyanic acid in its poisonous power, since one hundred parts of the oil contain nearly thirteen parts of anhydrous hydrocyanic acid. One drop of it has been known to kill a cat. In man, grave and even fatal effects have resulted from a dose of seventeen drops; but, on the other hand, recovery has taken place after the swallowing of half an ounce or more, when remedial measures were at once applied. Medicinally it is one of the best forms in which hydrocyanic acid can be administered, owing to its comparatively stable composition. The proper occasions for its use are indicated under Hydrocyanic Acid. It may be prescribed in doses varying from a quarter of a drop to one drop, and conveniently in mixture of almond.

OLEUM AMYGDALÆ EXPRESSUM, *U. S.*—ALMOND OIL.

Oleum amygdalæ, Br.; *Ol. amygdalæ dulcis, Ol. amygdalarum.—Expressed (sweet) oil of almond*, E.; *Huile d'amandes douces*, Fr.; (*Süsses*) *Mandelöl*, G.

Preparation.—Almond oil is made both from the sweet and bitter almonds. To obtain an unobjectionable oil, the almonds are freed from adhering dust by agitating them upon a sieve and removing discolored pieces, after which they are ground or bruised in an iron or stone mortar, inclosed in canvas bags, and subjected to considerable pressure between polished steel plates, which should not be heated beyond about 30° C. (86° F.). The press cake may be powdered and again expressed, when an additional quantity of oil will be obtained. The yield is 40 to 45 per cent. from sweet, and about 35 per cent. from bitter almonds, a little more when a hydraulic press is used. Expressing the residue at a higher temperature will yield more oil, which, however, is of inferior quality. The expressed turbid oil is set aside in a cool place, and then decanted from the sediment which may be filtered. About 20,000 to 25,000 pounds are annually imported into the United States; in 1867 only 10,544 pounds were entered.

Properties.—The oil is nearly colorless or of a pale straw color, almost inodorous, and has a bland taste. It is a thin fluid, and does not congeal until cooled to about —20° C. (—4° F.); its specific gravity is 0.917 to 0.920; exposed to air it readily turns rancid, but it is not a drying oil. It dissolves in about 30 parts of absolute alcohol, and readily in the usual solvents for fats.

Composition.—It consists mainly of olein, with a small quantity of palmitin. (See Oleum olivæ.)

Adulterations.—Sulphuric acid and chlorinated lime (see p. 950) will detect most of the cheaper oils. But the oils of peach and apricot seeds are very similar to almond oil. Their presence may, however, be shown, according to Hager (1870), by agitating the oil with an equal bulk of 25 per cent. nitric acid, which mixture may be warmed to 60° C. (140° F.) and still remain white or faintly yellowish if the almond oil be pure, but become deeper yellow in proportion to the amount of the other oils present. The two oils mentioned become at once yellowish, and gradually orange-yellow. Bieber (1877) recommended mixing 5 parts of the oil with one part of a cold mixture consisting of equal weights of sulphuric acid, water, and fuming nitric acid. Almond oil gives a yellowish-white mixture; oil of peach-kernels a reddish one, changing to dark orange; benne oil yellowish-red, becoming orange-red.

Off. Prep.—Oleum phosphoratum, *Br.;* Unguentum aquæ rosæ, *U. S.;* Unguent. cetacei, Unguent. hydrarg. oxidi rubri, Unguent. plumbi subacetat. comp., Unguent. simplex, *Br.*

Medical Action and Uses.—The expressed oil of almond is a singularly bland and agreeable oil and very useful as a demulcent. It was formerly used to allay *cough* and all irritations of the respiratory passages. It may be prescribed in an emulsion made with mucilage, or yelk of egg, and white sugar.

OLEUM ANETHI, *Br.*—OIL OF DILL.

Essence d'aneth, Fr.; *Dillöl*, G.

Preparation.—The volatile oil is obtained from the fruit of Anethum graveolens, *Lin.*, by distillation with water. The yield is about 3 to 5 per cent.

Properties.—Oil of dill has a pale yellow color, gradually changing to reddish-brown, the peculiar aromatic odor of the fruit, and a sweetish and warm, afterwards pungent, taste. Its specific gravity varies between .85 and .89, and its rotating power is about 206° to the right. It dissolves iodine with the evolution of some vapors, and is colored red-brown by sulphuric acid.

Composition.—The oil contains a hydrocarbon, *anethene*, $C_{10}H_{16}$, which has an odor resembling that of lemon, and an oxygenated portion which, according to Gladstone (1872), is isomeric or perhaps identical with the *carvol* of oil of caraway. This carvol is obtained by treating the oil with alcoholic solution of ammonium sulphide and decomposing the crystalline compound with an alkali. Both fractions are dextrogyre.

Medical Action and Uses.—Oil of dill is very seldom used in this country; like anise oil, etc., it may be employed to relieve flatulent *colic*, and externally as an anodyne. *Dose*, from two to five drops in hot sugar and water.

OLEUM ANIMALE ÆTHEREUM, *P. G.*—ANIMAL OIL.

Oleum animale Dippelii.—*Dippel's animal oil*, E.; *Huile animale de Dippel*, Fr.; *Ätherisches Thieröl*, G.

Preparation.—On the dry distillation of bones and other animal substances, a fetid, brown, thick, oily liquid is obtained, known as *bone oil, crude*, or *fetid animal oil.* This is purified for medicinal use by distilling it in a retort or flask, which is heated by a sand-bath, as long as a thin oil passes over. This is then mixed with four times its weight of water, and rectified in a metallic still as long as the distillate is colorless, or but slightly yellow. The oily liquid is separated from the water, and at once put into small vials, well corked, and preserved in a dark place. Though previously known and medicinally employed, it was first prepared from dried blood by J. C. Dippel in 1711.

Properties.—*Rectified animal oil* is a colorless or yellowish, thin, oily liquid, which has the average spec. grav. 0.80. It has a very penetrating empyreumatic and ethereal, but not a fetid, odor, and a pungent, acrid, afterwards cooling and bitter taste. It has a slight alkaline reaction to test-paper, dissolves in about 80 parts of water, and is readily soluble in alcohol, ether, fixed and volatile oils. Exposed to light and air it rapidly darkens in color, and acquires a thicker consistence.

Constituents.—This is a very complex mixture, containing a large number of volatile bases like *pyrrol* C_3H_5N, *pyrridin* C_5H_5N, *picolin* C_5H_7O, *lutidin* C_7H_9N, *collidin* $C_8H_{11}N$; also methylamin, propylamin, butylamin, and others. It contains also a neutral liquid which boils at 65.5° C. (150° F.), and different hydrocarbons.

Physiological Action and Medical Uses.—Given to dogs it produces paralysis of the hinder legs and general convulsions. A fluidrachm of this oil destroyed a medium-sized dog in fifteen minutes. Given to man in medicinal doses it excites a sense of warmth in the abdomen, renders the pulse more frequent and stronger, and increases the sweat and urine. A tablespoonful of it is said to have killed a man almost instantaneously; and an ounce and a half, taken by a woman with suicidal intent, caused violent vomiting and intense pain. After death the mouth and throat were dry and shrivelled, and the stomach inflamed and ecchymosed. Formerly the oil was used in the *typhoid state* of febrile affections, in *hysteria*, *epilepsy*, *paralysis*, chronic *rheumatism*, and *sciatica*, and to expel *tapeworms*. Internally it was prescribed in doses of from five to ten drops, and from that to thirty or forty drops, mixed with powdered sugar, or in sulphuric ether, or Hoffmann's anodyne. Externally it was applied by friction, pure or in liniments.

Formerly, a preparation known as Chabert's oil, and which was procured from a mixture of impure empyreumatic oil with oil of turpentine, by distillation, was in high repute as a cure for *tapeworm*. Its offensive taste and smell, and harsh action, caused it to be laid aside when the various tænicide medicines now in use began to be employed.

OLEUM ANISI, *U. S.*, *Br.*—OIL OF ANISE.

Essence d'anis, Fr.; *Anisöl*, G.

The volatile oil distilled from the fruit of Pimpinella anisum, *Lin.*, Woodv. Med. Bot., plate 180, and the oil distilled from the fruit of Illicium anisatum, *Lin.*, Nees, Plant. Med., plate 371. The latter is properly called *Oleum anisi stellati* (*Ol. badiani*); Oil of staranise, *E.;* Huile volatile de badiane, *F.;* Sternanisöl, *G.*

Preparation.—The oil is obtained by distillation of the fruit with water. The yield from anise is 1½ to 2½ per cent.; from staranise 2½ to 4 per cent.

Properties.—Both volatile oils are pale yellow, becoming darker by age, and have a sweet, aromatic taste, and an agreeable aromatic odor, differing somewhat in the two oils. The spec. grav. is .97 to .98, rising in old oils sometimes to 1.028 (Zeller). At a low temperature the oils solidify into a crystallizing mass, the freezing point of the true anise oil being usually near 10° C. (50° F.), and of staranise oil near 2° C. (35.6° F.). It varies, however, very considerably, not only in oils as obtained from different material, but because it changes on keeping, and becomes lower. The reactions of the two oils with the various reagents that have been recommended for the volatile oils, are so similar, that they do not afford any reliable means for distinguishing them. Both are entirely neutral to test-paper, have a very slight right or left rotating power, and are freely soluble in alcohol. The importation of anise oil into the United States increased from 3900 pounds in 1867 to 24,000 pounds in 1876, and 20,500 pounds in 1877.

Composition.—Oil of anise contains a small quantity of a hydrocarbon having the composition $C_{10}H_{16}$, but consists mainly of *anethol*, $C_{10}H_{12}O$, sp. grav. .98; this exists in two modifications, one liquid, the other solid at the ordinary temperature, and fusing at about 20° C. (68° F.), and both boiling between 220° and 225° C. (428° and 437° F.); they are present also in oil of fennel, and a liquid modification in the oil of *Artemisia dracunculus*, Lin., or *tarragon*, has the spec. grav. .945, and boils at 206° C. (402.8° F.). Anethol has a fainter, but more agreeable odor than oil of anise. It is not altered on being boiled with potassa solution; chromic acid converts it into colorless, inodorous, and nearly tasteless crystals of *anisic acid*, $C_8H_8O_3$; nitric acid yields the same compound, or anisoic, anisylic and oxalic acids, according to its concentration and duration of action. Sulphuric acid colors it red, and water separates afterwards inodorous *anisoin;* this is isomeric with anethol, like *metanethol* and *metanethol camphor*, which are produced under certain conditions. Landolph (1875) found Russian oil of anise to contain 90 per cent. of a mixture of anisic aldehyd and anise camphor, to which he gives the formula $C_{10}H_{16}O$.

Adulterations.—Oil of anise has been met with adulterated with alcohol, camphor, wax, and spermaceti; the last three for the purpose of raising its congealing point; camphor is detected in the pressed crystalline mass by its odor, the other two by their insolubility in 80 per cent. alcohol. Leonhardi (1878) reports the oil to be sometimes largely adulterated with the stearopten of Russian fennel oil, which is detected by the fennel odor developed on heating.

Off. Prep.—Essentia anisi, *Br.;* Extr. spigeliæ et sennæ fluid., Spiritus anisi, Syrup. sarsapar. comp. *U. S.;* Tinct. opii ammoniata, *Br.;* Tinct. opii camphorata (camphoræ comp.), *U. S., Br.;* Trochisci glycyrrhizæ et opii, *U. S.*

Medical Action and Uses.—Like other aromatic essential oils, when given to animals in large doses, it occasions lethargy and insensibility. In medicinal doses it acts as a local and general stimulant, and is used to expel *flatus*, allay *colic*, and prevent the griping of drastic purgatives. It has also been employed in the treatment of *chronic bronchitis*, associated with carbonate or muriate of ammonium. It may be prescribed in *doses* of from two to six drops on sugar, or in emulsion.

OLEUM ANTHEMIDIS, *Br.*—OIL OF CHAMOMILE.

Oleum chamomillæ romanæ.—Essence de camomille romaine, Fr.; *Römischkamillenöl*, G.

Preparation.—The volatile oil is obtained from the flowers of Anthemis nobilis, *Lin.*, by distillation with water. The yield is variable, between about $\frac{1}{5}$ and $\frac{1}{2}$ per cent.

Properties.—Fresh flowers seem to yield a blue-colored oil, while that obtained from dried flowers has a green or yellow color; or, if blue, changes rapidly to green and yellow. It has the odor of the flowers, and a warm, aromatic taste; it imparts a red color to litmus paper, and begins to boil at about 160° C. (320° F.), the boiling point rising gradually to above 200° C. (392° F.). It is sometimes distilled from the entire plant, and has then a greenish color, which, on exposure, changes to yellow. Its specific gravity is .90.

Composition.—The oil does not combine with sodium bisulphite. Potassa decomposes it, and B. Jaffé (1865) separated in this way 50 per cent. of impure and 30 per cent. of pure angelicic acid. Demarçay (1875) arrived at the conclusion that it is a mixture of several compound ethers, among which the butylic and amylic angelates and valerianates preponderate.

Off. Prep.—Extractum anthemidis, *Br.*

Medical Action and Uses.—Oil of chamomile is stimulant and antispasmodic, and is used to allay *vomiting*, relieve flatulent *colic*, and to modify the irritant action of cathartics in pill or mixture. It is often added to liniments used for *sprains*, *rheumatic pains*, etc. *Dose*, from one to five drops.

OLEUM BERGAMII, *U. S.*—OIL OF BERGAMOT.

Oleum Bergamottæ, P. G.—Essence de bergamote, Fr.; *Bergamottöl*, G.

The volatile oil obtained from the rind of the fruit of Citrus limetta, *D. C.;* C. bergamia var. vulgaris, *Risso*, s. C. aurantium var. bergamia, *W. & A.* Bentley and Trimen, Med. Plants, 52.

Origin.—The fruit is of a lemon-yellow color, and grows upon a small tree in southern Italy, evidently a variety produced by cultivation; the juice has a bitter and acid taste.

Preparation.—The oil vessels contained in the rind of the fruit are ruptured by means of a machine, wherein the fruit is subjected to a rotatory motion; the oil thus obtained deposits on standing a waxy matter, from which it is decanted. The amount imported into the United States was 41,857 pounds in 1876, and 21,697 pounds in 1877.

Properties.—Oil of bergamot has a green or greenish, sometimes a yellow color, and after rectification is colorless. Its specific gravity varies between .86 and .88, and its boiling point between 183° and 195° C. (351.4° and 383° F.). It has a bitterish aromatic taste, and an agreeable odor, less pleasant after rectification. It has a neutral reaction to test-paper. It dissolves 25 per cent. of carbonbisulphide and 8 per cent. of alcohol, .966, and is soluble in half its weight of alcohol, sp. gr. .85, and in glacial acetic acid. It deviates polarized light to the right from 7° (Pharmacographia) to 40° (Gladstone).

Composition.—The amount of oxygen has been found to vary between 2.6 and 16.14 per cent. in different portions of the distillate. The oil appears to be a mixture of hydrocarbons of the formula $C_{10}H_{16}$ with various hydrates. Distilled with phosphoric anhydrid, a volatile oil of the odor of turpentine is obtained. The waxy matter mentioned above crystallizes from alcohol in silky, colorless, inodorous, and tasteless needles; this *bergamot camphor* or *bergaptene* has the composition $C_9H_6O_3$.

Adulterations.—Oil of bergamot is often adulterated with oil of turpentine and oil of orange, and requires then a larger amount of alcohol for solution. The volatile oils obtained by distillation with water of the leaves and of the nearly exhausted rind, when mixed with oil of bergamot, render it less fragrant.

Medical Action and Uses.—It is a stimulant like other volatile oils, but is seldom employed except for the purpose of scenting ointments and toilet tinctures.

OLEUM BUBULUM.—NEAT'S-FOOT OIL.

Axungia pedum tauri.—Graisse des pieds du gros bétail, Fr.; *Klauenfett*, G.

Preparation.—It is made by boiling neat's feet deprived of their hoofs with water, skimming off the oil which rises to the surface, and keeping it for some time on warm water. After the impurities have settled it is ready for use.

Properties.—Neat's-foot oil is a pale yellow, and, when of good quality, nearly inodorous and tasteless liquid oil, which is but slightly thickened on exposure, does not readily turn rancid, and requires to be cooled to below the freezing point of water before it congeals to a soft white mass. On saponification it yields glycerin and fatty acids, which have not been specially investigated.

Action and Medical Uses.—Neat's-foot oil is much used in softening leather and rendering it pliable. Perhaps this operation may have suggested its administration in medicine as a substitute for cod-liver oil. If it had been efficient, of which there is no proof, its singularly repulsive smell and taste, as usually met with, and its tendency to cause diarrhœa would speedily have condemned it.

OLEUM CAJUPUTI, *U. S.*, *Br.*—OIL OF CAJEPUT.

Oleum cajeputi, P. G.—*Oil of cajuput*, E.; *Essence de cajeput*, Fr.; *Cajaputöl*, G.

The volatile oil obtained from the leaves of Melaleuca cajuputi, *Roxb.* (s. M. minor, *Smith*). Trans. Lond. Med. Bot. Soc.; Steph. and Church, Med. Bot., plate 84; Bentley and Trimen, Med. Plants, 108.

Nat. Ord.—Myrtaceæ.

Origin.—The species mentioned is a small tree, which has lanceolate entire leaves and terminal spikes of small white flowers with exserted stamens. It is indigenous to the East Indian islands. Bentham regards it as a mere variety of *M. leucadendron*, Lin., which extends into Further India, the Philippines, and a considerable portion of Australia, and often attains a moderately large size. The oil is prepared in Celebes, Bouro, and other islands of the Molucca Sea, by distilling the leaves with water. 1146 pounds of cajeput oil entered the United States in 1867, 3150 pounds in 1876, and 1129 pounds in 1877.

Properties.—Oil of cajeput is limpid, of a green color, a penetrating odor, suggesting that of camphor, rosemary, and mint, and a warm, camphoraceous, afterwards cooling taste. The specific gravity varies between .914 and .930; its boiling point is near 173° C. (343.4° F.). It does not congeal at —25° C. (—13° F.), is freely soluble in alcohol, and does not affect litmus paper. It dissolves iodine quietly or with the evolution of few reddish vapors; ammonia turns it yellowish, and sulphuric acid colors it brown, reddish, and finally purplish-brown. By rectification it becomes colorless.

Composition.—Blanchet determined its composition to be $C_{10}H_{16}.H_2O$. Schmidl (1860) obtained, between 175° and 178° C. (347° and 352.4° F.), two-thirds of the oil as a colorless distillate, which has the composition stated, and is the hydrate of a hydrocarbon named *cajeputene*, the latter obtainable by repeated distillation over phosphoric anhydrid. Cajeputene, $C_{10}H_{16}$, boils between 160° and 165° C. (320° and 329° F.), has an agreeable odor of hyacinth, and is slightly soluble in alcohol. Two other hydrocarbons of the same composition and insolubility in alcohol are obtained at the same time, of which *isocajeputene* boils at 176° C. (348.8° F.), and has a less agreeable odor, while *paracajeputene* is thick, yellow, and shows a blue fluorescence. Gladstone (1872) found the hydrate of cajeputene or *cajeputol* also in the volatile oils of *Melaleuca ericifolia* and *linarifolia*, Sm., and of *Eucalyptus oleosa*, F. Muel.; it is dextrogyre, its rotating power varying between 10° and 30°.

The green color of the oil is sometimes, at least, in part due to copper, the presence of which may be proven by agitating the oil with dilute hydrochloric acid and adding to the watery liquid some ferrocyanide of potassium, when a red-brown color or precipitate will occur. However, cajeput oils have been observed which were entirely free from copper, the green being due to chlorophyll.

Adulterations.—The admixture of oil of turpentine is indicated by decreased solubility in alcohol and the more violent reaction with iodine. Imitations made by mixing various volatile oils are detected by the same means and by their different odor. The oils examined by Gladstone cannot, it seems, be distinguished from the officinal.

Off. Prep.—Linimentum crotonis, Spiritus cajuputi, *Br.*

Medical Action and Uses.—This oil has long been prized in the East as a stimulant and diaphoretic medicine, and employed in dropsy, flatulent colic, chronic rheumatism, paralysis, hysteria, etc. It may be used internally as a remedy for *flatulent colic*, particularly when produced by cold or by the retrocession of gout or rheumatism, in *dysmenorrhœa* occasioned by temporary uterine congestion, in *cholera morbus*, and in epidemic *cholera*. In the last named disease it has been largely employed by Oriental physicians. It is of marked utility in cases of *nervous vomiting*, *nervous dysphagia*, *dyspnœa*, and *hiccup*. It has also been used as a *vermifuge*. As a local stimulant and rubefacient it is useful, when diluted with olive oil or added to camphorated liniments, in cases of *functional paralysis* and *muscular rheumatism*. With olive oil or glycerin, it is introduced on cotton into the auditory canal for the relief of *otalgia* and of *deafness*. It is one of the best remedies for *toothache* depending upon caries, when a drop of it upon cotton is introduced into the hollow tooth; and a few drops of it rubbed upon the painful part relieve *nervous headache* and *local neuralgia*. It is a useful stimulant in chronic *scaly affections of the skin*, and in *acne rosacea*. It may be given internally in *doses* of from two to ten drops, on sugar, with Hoffmann's anodyne, or with tinctures or infusions of antispasmodic medicines. As a vermifuge, it may be mixed with honey, in the proportion of one part to thirty or more, and dessertspoonful doses of the mixture may be given every hour or two. It may also be administered by enema.

OLEUM CAMPHORÆ, *U. S.*—OIL OF CAMPHOR.

Huile volatile de camphre, Fr.; *Flüchtiges Kampferöl*, G.

The volatile oil obtained from Camphora officinarum, *Nees.*

Origin.—The oil is obtained in the preparation of crude camphor, a portion also in refining this product (see page 329). It is known in commerce as camphor oil of Formosa.

Properties.—It is a dark wine-yellow or yellowish-brown liquid, having a camphor-like odor and taste, and the specific gravity .940. At a low temperature, it deposits a considerable quantity of camphor in the form of crystals, and at about 180° C. (356° F.), it begins to boil. It turns the plane of polarized light to the right.

Composition.—By careful fractional distillation, a considerable portion of camphor is left in the retort, but cannot be completely removed by this means. The liquid distillate has, according to Martius, the odor of camphor and cajeput, and, according to Mulder, is a solution of laurel camphor, $C_{10}H_{16}O$, in a hydrocarbon of the composition $C_{10}H_{16}$.

CAMPHOR OIL OF BORNEO is obtained from *Dryobalanops camphora*, Colebr. (see page 330), by tapping or felling the tree. It is a rather viscid brown-yellow or reddish oil, which is a solution of resin and some Borneo camphor, $C_{10}H_{18}O$, in a hydrocarbon, $C_{10}H_{16}$; the latter has a terebinthinate odor, and is identical with the hydrocarbon of oil of valerian, hence the names *borneene* and *valerene*. The crude oil is dextrogyre, begins to boil at about 165° C. (329° F.), and deposits little or no camphor when placed in a freezing mixture. It is rarely, if ever, met with in commerce.

Medical Action and Uses.—Oil of camphor (which should not be confounded with camphorated oil) possesses properties identical with those of camphor, and may be used for similar purposes; but it is very seldom employed. The *dose* is two or three drops.

OLEUM CARI, *U. S.*—OIL OF CARAWAY.

Oleum carui, Br.; *Oleum carvi*, P. G.—*Essence de carvi*, Fr.; *Kümmelöl*, G.

Preparation.—The volatile oil is obtained from the fruit of Carum carui, *Lin.*, by distilling it with water; the yield is variable, but averages about 4 per cent. The fruit which is grown in northern countries is generally richer in oil than that from more southern localities. 3600 pounds passed into the United States in 1867, 6614 pounds in 1876, and 5528 pounds in 1877.

Properties.—Oil of caraway is limpid, colorless or pale yellow, becoming brown and viscid on exposure. Its specific gravity is usually about .91 or .92, but in old oil may rise to .97. When fresh it has no action on litmus; its odor is agreeable; its taste burning aromatic. It dissolves readily in alcohol, turns polarized light to the right, and commences to boil at 190° C. (374° F.).

An inferior oil of caraway is made from the refuse or "chaff" of the fruit; it is less agreeable in odor, and not unfrequently mixed with oil of turpentine.

Composition.—By repeated fractional distillation, Völkel (1840) separated *carvene*, $C_{10}H_{16}$, which has little odor and taste, and boils at 173° C. (343.4°

F.), and *carvol*, $C_{10}H_{14}O$, which is liquid, has an agreeable odor, and boils at 227° C. (440.6° F.) (*Gladstone*) or at 250° C. (482° F.) (*Varrentrapp*). In contact with alcoholic solution of ammonium sulphide, it yields white silky needles of $2(C_{10}H_{14}O).H_2S$, from which carvol is again separated by potassa. Carvol (see also Ol. anethi) is isomeric with menthol of spearmint, myristicol of nutmeg, thymol, cuminic alcohol, and *carvacrol;* the latter is a rather viscid, colorless, or yellowish oil, resembling creasote in odor and taste, and may be obtained by distilling a mixture of oil of caraway and potassa until carvene has been expelled, decomposing the residue by sulphuric acid, and rectifying the oil.

Off. Prep.—Confect. scammonii, *Br.;* Extr. spigeliæ et sennæ fluid., *U. S.;* Pilula aloes barbad., *Br.;* Spirit. juniperi comp., *U. S.*

Medical Action and Uses.—The properties of this oil are nearly identical with those of oil of anise. Given to animals in large doses it causes death by asthenia. It may be used in the treatment of *flatulent colic*, and whenever a gastric stimulant or a carminative is required. Locally it acts, like other essential oils, as an anæsthetic. It may be administered in sweetened water, ether, or Hoffmann's anodyne, in the *dose* of from one to ten drops.

OLEUM CARYOPHYLLI, *U. S.*, *Br.*—OIL OF CLOVES.

Oleum caryophyllorum, P. G.—*Essence de girofles*, Fr.; *Nelkenöl*, G.

Preparation.—The volatile oil is obtained from cloves, the flower-buds of Caryophyllus aromaticus, *Lin.*, by distilling them with water. For this purpose the cloves require to be bruised, cohobation should be repeatedly resorted to, and salt may be added (see page 945) in order to raise the boiling point. If the cloves have been properly bruised, the three or four times repeated distillation of the water from the same cloves is usually sufficient; but, if the powder be very coarse, the distillation will have to be repeated more frequently. At first the oil coming over is chiefly the light portion which floats on the water; afterwards the heavy portion distils, and the two portions united constitute the commercial article. The yield is 15 to 20 per cent. Clove stalks are said to be sometimes used in Europe in the distillation of this oil. In the United States, cloves from South America are employed for distilling the oil, and the entire want is now supplied in this country. In 1867 the amount imported was 956 pounds, which decreased in 1877 to 2 pounds.

Properties.—When recently distilled, oil of cloves is of a pale yellow color, but becomes darker and finally brown-yellow on keeping. It has a strong odor of cloves, a burning aromatic taste, and boils at 240° C. (455° F.). Its specific gravity varies between 1.034 and 1.056; oil of clove stalks, though agreeing in odor, has a density of about 1.009. Oil of cloves dissolves freely in alcohol, the solution having a slight acid reaction, and yielding with ferric chloride a purplish-blue color. Sulphuric acid colors the oil blood-red, finally blue; iodine dissolves in it quietly; strong potassa solution converts it into a crystalline mass of eugenate of potassium; and fuming nitric acid acts violently upon it, sometimes with ignition. The oil is without action or with but slight action (—4°, Gladstone) upon polarized light.

Composition.—On distilling a mixture of oil of cloves with excess of potassa, the colorless distillate is the *light oil of cloves*, and has the composition $C_{10}H_{16}$; its odor is distinct from that of cloves, more terebinthinate; it has the density .91, and boils at 251° C. (483.8° F.). On decomposing the eugenate of potassium with sulphuric acid and rectifying the separated oil, *eugenic acid* or *eugenol*, $C_{10}H_{12}O_2$, is obtained as a colorless oil having the odor of cloves, the specific gravity 1.076 (Stenhouse), and, according to Williams, the same boiling point as the preceding hydrocarbon; it yields with bases crystallizable salts, which, with the exception of the barium compound, are decomposed by much water or alcohol, and are colored blue or purple by ferric salts. By treating it in an atmosphere of carbonic acid with sodium, Scheuch (1863) obtained the sodium salt of *eugetinic acid*, $C_{11}H_{12}O_4$, which is crystallizable, soluble in water, colors ferric salts deep blue, and is decomposed by heat into carbonic and eugenic acids. The same author proved likewise the presence in oil of cloves of salicylic acid, most probably in the form of an ether.

Adulterations.—The determination of the boiling point and the specific gravity are sufficient for detecting most adulterations to which oil of cloves is sometimes subject; on treating the suspected oil with alcoholic solution of potassa the odor of cloves disappears, and the nature of the adulteration is established. For the detection of carbolic acid, Jacquemin (1875) recommended adding a trace of anilin, shaking with water, and adding a little chlorinated soda, when a blue color will be produced. Flückiger (1870) proposed to shake 1 part of oil with 50 parts of hot water, concentrate the aqueous liquid by evaporation at a moderate heat, add a drop of ammonia and a little chlorinated lime; in the presence of carbolic acid a green color passing into blue will be produced.

Off. Prep.—Confect. scammonii, Pil. colocynth. comp., Pil. colocynth. et hyoscyami, *Br.*

Medical Action and Uses.—The action and uses of oil of cloves are essentially the same as those of the oils of caraway and anise. It is seldom employed internally, but is sometimes used to allay the pain of *carious teeth*, and of *earache*.

OLEUM CHENOPODII, *U. S.*—OIL OF WORMSEED.

Essence de chénopode anthelmintique, Fr.; *Amerikanisches Wurmsamenöl*, G.

Preparation.—The volatile oil is obtained from the fruit of Chenopodium anthelminticum, *Lin.*, by distilling it with water. Much of the oil is distilled in Maryland, and in some of the Western States. The fruit yields about 3 to 3½ per cent., the fresh herb ½ to 1 per cent. The Western oil is rather less pungent than the Baltimore oil of wormseed.

Properties.—Oil of wormseed is colorless or yellowish, limpid, becoming brown and thick on exposure. It has the peculiar odor of wormseed, and a bitterish, pungent, and somewhat cooling taste. Its specific gravity, when fresh, is .902 to .91, and increases by age to .960. It boils at 180° to 190° C. (356° to 374° F.), dissolves iodine slowly, and turns brown-red when boiled with nitroprusside of copper.

Composition.—Garrigues (1854) found oil of wormseed to be a mixture of a hydrocarbon, $C_{10}H_{16}$, and a liquid oxygenated oil, $C_{10}H_{16}O$. The former has the density .932, boils near 176° C. (350.6° F.), and yields a liquid and a crystalline compound with chlorine. The specific gravity of the latter is .987, its boiling point 245° C. (473° F.).

Medical Uses.—Wormseed oil is almost exclusively used as an anthelmintic, although occasionally employed for the cure of *intermittent fever*, *hysteria*, *chorea*, and other *nervous affections*. In America it is one of the most popular remedies for *lumbricoid worms;* but it has also been used successfully to expel *tæniæ*. It is true that in Europe some observers have tended to discredit its efficacy, and even in this country there is more evidence of its utility in cases of gastro-intestinal *dyspepsia* among children, which often is mistaken for verminous disease, than of its direct vermifuge powers. It may be given to children in *doses* of from five to ten drops, on sugar, and repeated twice daily for several days, when it should be followed by a dose of castor oil.

OLEUM CINNAMOMI, *U. S.*, *Br.*—OIL OF CINNAMON.

Oleum cinnamomi zeylanici, P. G.—*Oil of Ceylon cinnamon*, E.; *Essence de cannelle*, F.; *Zeylonisches Zimmtöl*, G.

Preparation.—The Pharmacopœia recognizes only the volatile oil of Ceylon cinnamon, which is almost exclusively prepared in Ceylon by distilling the chips and refuse bark with water. However, judging from the custom-house entries, but little of the oil is imported into the United States. The importation in 1867 amounted to 46 pounds; in 1877 to 15 pounds; while 20,685 pounds of oil of Chinese cinnamon (or Cinnamon cassia) were imported in 1867, and an annual average of 43,129 pounds during the three years ending June 30, 1877. The latter oil is sometimes distilled in the United States. Ceylon cinnamon yields ½ to 1 per cent., Chinese cinnamon ½ to 1½ per cent. of volatile oil.

Properties.—OIL OF CEYLON CINNAMON is a pale-yellow or reddish liquid, becoming red-brown and thicker on exposure, finally separating crystals of cinnamic acid. It has a strong but agreeable cinnamon odor, and a sweet and at the same time hot, aromatic taste. Its specific gravity varies between 1.035 and 1.055, and increases by age. It remains clear at the freezing point of water, but at a still lower temperature separates a stearopten; it has no action on polarized light, or shows a slight left rotation, is readily soluble in alcohol, and has a neutral reaction on litmus paper when fresh, and an acid reaction when old. It dissolves iodine almost quietly, and soon forms a thick mass; fuming nitric acid imparts to it a carmine color without causing effervescence; boiling with nitroprusside of copper turns it red, then dark-brown; its alcoholic solution is somewhat darkened by ferric chloride.

OIL OF CASSIA (*Chinese cinnamon*) resembles the preceding oil very closely in all its properties, except that its color is more brownish, its odor less delicate, its taste less sweet, and its specific gravity greater, being usually 1.060 to 1.065; sometimes it is slightly dextrogyre.

Composition.—Both oils contain variable quantities of hydrocarbon, but consist chiefly of *cinnamic aldehyd*, C_9H_8O; and, when old, also resin and cinnamic acid, $C_9H_8O_2$. In its pure state, cinnamaldehyd is a colorless oil, heavier than water, combines with strong nitric acid in the cold, forming crystals, which are soluble in alcohol and ether, decomposed by water, and, when heated, yield oil of bitter almond and benzoic acid. Oxidizing agents generally, when acting upon cinnamaldehyd, generate the odor of bitter almonds, and finally produce benzoic acid; heated with solid potassium hydrate, potassium cinnamate is formed, hydrogen being given off; $C_9H_8O + KHO$ yields $C_9H_7KO_2 + H_2$. *Cinnamic acid* crystallizes in shining, colorless prisms, which are inodorous, dissolve freely in alcohol, ether, and boiling water, fuse at about 130° C. (266° F.), boil and volatilize without decomposition at about 295° C. (563° F.), and it is oxidized by chlorinated lime and hot dilute nitric acid to oil of bitter almond and benzoic acid.

Adulterations.—Oil of cinnamon is sometimes mixed with oil of cassia, which is best detected by the difference in their physical properties pointed out above. An adulteration with oil of cloves cannot be detected by the odor, except on heating, when acrid vapors will be given off. The behavior to ferric chloride and cold fuming nitric acid, afford additional means for detection.

Off. Prep.—Aqua cinnamomi, Spiritus cinnamomi, *U. S.*

Medical Action and Uses.—Excessive doses of this oil given to rabbits produce violent action of the heart, hurried respiration, distress, evacuation of solid feces, insensibility, slow and labored respiration, cold extremities, and death. The gastro-intestinal mucous membrane is not inflamed. The oil is much employed to give an agreeable flavor to medicinal compounds, and render them acceptable to the stomach. If the virtues attributed to cinnamon (see Cinnamomum) in uterine hemorrhage are real, they would probably be displayed more efficiently by the oil than by any other preparation of the medicine.

OLEUM COCOIS, *P. G.*—COCOANUT OIL.

Cocoanut butter, E.; *Beurre de coco*, Fr.; *Kokosnussöl*, G.

From Cocos nucifera, *Lin.* *Nat. Ord.*—Palmæ.

Origin.—The cocoanut tree is now met with in all tropical countries. It grows to a height of 70 or 80 feet, and has at the apex a tuft of leaves, which are 12 feet and more long, and have numerous narrow rigid and long leaflets. The yellowish-white flowers produce the well-known cocoanuts, which in their unripe state contain a sweetish liquid. The seeds contain much fixed oil, which is obtained by hot pressure or on being boiled in water. Nearly 267,000 gallons of cocoanut oil were imported into the United States in the year 1876–1877.

Properties.—Cocoanut oil is of a butyraceous consistence, white, and has a peculiar disagreeable odor, which is also observed in the soap prepared with it. It fuses at about 23° C. (73.4° F.) to a thin transparent oil, congeals again near 18° C. (64.4° F.), and on exposure to the air becomes rancid.

Composition.—By cold pressure it may be separated into a liquid and solid portion, both of which are glycerides. According to Görgey and Oudemans, the acids contained in cocoanut oil are palmitic and myristic, but principally lauric acid, together with caprinic, caprylic, and capronic acids.

Medical Action and Uses.—Cocoanut oil has been tried as a substitute for cod-liver oil, but, like other succedanea for that oil, was found inefficient. It was given in tablespoonful doses. It is chiefly valuable for its economical and pharmaceutical uses.

OLEUM COPAIBÆ, *U. S.*, *Br.*—OIL OF COPAIBA.

Oleum balsami copaivæ.—Essence de copahu, Fr; *Copaibaöl*, G.

Preparation.—The oil is obtained by distilling copaiba with water, a metallic still being preferable to a glass retort; a considerable quantity of water, or preferably steam should be used, or the distilled water returned to the still, until all the oil has been obtained. All that is consumed in the United States is prepared here from Para copaiba, which yields 50 to 60 per cent., or even more.

Properties.—Oil of copaiba is limpid, colorless, or pale yellowish, and on exposure becomes slowly thicker and yellow. It has the odor of copaiba, a pungent bitterish taste, neutral reaction to test-paper, spec. grav. .88 to .91, and boils at about 250° C. (482° F.). It dissolves in about 40 parts of alcohol spec. grav. .85, mixes with iodine without violent reaction, and yields with hydrochloric acid gas a liquid and a crystallizable compound. It deviates polarized light to the left.

Composition.—The oil has the composition of oil of turpentine, $C_{10}H_{16}$, and consists of several isomeric modifications.

Adulterations.—The addition of oil of turpentine is detected by the odor, and by the more violent reaction with iodine.

Medical Action and Uses.—Oil of copaiba is poisonous to rabbits in doses of an ounce or more. The symptoms produced by it are hurried breathing, palpitation, restlessness, frequent micturition, diarrhœa with mucous or bloody stools, and death by asthenia. After death a partial destruction of the gastro-intestinal epithelium is the only lesion observed. Upon the human skin it acts very feebly as an irritant. When taken internally it is excreted by the urine, which then furnishes a precipitate with nitric or muriatic acid. It is very doubtful whether this oil has any efficient control over *gonorrhœa*, the disease for which copaiba itself is chiefly employed. It probably is more useful in chronic pulmonary catarrh, or *chronic bronchitis*, since it is apparently through the lungs that the odorous constituent of all oleoresins is eliminated. But clinical evidence upon this point is wanting, unless, indeed, the negative proof afforded by the silence of all competent authorities be accepted as sufficient. The *dose* of the oil is from ten to fifteen drops.

OLEUM CORIANDRI, *Br.*—OIL OF CORIANDER.

Essence de coriandre, Fr.; *Korianderöl*, G.

Preparation.—The volatile oil is obtained from the bruised fruit of Coriandrum sativum, *Lin.*, by distilling it with water. The yield is about ½ per cent.

Properties.—It is colorless or pale yellow, has a mild and agreeable aromatic odor and taste, a spec. grav. of .86 to .87, commences to boil at about 150° C. (302° F.), and dissolves readily in alcohol. Iodine and fuming nitric acid act energetically upon it, the latter producing a greenish resin.

Composition.—The oil has the composition $C_{10}H_{18}O$, and is isomeric with borneol. From Kawalier's investigations (1852), it appears sometimes to contain also a hydrocarbon, $C_{10}H_{16}$.

Adulteration.—Leonhardi (1878) mentions oil of orange, which is detected by its insolubility in an equal bulk of 85 per cent. alcohol.

Off. Prep.—Syrupus sennæ, *Br.*

Medical Action and Uses.—Like oil of anise, fennel, etc., this oil is aromatic and carminative, and is used in flatulent *colic*, to relieve the pain of *rheumatism*, *neuralgia*, etc., and to mitigate the griping operation of certain purgatives. It corrects the odor and taste of fluid extract of senna better than any other aromatic. *Dose*, one to five drops.

OLEUM CUBEBÆ, *U. S.*, *Br.*—OIL OF CUBEB.

Oleum cubebarum.—*Oil of cubebs*, E.; *Essence de cubèbes*, Fr.; *Kubebenöl*, G.

Preparation.—The volatile oil is obtained from the bruised fruit of Cubeba officinalis, *Miq.*, by distilling it with water, repeated cohobation being necessary. The yield is about 10 per cent, but varies considerably with the quality of the fruit. It is distilled in the United States, little being imported; in 1867, 558 pounds, none in 1876, and only 5 pounds in 1877.

Properties.—Oil of cubebs has a greenish or yellowish tint, but after rectification is colorless, and, on exposure, becomes thick like olive oil. It has the odor of cubebs, a warm, camphoraceous, aromatic taste; spec. grav. .92; a neutral reaction; boils at about 250° C. (482° F.); dissolves in 25 parts of alcohol, and turns polarized light to the left. Iodine dissolves in the oil quietly, but evolves some vapors; concentrated sulphuric acid colors it yellow, and, on warming, red.

Composition.—Oil of cubebs consists chiefly of *cubebene* $C_{10}H_{16}$, or perhaps $C_{30}H_{48}$, and in the cold sometimes separates crystals of *cubeb camphor*, which is a hydrate of the former, of the formula $C_{30}H_{48}.2H_2O$, and fuses below 70° C. (158° F.).

Medical Action and Uses.—In the dose of an ounce oil of cubeb produces symptoms in rabbits almost identical with those of oil of copaiba, but more strongly marked. In man it causes, occasionally, an eruption, as copaiba does. It displays no curative virtues in gonorrhœa. The *dose* is from ten to fifteen drops or more.

OLEUM ERIGERONTIS CANADENSIS, *U. S.*—OIL OF CANADA ERIGERON.

Preparation.—The volatile oil is obtained in the United States from the fresh flowering herb of Erigeron canadense, *Lin.*, by distilling it with water.

Properties.—Oil of erigeron is a limpid, pale-yellow liquid, of a peculiar aromatic, persistent odor, somewhat like that of hemlock (Abies canadensis), and of an aromatic, not very pungent taste. It has the spec. grav. .845, and commences to boil at about 155° C. (311° F.) It dissolves iodine without explosion, is gradually colored reddish by potassa, and slowly acted on in the cold by fuming nitric acid. The oil becomes thick and reddish-brown by age, and is not very freely soluble in 80 per cent. alcohol.

Composition.—Nothing is known of its constituents, except that it contains oxygen, as ascertained by Procter (1854).

Medical Action and Uses.—This oil has had a certain reputation for controlling uterine hemorrhage, and the plant from which it is derived was held by the aborigines to quicken *uterine contractions.* The evidence respecting its virtues is conflicting, and seems, on the whole, not adapted to inspire much confidence. Like other nervo-vascular stimulants it is said to have been useful in the *typhoid state.* The *dose* is from five to ten drops.

OLEUM FŒNICULI, *U. S.*—OIL OF FENNEL.

Essence de fenouil, Fr.; *Fenchelöl*, G.

Preparation.—The volatile oil is obtained from bruised fennel by distilling it with water, or preferably, by means of superheated steam. The yield is about 3½ or 4 per cent. The oil used in the United States is chiefly procured from Germany and France.

Properties.—Oil of fennel is colorless or yellowish, has a neutral reaction, an agreeable odor, a sweetish, aromatic taste (*oil of sweet fennel*), and is of the spec. grav. .96 to .99; it congeals below 10° C. (50° F.), sometimes not until cooled below the freezing point of water, and Zeller obtained an oil which remained liquid at —20° C. (—4° F.). Boiled with nitroprusside of copper, it turns yellowish-brown or red-brown; on the addition of iodine it becomes thick like an extract, or even brittle. It is soluble in 1 or 2 parts of alcohol, and turns the ray of polarized light to the right.

Composition.—The difference in the physical properties is due to the variable proportion of liquid and solid *anethol* contained in it (see Ol. anisi, page 962). The oil also contains a hydrocarbon, isomeric with oil of turpentine.

Off. Prep.—Aqua fœniculi, Spiritus juniperi comp., *U. S.*

Medical Action and Uses.—The action of fennel oil when given to animals in large doses appears to be identical with that of oil of anise. Its medicinal operation closely resembles that of the same oil. It is used in *flatulent* disorders and to qualify the action of harsh purgatives, and is sometimes employed as a *galactagogue*, and as an *emmenagogue.* The *dose* is from five to ten drops.

OLEUM GAULTHERIÆ, *U. S.*—OIL OF GAULTHERIA.

Oil of wintergreen, E.

Preparation.—This volatile oil is obtained from Gaultheria procumbens, *Lin.*, the whole plant being usually employed. The chief supply is derived from New Jersey, but some is also prepared in Pennsylvania and other States.

Properties.—Oil of gaultheria is usually of a reddish color, but may be obtained colorless by rectification. It has a strong and agreeable aromatic odor and a sweetish warm aromatic taste, and begins to boil a little above 200° C. (392° F.). It is the heaviest of the volatile oils, its density being 1.17 to 1.18. It is slightly dextrogyre, and dissolves readily in alcohol, and but to a small degree in water; the solutions acquire a dark purple color on the addition of ferric chloride. The pure oil is not colored on the addition of strong nitric acid, but soon congeals into colorless crystals of a nitro-compound. A solid crystalline mass is also obtained on agitating the oil with concentrated solution of potassa or soda.

Composition.—Procter (1842) recognized the presence in this oil of salicylic acid. Cahours subsequently (1843) proved it to consist to the amount of about 90 per cent. of *methylsalicylic acid* or *methylsalicylic ether*, $CH_3.C_7H_5O_3$, which with some other salicylic ethers is now also artifically prepared for use in the arts. In its pure state it is a colorless oil, has the spec. grav. 1.18, boils at 222° C. (431.6° F.), and forms crystalline compounds with the alkalies. The remaining constituent of oil of wintergreen is *gaultherilene*, a colorless thin hydrocarbon, of the formula $C_{10}H_{16}$, boiling at 160° C. (320° F.), and having an agreeable somewhat pepper-like odor. Volatile oils of similar composition have been obtained from Gaultheria hispidula, Polygala pauciflora, Monotropa hypopitys, and the bark of Betula lenta.

Adulterations.—The great density of this volatile oil prevents its adulteration with most cheaper ones, which would reduce its specific gravity. A mixture of alcohol and chloroform has been employed for the purpose, but is readily detected by the low boiling point and the character of the first fractional distillate. The most common adulterant is oil of sassafras, which is colored dark red and converted into a brown-red resinous mass by strong nitric acid. The pure oil yields nearly colorless crystals of *methylnitrosalicylic acid*.

Off. Prep.—Syrup. sarsapar. comp., Trochisci morphiæ et ipecacuanhæ, *U. S.*

Medical Action and Uses.—Its action in large doses closely resembles that of the other aromatic essential oils. In the case of a boy nine years old half an ounce of it occasioned vomiting, purging, epigastric pain, fever, labored and slow respiration, dulness of hearing, and an uncontrollable desire for food. It is sometimes used as a carminative, but most frequently to conceal the taste of nauseous medicines. It assists in flavoring the compound syrup of sarsaparilla.

OLEUM HEDEOMÆ, *U. S.*—OIL OF HEDEOMA.

Oil of pennyroyal, E.

Preparation.—This volatile oil is prepared in New Jersey and other parts of the United States by distilling the fresh herb of Hedeoma pulegioides, *Lin.*, with water.

Properties.—It is a limpid, colorless, or yellowish volatile oil, of a peculiar pungent mintlike odor and taste, and has a specific gravity of .94 to .95. It is readily soluble in alcohol, and dissolves iodine with a brisk explosive reaction, yielding a viscous liquid.

Composition.—Oil of pennyroyal contains oxygen, but its exact composition has not been ascertained.

Medical Action and Uses.—It has essentially the same action and virtues as the associated volatile oils; that is to say, it is an aromatic stimulant, carminative, and emmenagogue under fit conditions, and is added to embrocations to increase their anodyne and rubefacient action. The *dose* is from two to ten drops.

OLEUM JUNIPERI, *U. S.*, *Br.*—OIL OF JUNIPER.

Oleum fructus (vel baccæ) juniperi.—Oil of juniper berries, E.; *Essence de genièvre*, Fr.; *Wachholderbeeröl*, G.

Preparation.—Ripe or nearly ripe juniper berries are well bruised, mixed with table salt and water, and distilled either over the naked fire, or by the aid of steam. The yield is usually half to three-quarters per cent., and sometimes exceeds one per cent. Between 5000 and 6000 pounds are annually imported from Europe into the United States.

Properties.—Oil of juniper berries is colorless, or pale greenish yellow, limpid, but on exposure rapidly thickens, and turns yellow and reddish-brown. Its specific gravity varies between .85 and .90; it begins to boil at 155° C. (311° F.), or if obtained from ripe berries at 205° C. (401° F.) (*Blanchet*), has the peculiar odor of the berries, and a warm aromatic, somewhat terebinthinate taste, turns polarized light slightly to the left, is slightly soluble in 80 per cent. alcohol, and shows a neutral reaction to test-paper. Iodine acts energetically upon the limpid oil, sometimes producing fulmination; sulphuric acid colors it brown and red. Old oil of juniper contains formic acid, from which it may be freed by sodium carbonate and rectification.

Composition.—The oil is a mixture of hydrocarbons of the general formula $C_{10}H_{16}$, which differ in their boiling point (see above), a portion boiling at 282° C. (539.6° F.), (*Soubeiran and Capitaine*). It yields with hydrochloric acid gas a liquid compound.

Adulteration.—The similarity of oil of juniper and oil of turpentine in specific gravity, boiling point, and behavior to solvents and reagents, renders the detection of an adulteration with the latter rather difficult, except by the formation of a solid compound with hydrochloric acid gas and by its different odor, particularly after exposure.

The *oil of juniper wood*, obtained by distillation with water, has a different odor, and is at first limpid and colorless, but on exposure becomes thick, yellow, and finally dark brown.

Oleum juniperi empyreumaticum, P. G., s. *Oleum cadinum; Oil of cade*, E.; *Huile de cade*, Fr.; *Kadeöl*, G., is an empyreumatic, dark-brown, tarlike liquid obtained from the wood of Juniperus oxycedrus, *Lin.* The empyreumatic oil of common juniper wood is said to be frequently sold in its place.

Off. Prep.—Spiritus juniperi, *U. S.*, *Br.;* Spiritus juniperi comp., *U. S.*

Medical Action and Uses.—Oil of juniper is stomachic, carminative, and diuretic. In large doses it occasions in animals the same effects upon the nervous and vascular systems as other essential oils, with the addition of diuresis. The last-mentioned operation is evident in man as an effect of medicinal doses. It reddens and may even blister the skin. It is an efficient ingredient of diuretic infusions and mixtures, is much used to promote urination, in the form of Holland gin, and when inhaled from an atomized solution its diuretic virtues are sometimes promptly and distinctly manifested. The *dose* is from five to fifteen drops.

OLEUM LAVANDULÆ, *U. S.*, *Br.*—OIL OF LAVENDER.

Essence de lavande, Fr.; *Lavendelöl*, G.

Preparation.—Oil of lavender is distilled in Great Britain and France from the flowers alone, or from the flowering tops or the entire plant of Lavandula vera, *D. C.*, steam heat being usually resorted to. The flowers yield about one and a half per cent. of the oil; the quantity however varies, and seems to increase in plants grown in southern localities. Stem and leaves yield a small portion of less fragrant oil. Between 30,000 and 35,000 pounds are annually imported into the United States.

Properties.—The oil is very limpid, colorless, yellowish, or greenish yellow and neutral, and acquires by age an acid reaction and viscid consistence. Its specific gravity varies between .87 and .91; it commences to boil at about 185° C. (365° F.), dissolves in its own weight of alcohol, specific gravity .835 to .850, has a lævogyre action, reacts briskly and with some detonation on the addition of iodine, and acquires a brown color when agitated with corrosive sublimate. Exposed to a low temperature it separates stearopten. Its fragrance varies with the part of the plant used for distillation; its taste is bitterish and pungent. The better quality is known in commerce as *oil of garden lavender*.

Composition.—The most volatile portion is a hydrocarbon of the formula $C_{10}H_{16}$. The stearopten is stated by Dumas to be identical with camphor.

Adulteration.—The admixture of oil of turpentine is detected by the decreased solubility in alcohol. Oil of spike lavender has a deeper green-yellow color, and a more terebinthinate camphoraceous odor, but agrees with oil of lavender in solubility.

Off. Prep.—Liniment. camphoræ comp., *Br.;* Spiritus ammoniæ aromat., *U. S.;* Spiritus lavandulæ, Spiritus (Tinctura) lavandulæ comp., *U. S.*, *Br.*

Medical Action and Uses.—This preparation is very seldom used alone, although it may be employed to calm *nervous headache*, by rubbing a few drops of it upon the temples, or by its internal use in the dose of four or five drops. Its carminative and general stimulant operation is usually obtained through the simple and compound spirit of lavender.

OLEUM LIMONIS, *U. S.*, *Br.*—OIL OF LEMON.

Oleum citri, P. G.; *Oleum de cedro.*—*Essence de citron*, Fr.; *Citronenöl*, G.

Preparation.—The volatile oil is obtained from the fresh rind of the lemon by squeezing it upon a sponge, and expressing the latter when saturated; or the oil-cells are ruptured by a process of superficial grating, the oil being drained off. An oil of inferior fragrance is obtained by grating the outer rind completely off and distilling the magma with water. Oil of lemon is manufactured in Southern France and Italy. In 1867, 34,227 pounds of oil of lemon and orange were imported by the United States, against 67,585 pounds in 1877.

Properties.—Oil of lemon has a pale yellow color, is limpid, neutral, of a very agreeable fragrance, and mild, aromatic, bitterish taste. As received in commerce, it is usually turbid, but becomes clear on standing; by age, it acquires a thicker consistence and a pungent terebinthinate odor and taste, which change is prevented or retarded by the addition of 3 or 4 per cent. of alcohol and decantation of the clear oil from the sediment. Its specific gravity is about .852; it commences to boil at about 160° C. (320° F.), rotates polarized light to the right, produces a brisk fulmination with iodine, yields with Frœhde's reagent a deep orange-brown color (Dragendorff, 1876), and by hydrochloric acid gas is converted into a liquid and a solid compound, which, distilled over lime, yield again colorless oils, the former *citrylene*, the latter *citrene* (or *citronyl*) having a lemon-like odor. Oil of lemon yields with 7 parts of alcohol, specific gravity .830, a turbid solution.

Composition.—Aside from a small quantity of an oxygenated compound, oil of lemon consists of two hydrocarbons having the general formula $C_{10}H_{16}$.

Adulterations with the volatile oils of other fruits of the genus Citrus are very difficult to detect; odor and taste must be chiefly relied on.

Off. Prep.—Linimentum potassii iodidi cum sapone, *Br.;* Spiritus ammoniæ aromat., *U. S.*, *Br.;* Syrupus acidi citrici, *U. S.*

Medical Uses.—Oil of lemons is used almost exclusively as a flavoring agent and as a perfume.

OLEUM LINI, *U. S.*, *Br.*—FLAXSEED OIL.

Linseed oil, E.; *Huile de lin*, Fr.; *Leinöl*, *Leinsamenöl*, G.

Preparation.—This oil is made on the large scale by thoroughly drying the seed with the aid of heat, crushing, and forcibly expressing it. The yield by cold pressure is 10 to 20 per cent., by hot pressure 25 to 28 per cent. It is largely manufactured in this country; in 1867, over 3,200,000 gallons were imported into the United States, but the quantity decreased to 963 gallons in 1877. The importation of flaxseed amounted, in the former year, to 1,769,192 bushels, and in the latter to nearly 85,000,000 pounds.

Properties.—Expressed in the cold, linseed oil is limpid, neutral to test-paper, yellowish, and of a bland, not unpleasant taste. As usually met with, it is somewhat thicker, brownish, has more odor, and a somewhat acrid taste. Its specific gravity is usually .934, but may vary between .928 and .953. It does not solidify at —10° C. (+14° F.), imparts a yellow color to alcohol on being agitated with it, and yields with alkalies a very soft soap. In contact with fuming nitric acid it ignites, but when agitated with nitric acid, specific gravity 1.33, it turns green, and afterwards brown. Exposed to air, it gradually solidifies, and in the crude state, when mixed with mucilaginous matters, it quickly turns rancid and acquires an acid reaction; to obviate this change, the seed before expression is completely deprived of water.

Composition.—According to Mulder (1865), linseed oil is a mixture of about 80 per cent. of *linolein*, with palmitin, myristin, and some elain, all being glycerides. *Linoleic acid* has the formula $C_{16}H_{28}O_4$, and is a colorless acid liquid, readily soluble in alcohol and ether, and on exposure to air is converted into the hydrate of *oxylinoleic acid*, which, in its pure state, is colorless and has the composition $C_{16}H_{26}O_5$, and on continued exposure, more rapidly if frequently moistened with ether, is transformed into *linoxyn*, $C_{32}H_{54}O_{11}$. This latter compound is insoluble in ether, and is produced in a few days on the exposure of boiled linseed oil.

OLEUM LINI SULPHURATUM, *P. G.*, s. *Balsamum sulphuris.*—Six parts of Linseed Oil are intimately mixed in an iron vessel with one part of Sublimed Sulphur, and the mixture boiled over a slow fire in an iron vessel with constant stirring, until the whole has united into a homogeneous mass. *P. G.* The mixture has about the consistence of a thick syrup, and is of a dark red-brown color.

Off. Prep.—Ceratum resinæ comp., Linim. calcis, *U. S.*

Medical Uses.—Flaxseed oil is laxative in the *dose* of one or two ounces. It has been recommended to be given in this manner as a remedy for *hemorrhoids*. Only cold-pressed oil should be used internally. Its most important application is to the treatment of *burns*, when mixed with an equal quantity of lime-water. The same mixture (Linimentum calcis) is also applied with advantage in *impetigo*.

OLEUM MENTHÆ PIPERITÆ, *U. S.*, *Br.*—OIL OF PEPPERMINT.

Essence de menthe poivrée, Fr.; *Pfefferminzöl*, G.

Preparation.—The volatile oil is obtained from the fresh herb of Mentha piperita, *Lin.*, by distilling it with water. For medicinal purposes an oil is preferable which has been rectified by steam distillation. It is largely produced in Michigan, New York, and other States of the Union, and to some extent is exported to Europe, while, on the other hand, some European rectified oil of peppermint is imported into the United States. In Great Britain the yield is stated to be from 8 to 12 pounds of oil per acre (Pharmacographia); in the United States it is said to be sometimes as high as 20 pounds (Stearns, 1858).

Properties.—Oil of peppermint is a colorless, or more frequently yellowish or greenish liquid, which, on exposure, becomes brownish and viscid. Its specific gravity is usually near .90, but varies between .84 and .94. It commences to boil near 190° C. (374° F.), and, at a low temperature, sometimes deposits crystals of menthol. It has a peculiar pungent odor, and a hot, somewhat camphoraceous, and, when old, also bitterish taste, followed by a sensation of cold. It dissolves clear in from 1 to 3 parts of 80 per cent. alcohol, the solution usually becoming opalescent with more alcohol, and depositing slowly a minute white precipitate. It is neutral to test-paper when fresh, and turns polarized light to the left. In its action towards reagents it shows very considerable differences. Jehn (1873) observed that chloral hydrate produces with this oil a rose and cherry-red color; and Dragendorff (1875) proved that this reaction is occasioned by some unknown constituent of impure chloral hydrate, and becomes less distinct the purer the reagent is. Strong nitric acid colors it purplish to brown; but when from 50 to 70 drops of the oil are mixed with 1 drop of nitric acid, specific gravity 1.2, the mixture is gradually changed from yellowish to brownish, and finally to a permanent violet, blue, or greenish-blue when viewed in transmitted light, while in reflected light the mixture is of a red-copper color and opaque; the reaction, which is not prevented by oil of turpentine, may be hastened by warming the mixture or by decreasing the oil (Flückiger, 1871). Picric acid dissolves in oil of peppermint, with a yellow color, gradually, or, when slightly heated, more rapidly, changing to green; in presence of water and air a reddish-yellow is afterwards produced (Frebault, 1874). Iodine does not act energetically with the oil, but dissolves and renders it thicker. With ethereal or chloroformic solution of bromine a rose-red or violet color is produced, changing gradually to a dirty-pink or purplish color. In consequence of insufficient weeding of the mint fields, American oil of peppermint is not unfrequently mixed with oil of erigeron (see page 972), acquires a rank "weedy" smell, and seems to be disposed to resinify more rapidly.

Composition.—Oil of peppermint owes its peculiar odor to *menthol* (mint camphor, mint stearopten), $C_{10}H_{20}O$, which is chiefly contained in the last portions obtained on subjecting the oil to fractional distillation. It forms colorless prisms which fuse at about 35° C. (95° F.), and boil near 210° C. (410° F.). Distilled with phosphoric anhydrid it yields *menthene*, $C_{10}H_{18}$, which is a colorless liquid of an agreeable odor.

Adulterations.—Besides oil of erigeron, alcohol, castor oil, and oil of turpentine have been employed for the purpose; the presence of the last two bodies renders the oil not readily soluble in 80 per cent. alcohol, and the last one mentioned causes it to be acted on with more violence by iodine. Menthol is sometimes met with in commerce as *Chinese oil of peppermint*, and is obtained in China from a variety of either *M. piperita* or *M. arvensis;* on one occasion it was largely adulterated with magnesium sulphate.

Off. Prep.—Aqua menthæ piperitæ, *U. S.;* Essentia menthæ piper., *Br.;* Pilul. rhei comp., Spiritus menthæ piper., *U. S.*, *Br.;* Trochisci menthæ piper., *U. S.*

Medical Action and Uses.—Elsewhere (see Mentha piperita) are described the carminative and anodyne virtues of peppermint, which belong to all its preparations, and especially to its essence (*Spiritus menthæ piperitæ*), which is merely an alcoholic solution of the oil of peppermint. The latter appears to possess in a remarkable degree the analgesic properties of its class. Anciently, peppermint was employed by the Romans as an application to the temples for the relief of headache; and within a few years it became known that the oil was used by the Chinese for a similar purpose. In imitation of their practice, it has been a good deal employed as a local anodyne in *neuralgic headache*, applied over the supraorbital, the temporal, or other nerve in which the pain is most severe. A small wad of compressed cotton saturated with the oil should be laid upon the painful spot, covered with a piece of sheet caoutchouc, and bound firmly in its place. Merely painting the skin with the oil by means of a brush or a tuft of cotton will sometimes answer the purpose. In local *rheumatic* affections the latter method is often very efficient. In *dental caries* this oil is quite as efficient in relieving pain as oil of cloves, and more permanent in its effects than chloroform. For internal use, oil of peppermint may be prescribed in *doses* of from one to three drops; but the officinal *spirit* is to be preferred.

OLEUM MENTHÆ VIRIDIS, *U. S.*, *Br.*—OIL OF SPEARMINT.

Essence de menthe verte, Fr.; *Römisch-Minzöl*, G.

Preparation.—This volatile oil is distilled in the United States and Great Britain from fresh spearmint; the yield is about $\frac{1}{4}$ to $\frac{1}{2}$ per cent.

Properties.—It resembles oil of peppermint in color, specific gravity, changes produced by exposure, and behavior to iodine and to polarized light; but differs from it in odor and the slight cooling taste. We have noticed that fresh oil of spearmint usually dissolves clear in all proportions, while old oil yields a turbid solution with more than 3 parts of 80 per cent. alcohol. Its boiling point, according to Kane, is 160° C. (320° F.).

Composition.—Gladstone (1863) separated from the oil a hydrocarbon, $C_{10}H_{16}$, and an oxygenated oil, $C_{10}H_{14}O$, to which the odor is due, and which has the density .9515 and boils at 225° C. (437° F.).

Off. Prep.—Aqua menthæ viridis, *U. S.*, *Br.;* Spiritus menthæ viridis, *U. S.*

Medical Uses.—Oil of spearmint is less used than the oils of peppermint and horsemint. It appears to be less powerful than those oils, and may be prescribed in *doses* of from two to five drops diluted with sweetened water, or in the form of essence of spearmint.

OLEUM MONARDÆ, *U. S.*—OIL OF HORSEMINT.

Essence de menthe à cheval, Fr.; *Pferdeminzöl*, G.

Preparation.—This volatile oil is obtained in the United States from fresh horsemint by distillation with water or steam.

Properties.—It is a yellowish or usually of a reddish or brownish-red color, lighter than water, readily soluble in alcohol, crystallizing below 5° C. (39° F.), and of a peculiar fragrant odor, and pungent taste. Boiled with nitroprusside of copper it becomes colorless, greenish, brown, and finally nearly black. Iodine dissolves quietly, turning the oil bright red, afterwards blackish and pitchy.

Composition.—The elæopten is probably a hydrocarbon, but has not been further examined. The stearopten is *thymol*, $C_{10}H_{14}O$, identical with that obtained from oil of thyme, and from the oil of *Ptychotis ajowan;* it crystallizes in colorless tabular crystals, has a peculiar odor and pungent taste, is neutral to test-paper, and to polarized light, has the spec. grav. 1.028, fuses at or above 45° C. (113° F.), and boils near 230° C. (446° F.). It is soluble in 333 parts of water, and unites with soda to a crystalline compound, $C_{10}H_{13}NaO$; hence it is sometimes called *thymic acid.*

Medical Action and Uses.—The smallest drop of the oil of horsemint diffuses a pungent, aromatic, and persistent heat over the tongue and fauces, and when applied to the skin it excites redness, heat, and, if the application is continued, pain and vesication. It may be used for the same purposes as oil of peppermint, etc., but is more frequently employed with soap-liniment, or camphorated oil, as an embrocation to relieve the pain of *muscular rheumatism, chronic articular rheumatism,* and *neuralgia.* It is also employed in liniments in local *paralysis, flatulent colic, cholera infantum,* and even in *low forms of fever.* For these purposes one part of the oil to three or four of the excipient may be prescribed. In neuralgia it may be applied pure. Internally, the oil may be given in doses of two or three drops properly diluted with sweetened water.

OLEUM MORRHUÆ, *U. S.*, *Br.*—COD-LIVER OIL.

Oleum jecoris aselli, P. G.; *Oleum hepatis morrhuæ.*—*Cod oil*, E.; *Huile de morue, Huile de foie de morue*, Fr.; *Leberthran, Stockfischleberthran*, G.

Origin.—The fixed oil obtained from the liver of Gadus morrhua, and of other species of Gadus; *Class* Pisces; *Ord.* Teleostia; *Fam.* Gadida.

The *common cod*, formerly called *asellus major*, inhabits the Northern Atlantic, and is frequently met with on the North American coast on and near the banks of Newfoundland, where it seems the *hake, G. merluccius, pollack, G. pollachius*, and *haddock, G. æglifinus*, are likewise used to some extent for the same purpose. On the Norwegian coast, according to De Jongh (1843), cod-liver oil is mainly produced from the *dorse, G. callarias,* but also from the coalfish, *G. carbonarius*, and the *pollack.*

Preparation.—On the coast of Norway the carefully cleaned livers are placed in baskets or barrels, exposed to a sunny place, where the oil slowly exudes, and is removed and filtered; or the livers are slowly heated in a steam- or water-bath, or sometimes boiled with water, the oil being skimmed off from the surface (see *Proc. Amer. Phar. Assoc.*, 1876, p. 810). On the coast of North America cod-liver oil is now generally more carefully prepared. The introduction of ice as a means of preserving has developed the business of transporting codfish fresh to the inland cities during the catching season, from December to March; and likewise that of the proper preparation of cod-liver oil from fresh livers on shore by means of gradually applied steam-heat, whereby the oil is separated from the tissues, the watery portion subsiding, the oil being afterwards filtered and kept in dry vessels in a cool place (see *Amer. Journ. Phar.*, 1854, p. 1, and 1870, p. 214; *Proc. Amer. Phar. Assoc.*, 1875, p. 659.)

Properties.—The purest cod-liver oil is of a pale yellow color, and faint acid reaction; but if prepared at a high temperature, or if the livers are allowed to more or less putrefy, it has a more decided reaction and a pale or darker reddish-brown color, the darkest varieties being transparent only in thin layers, and having a repulsive fishy odor, and a bitterish acrid taste. The acridity and fishy smell are less marked in the light brown oil, and still less in the yellow or white oil, which is nearly bland. At 15° C. (59° F.) the spec. grav. of light cod-liver oil is .92 to .925, of the dark colored about .930. Cold alcohol dissolves not over 2.5 per cent. from the yellow, but about 6 per cent. from dark brown cod-liver oil. At a low temperature a granular crystalline deposit is separated, in largest proportion from the darker colored oil. On the addition of sulphuric acid a violet color soon changing to brown-red is produced, due to the presence of biliary compounds; nitric acid colors it purple, afterwards violet and brown.

Composition.—Cod-liver oil has been repeatedly analyzed, and found to be a mixture of several glycerides, the principal one being olein, with variable quantities of stearin and palmitin increasing with the darker color. Hopfer de l'Orme (1837) first proved the presence of iodine, which, according to L. Gmelin (1840), was supposed to be in combination with potassium; however, hot and cold water and alcohol fail to extract it, and the precise form in which iodine is present is still unknown. The same may be said of bromine, phosphorus and sulphur. Chevallier, Donovan, Herberger, Marder, and others did not find iodine in all samples of cod-liver oil; De Jongh determined its amount to vary between .029 in dark, and .040 per cent. in light brown oil; some investigators have found it in the ashes of soap prepared from it, others in the mother-liquor after separating the soap. Winckler's (1852) statement that glycerin could not be obtained from cod-liver oil, which he regarded as an organic whole, containing oxide of propyle, has not been corroborated by other investigators. De Jongh regards the acid reaction of cod-liver oil as being due to butyric and acetic acids, and has recognized the presence in it of several biliary acids and coloring principles, besides *gaduin*, $C_{35}H_{46}O_9$, which is dissolved from the lead soap by ether, and separated with oleic acid by sulphuric acid. By combining with soda, dissolving in alcohol of 30° B., and cooling to the freezing point of water, the soap is deposited, and gaduin may be obtained on the addition of sulphuric acid; it is dark brown, brittle, inodorous, tasteless, soluble with a red color in sulphuric acid, and reprecipitated by water. It is probably a derivative of bile. *Gadic acid* is the name given by Luck (1857) to a deposit obtained from a light brown cod-liver oil; recrystallized from hot alcohol it fused between 63° and 64° C. (145.4° and 147.2° F.).

Adulterations are very difficult to detect, because the colors mentioned above are but slightly modified by the presence of other oils, and the oils obtained from the livers of some other fishes show similar reactions. Some fish oils, however, are but slightly colored by sulphuric acid; others do not become violet at first, but at once turn brown-red or dark brown. Such substitutions may be detected by this test. An adulteration with resin, noticed by Böttger in 1858, may be detected by the solubility of the adulterant in alcohol. In other respects the physical properties, as detailed above, still afford the best criterion of the purity and quality of cod-liver oil.

In France the liver oil of the ray or *common skate* (raie, *Fr.*, Rochen, *G.*), *Raja batis*, Lin., and in Australia *dugong oil*, an oil produced from the fleshy part of *Halicore dugong*, Cuvier, a fish inhabiting the waters of Eastern Australia and the Indian Archipelago, have been used in place of cod-liver oil.

OLEUM MORRHUÆ FERRATUM has been recommended for some years. Bernbeck (1875) published a process of which the following is an outline: A solution of one part of well-dried neutral olive-oil soap in twenty parts of hot water is precipitated by the gradual addition of a similar solution of one part of ferrous sulphate; the precipitated iron soap is rapidly collected on muslin, washed and expressed to remove the water. This cake, though oxidizing superficially, will internally retain its whitish color for a long time. Four parts of this soap are melted and ninety-six parts of previously warmed cod-liver oil are added, and the heat continued for half an hour or more. This oil is of a dark brown color, and contains 1 per cent. of metallic iron, mostly as ferrous oleate.

EXTRACT OF COD-LIVER is the watery liquid obtained from the livers in preparing the oil, and evaporated; it yields 12½ to 15 per cent. of extract, which is said to consist of biliary constituents 60.6, water 21.8, the remainder being various salts. It was at one time (1866) recommended as a substitute for cod-liver oil.

Physiological Action.—When healthy animals eat a certain quantity of cod-liver oil mixed with their ordinary food, it appears to promote their fattening if a moderate proportion is not exceeded. When more is given them the digestion becomes deranged, and their fat acquires a yellow color and a fishy taste. When the oil is rubbed into the shaven skin of dogs the animals appear to be in as good condition as those which had taken the oil internally, and the same evidences of its absorption are found in the bile and in the richness of the chyle in non-nucleated corpuscles. The fattening operation of the oil in man is familiar to every one; in connection with it the blood becomes richer in corpuscular elements, especially of red corpuscles, thereby, in certain cases, producing a morbid excess of nutritive action which sometimes exhibits itself in hemorrhage, and sometimes in local congestions. When it is given in suitable doses and in appropriate cases, it improves the appetite and digestion; but if taken in excess of the powers of assimilation, and too long continued, it impairs the appetite, renders the tongue foul, excites heartburn, rancid eructations, and even vomiting and diarrhœa, while itching of the skin and a papular eruption are produced, and the perspiration exhales a fishy smell.

Cod-liver oil is essentially a fat-producing agent, and thereby it retards that waste of nitrogenous tissues which is a charateristic of the diseases in which it is most serviceable. In this connection it should be borne in mind that among the various agents vaunted from time to time as remedies for consumption, the most efficient have been oils and fats, *e. g.*, asses' milk, cream, butter, fat pork, buffalo marrow, etc. But cod-liver oil has the advantage over all of these articles that it excels them in digestibility. On what the latter quality depends is not fully determined, but the most plausible opinion is that it is due to the portion of biliary matter which the oil holds in solution. It has been shown experimentally that different oils vary extremely in their diffusibility through membranes, and that cod-liver oil possesses six or eight times more of it than other oils, vegetable or animal. Such appears to be the simple fact, but the explanation of it is not easy. It has been ascribed to the presence in the oil of a certain proportion of bile, and it is asserted that when this bile is removed the oil loses its diffusibility in the same proportion. But on the other hand it is alleged that the process employed to remove the bile does not really do so, but eliminates certain other constituents of the oil. However this may be, no more satisfactory theory has been proposed than that which assigns the peculiar digestibility of the oil to the presence in it of biliary matter. And this view is corroborated by the experiment in which an animal with a biliary fistula became more and more emaciated as long as it used only its ordinary food, but regained flesh and strength when a due proportion of cod-liver oil was added.

Medical Uses.—From time immemorial cod-liver oil was used as a popular remedy for chronic gout and rheumatism, rickets, and scrofula, in Great Britain and the countries bordering on the German Ocean, but it was not until about 1841 that it became generally known and used as a remedy for pulmonary consumption. The enthusiasm which inevitably attends the introduction of a new medicine of real efficacy, exaggerated the benefits conferred by cod-liver oil in these several diseases, but time and well-considered experience have nevertheless proved it to be a valuable remedy. Its curative powers in *chronic rheumatism* have been strikingly shown in cases of that disease prolonged by a cachectic state of the system, cases in which the muscles grow rigid, and the joints stiff, and when to the debilitating influence of these infirmities is added the operation of dampness, crowding, bad ventilation, and coarse and insufficient food, especially in persons of an originally scrofulous constitution. In regard to *scrofula* itself, the medicine is singularly efficacious when the disease affects the internal lymphatic glands and the bones, and under the bad hygienic conditions enumerated above. Yet it is by no means to be depended upon in cases of supposed mesenteric disease; not only because the enlargement of the abdomen which is thought to indicate its existence in children, is commonly a result of splenic or hepatic disorder, but, still more, because true *tabes mesenterica* is most apt to be associated with incurable tuberculosis of the intestines. It is of little use in scrofulous enlargement of the parotid, thyroid, and submaxillary glands, or of the glands of the neck, axillæ, and groins; but its efficacy is seen in the cure of the ulcers left after the discharge of softened scrofulous matter from these parts. Its utility in *scrofulous ophthalmia* is far from being established. At least one-half of the cases receive no benefit from it. It is a more valuable remedy in all forms of idiopathic *strumous caries*, especially when it affects the epiphyses of the long bones; and is still more evidently beneficial in *rachitis*. In the treatment of *white swelling* and other forms of *chronic arthritis*, and of *fistulæ* and *abscesses* in the neighborhood of joints, its powers are sometimes signally displayed. The various diseases of the skin to which scrofulous persons are peculiarly liable are often most favorably influenced by this medicine. Among these *lupus vulgaris* is reputed to have been cured by it more frequently than by any other internal remedy; while some high authorities declare that no cure of existing lupus ever results directly from any kind of internal treatment whatever. It is true, also, that even when given for this disease it is generally associated with other and active medicines. In other scrofulous diseases of the skin, and especially of the scalp, this oil appears to have been used with success both internally and topically. Such diseases are *impetigo*, *chronic eczema*, *psoriasis*, and *favus*. Even *ichthyosis* is said to have been cured by similar means.

The great success which cod-liver oil at one time was believed to have gained as a cure for *pulmonary consumption* has tended more than any other cause to maintain the reputation of the medicine. It is now determined that it exerts little if any direct influence upon the structural elements of that disease, and that it can be said to cure only those rare cases in which other and especially hygienic methods have also restored consumptive patients to apparently good health. Such are the cases in which the patient is of a sluggish, lymphatic temperament, and in which the tubercular deposit is strictly limited to a small portion only of one lung. The efficiency of the medicine is much more notable when a cavity is already formed than when the deposit is in a crude state. It plainly acts by maintaining the general health of the system, while the local disease undergoes retrogression; for it constantly happens that although the latter process fails to occur, but on the contrary the destruction of the lung advances, yet the patient for a time gains weight and strength. In the more favorable examples the symptoms which depend upon the local lesion are mitigated and even suspended, such as fever, sweating, cough, and expectoration. Yet, in proportion as these symptoms prevail, the oil fails to do good, or is not tolerated. Although cod-liver oil is no longer claimed to be a cure for consumption, it still remains incomparably the most efficient medicine in prolonging the lives of the victims of this disease, and enabling them to take advantage of the hygienic measures upon which the main reliance must be placed. *Chronic bronchitis*, which is so apt to be mistaken for tubercular phthisis, is often signally benefited by this medicine, and by the same mode of action. A like remark is applicable to numerous diseases of the *nervous system* due to, or maintained by, an exhausted condition of its functions.

In all diseases its use is contraindicated when it cannot be retained by the stomach; when it is not well digested, but causes eructation, heartburn, diarrhœa, etc.; and when fever is present.

Administration.—The average *dose* of cod-liver oil is a tablespoonful three times a day, an hour or two after meals. It is better to begin with half of this quantity. Various means have been employed to disguise the taste and smell of the oil and render it acceptable to the stomach. These means are generally needless among children, who often become fond of the medicine, and among persons whose taste is not fastidious. The use of ether, naphtha, peppermint, and similar agents is objectionable, since they become volatilized in the stomach, and renew the taste of the oil by eructation. Less apt to produce this effect is alcohol in the form of some distilled spirit, with which the mouth should first be washed, after which the oil floating upon another portion of the liquor may be rapidly swallowed. Malt liquor which froths readily is an excellent article for enveloping the oil and concealing its taste. Floated on iron-rust water, with some of which the mouth and fauces have just been washed, is another available means of effecting the same purpose. But the best of these is chewing a small fragment of smoked herring. When the stomach tends to reject the oil, this effect can sometimes be prevented by preceding each dose by one of a solution of cyanide of potassium, containing not more than one-eighth of a grain of the cyanide. But the possible dangers of the misuse of this solution forbid its ordinary employment. It is better, as well as safer, to swallow a tablespoonful of lime-water, or five or more grains of subnitrate or subcarbonate of bismuth, a few minutes before the oil is taken. The oil has sometimes been mixed with arrowroot, or with spermaceti, forming a bolus which may be taken inclosed in a wafer.

OLEUM MYRISTICÆ, *U. S.*, *Br.*—OIL OF NUTMEG.

Oleum nucistæ æthereum.—*Volatile oil of nutmeg*, E.; *Essence de muscades*, Fr.; *Ætherisches Muskatöl*, G.

Preparation.—The volatile oil is obtained by distilling ground nutmegs by the aid of steam. The yield is between 2 and 3 per cent., but selected nutmegs have yielded 6 per cent. Cloëz (1864) suggests exhaustion with carbon bisulphide and distilling the extract by means of steam.

Properties.—The oil is colorless or pale yellowish, limpid, of specific gravity .92 to .95, of an agreeable aromatic odor, a warm somewhat camphoraceous taste, and dextrogyre to polarized light. It is readily soluble in alcohol, commences to boil at 160° C. (320° F.), fulminates when brought into contact with iodine, is energetically acted on by nitric acid, becomes dark-red with Fröhde's reagent, and violet by muriatic acid (Dragendorff, 1877).

Composition.—The most volatile portion, after treatment with sodium, was found by Cloëz to be a left rotating hydrocarbon, $C_{10}H_{16}$, having the odor of nutmeg and of lemon, and boiling at 165° C. (329° F.). It is the *myristicene* of Gladstone (1872), who named the oxygenated portion *myristicol*, $C_{10}H_{14}O$; this is dextrogyre, boils at 224° C. (435° F.), and does not, like menthol and carvol, yield a crystalline compound with H_2S. The *nutmeg camphor* of John (1821), or *myristicin* of Gmelin, which separates sometimes on standing, was ascertained by Flückiger (1874) to be myristic acid. (See below.)

Off. Prep.—Pil. aloes socotr., *Br.*; Spirit. ammon. aromat., *U. S.*, *Br.*; Spir. myristicæ, *Br.*

Medical Uses.—Oil of nutmeg is seldom used in medicine; it may be employed for the same purposes as nutmeg, in *doses* of two or three drops.

OLEUM MYRISTICÆ EXPRESSUM, *Br.*—EXPRESSED OIL OF NUTMEG.

Oleum myristicæ, P. G.; *Oleum nucistæ expressum, Adeps (vel Butyrum) nucistæ.*—*Nutmeg butter*, E.; *Beurre de muscade*, Fr.; *Muskatnussöl, Muskatbutter*, G.

Preparation.—This fixed oil is obtained in the East Indies by beating nutmegs into a paste, which is expressed between heated plates. The yield is about 28 per cent., and the annual importation into the United States between 200 and 300 pounds. It is incorrectly called *oil of mace.*

Properties.—It is found in commerce in the shape of blocks, about two and a half inches thick and ten inches long, and is wrapped in palm leaves. It is solid and firm, unctuous to the touch, of a mottled appearance, orange and brown in color, of specific gravity .995, and has the fragrance and aromatic but bland taste of nutmegs. It melts at about 45° C. (113° F.), and is soluble in two parts of warm ether and four parts of boiling strong alcohol. (Lecanu.)

Constituents.—Cold alcohol dissolves about 6 per cent. of volatile oil (see p. 983) and 37 per cent. of fat, accompanied by brown-yellow coloring matter, which has not been further examined. The remaining white fat is *myristin*, $C_3H_5O_3.3C_{14}H_{27}O_2$, which crystallizes from hot alcohol or ether, and fuses at 31° C. (87.8° F.). Heintz (1854) found the melting point of *myristic acid* at 53.8° C. (128.8° F.). The myristicin of *otoba butter*, from Myristica otoba, of New Grenada, melts at 46° C. (114.8° F.), according to Uricoechea (1854).

Adulterations and Substitutions.—The expressed fats of *Myristica fatua* and *otoba* resemble the officinal article, but have not the fragrance of the latter. Artificial mixtures made from animal fats are not soluble in the same amount of hot alcohol.

CERATUM MYRISTICÆ, P. G., also known as *Balsamum nucistæ*, is made by melting together yellow wax one part, olive oil two parts, and expressed oil of nutmeg six parts, pouring into paper capsules, and cutting into square cakes.

Off. Prep.—Emplast. calefaciens, Empl. picis, *Br.*

Medical Uses.—Oil of nutmeg is sometimes used for the friction of rheumatic parts, but chiefly as a bland and smooth fatty substance that does not easily grow rancid, and is therefore suitable as an excipient of more active topical medicines.

OLEUM OLIVÆ, *U. S.*, *Br.*—OLIVE OIL.

Oleum olivarum, P. G.—*Sweet oil*, E.; *Huile d'olive*, Fr.; *Olivenöl*, G.

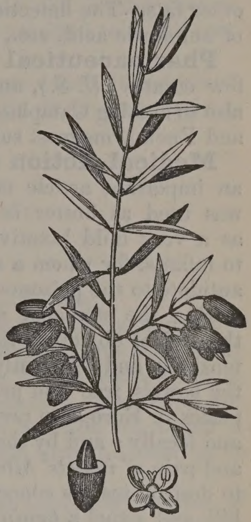
The fixed oil obtained from the fruit of Olea europæa, *Lin.* Woodville, Med. Bot. t. 98; Bentley and Trimen, Med. Plants, 172.

Nat. Ord.—Oleaceæ.

Origin.—In its wild state, the olive is almost shrubby, much branched and thorny; but under cultivation it is a medium-sized tree, 30 or 40 feet high. It is indigenous to Western Asia, particularly Syria, and has been cultivated for a long time in the countries bordering on the Mediterranean. It has been introduced into the Southern United States, California, and several South American and other countries. The tree has evergreen, opposite, shortly petiolate leaves, which are about two inches long, lanceolate, acute at both ends, entire and revolute on the margin, and densely scaly, silvery gray, brownish- or glaucous-green beneath. The numerous small white flowers are in axillary racemes, diandrous, have a two-celled and four-ovuled superior embryo, and produce a purplish-black ovate drupe about an inch long, with a greenish firm sarcocarp, and an obliquely oblong keeled putamen, containing a single albuminous seed.

The leaves and bark have been employed in France as a febrifuge. De Luca (1861, etc.) found the leaves and green fruit to contain mannite, which diminishes in the latter as the fruit ripens, and disappears entirely when it becomes perfectly ripe. It contains then the largest amount of oil, equal in weight to nearly 70 per cent. of the sarcocarp.

Fig. 121.



Olea europæa, *Lin.*

Preparation.—The finest quality of olive oil is obtained by crushing the recently collected olives in a suitable mill to a pulpy mass, and subjecting this to moderate pressure, the oil, called *virgin oil*, being collected in cisterns containing water, from the surface of which it is subsequently skimmed. The press cakes are afterwards thoroughly mixed with boiling water and the marc again expressed, using an increased pressure, whereby a second quality of oil is obtained. A larger amount of oil, but much inferior in quality, is yielded by expressing olives which have been kept in heaps and undergone a kind of fermentation; this oil is known in France as *huile fermentée;* and a still inferior oil is prepared by again mixing the residue with boiling water and expressing.

Olive oil enters commerce put up in bottles of various sizes, also in stone jugs and in barrels. The importation of olive oil into the United States amounts annually to over 300,000 gallons, fully three-fifths of which quantity is *salad oil.*

Properties.—Olive oil is a pale yellow or greenish-yellow oily liquid, having a slight agreeable odor and a bland taste, leaving, even in its freshest condition, a slight sense of acridity (*Pharmacographia*), which is somewhat increased on keeping. Its specific gravity at 15° C. (59° F.) is 0.9178. At and below 10° C. (50° F.), olive oil separates white crystalline granules, and congeals completely at or below the freezing point of water, yielding, however, by strong pressure from 67 to 72 per cent. of liquid oil, which remains fluid at —10° C. (14° F.), and is nearly pure *olein.* The solid portion fuses between 20° C. (68° F.) (Pelouze and Boudet), and 28° C. (82.4° F.) (Lecanu), and is easily soluble in ether. Olive oil is sparingly soluble in alcohol, freely soluble in ether, does not readily become rancid, and belongs to the non-drying oils. When heated to 120° C. (248° F.), it becomes lighter, and at 220° C. (428° F.), nearly colorless and, at the same time, rancid; it commences to boil at about 315° C. (600° F.).

Inferior qualities of olive oil are of a deeper hue, have a more decidedly acrid after-taste, and turn rancid on exposure.

Composition.—The liquid portion is *triolein* (olein), $C_3H_5O_3.3C_{18}H_{33}O$, and is identical with the liquid portion of most non-drying fats, as far as they have been examined. The solid part was called *margarin* by Chevreul, which was proven by Heintz (1852) to be a mixture containing chiefly *palmitin.* Palmitic acid, $C_{16}H_{32}O_2$, was obtained from olive oil by Collett (1854), and also by Heintz and Krug (1857), who likewise isolated *arachic (butinic) acid*, $C_{20}H_{40}O_2$, and probably stearic acid. On saponification, glycerin is obtained. The fats composing olive oil are, therefore, triolein, tripalmitin, triarachin, and possibly tristearin. Beneke (1862) announced also the presence of a small quantity of *cholesterin*, $C_{26}H_{44}O$, which is soluble in alcohol (see page 608).

Adulterations.—Olive oil is frequently adulterated with other bland oils, some of which are occasionally even substituted for it. The determination of its purity has been the subject of much research, but from the chemical identity of the constituent compounds of many oils, and the natural variation of their relative proportions in the same fat, it is evidently attended with many difficulties. A higher specific gravity than given above points to an admixture of other fats. The detection of drying in non-drying oils, and the testing by means of sulphuric acid, etc., have been described above (see page 950).

Pharmaceutical Uses.—Olive oil is employed in the preparation of a few cerates (*U. S.*), and ointments (*Br.*), and of most liniments and plasters; also in making Cataplasma lini, *Br.;* Charta cantharidis (epispastica), *U. S.*, *Br.;* and Enema magnes. sulphat., *Br.*

Medical Action and Uses.—From time immemorial olive oil formed an important article of food in countries where the olive tree flourishes, and was used as butter is elsewhere. In the dose of one or two ounces it acts as a very mild laxative, but it is seldom administered for this purpose except to infants, for whom a sufficient dose is a teaspoonful. It has been used as an antidote to the poisonous effects of *cantharides*, and is probably efficient in protecting the stomach, as well as by occasioning vomiting, notwithstanding the theoretical objection that cantharidin is soluble in sweet oil. It has been extensively and efficiently employed by workmen in white-lead factories to keep the bowels free and prevent the absorption of the metal. It is used in some places in Europe to prevent the poisonous effects of *vipers' bites*, both internally and locally; and by the latter method it is familiarly applied to allay the swelling and pain of *insects' bites and stings.* It is often poured into the *auditory canal* to destroy insects concealed therein; and large doses of it have been known to kill and expel a *tænia.* Externally it is a convenient and efficient protective and lenitive for superficial *wounds*, *excoriations*, *burns*, *bruises*, and *sprains.* In the two last-mentioned injuries it should be applied warm, and in them also it affords a convenient vehicle for the application of camphor, morphia, and various other anodynes or stimulants. The same is true in regard to several local inflammations, especially *earache.* With lime-water it forms the liniment so useful in burns (*Linimentum calcis*). Anciently the custom of anointing the body with oil was practised, as it still is in Oriental countries, after warm bathing, and also as a protective against the plague. It is now occasionally used to moderate excessive *sweating.* Warm oil is a soothing and efficient application, when made with appropriate pressure or friction, in lessening the pain and swelling of enlarged glands, particularly those which are actively engorged, as the *mammæ* during pregnancy and after parturition. It is sometimes injected into the rectum in *dysentery*, and to destroy rectal *ascarides* (oxyures); and it is habitually employed to facilitate the introduction of *sounds*, *catheters*, *bougies*, *specula*, *pessaries*, etc., into the natural cavities of the body. It was an old custom to dip cutting surgical instruments in oil before incising the flesh.

The *dose* of olive oil as a laxative is one or two fluidounces for adults, and for infants one or two fluidrachms.

OLEUM ORIGANI, *U. S.*—OIL OF ORIGANUM.

Essence d'origan, Fr.; *Dostenöl*, G.

Preparation.—This volatile oil is obtained from the fresh herb of Origanum vulgare, *Lin.*, by distilling it with water. Raybaud obtained only 0.024 to 0.03 per cent. from the fresh plant, and Redtel 2 per cent. from the recently dried herb. Red oil of thyme (see page 1002) is often sold in its place.

Properties.—It is pale-yellow and limpid, becoming thicker and brown-yellow on exposure, has a strong aromatic odor and a warm, pungent, and slightly bitter taste. Its specific gravity varies between 0.87 and 0.91. It yields a turbid solution with 12 parts of alcohol specific gravity 0.85, fulminates when brought into contact with powdered iodine, acquires with sulphuric acid a dark blood-red color, and a deep-brown one with potassium bichromate and sulphuric acid (Zeller).

Composition.—Oil of origanum consists of a liquid and a solid portion, which have not been fully investigated. Kane (1838) ascribed to it the composition $(C_{10}H_{16})_5O$.

Medical Action and Uses.—Like the plant from which it is derived, this oil is stimulant and carminative, and is applied locally as an anæsthetic to relieve the pain of *carious teeth*, *neuralgia*, etc.

OLEUM PALMÆ.—PALM OIL.

Huile de palme, Fr.; *Palmöl*, *Palmbutter*, G.

From the fruit of Elais guineensis, *Jacq.* *Nat. Ord.*—Palmæ.

Origin.—The oil palm is a tall tree indigenous to Western Africa, and introduced into other tropical countries. It has large pinnate leaves with spiny petioles and long narrow linear leaflets. The fruit is a yellow mottled drupe, about an inch long, and contains a leathery very oily sarcocarp, from which the fat is obtained by pressure. The kernel yields likewise a bland oil which is white. Nearly 917,000 gallons of palm oil were imported into this country in the year 1876–1877.

Properties.—Palm oil is solid at the common temperature, butyraceous, of a reddish-yellow color, and when fresh of an agreeable violet-like odor, and fuses at 27° C. (80.6° F.). On keeping, it acquires a rancid odor, a portion of the fat being decomposed into free acids and glycerin, the fusing point rising at the same time. When rapidly heated to 240° C. (464° F.) it is bleached. It is partly soluble in alcohol, but entirely so in ether.

Composition.—It consists chiefly of tripalmitin and triolein, and contains a peculiar ferment, inducing its decomposition. It is largely used in the preparation of soap.

Medical Action and Uses.—Palm oil has hardly any peculiar virtues to distinguish it from other vegetable fats, except that it is less drying and more emollient. It is supposed to be especially adapted for bathing *bruises* and *sprains*. Its agreeable odor recommends it.

OLEUM PHOSPHORATUM, *Br. Add.*—PHOSPHORATED OIL.

Huile phosphorée, *Liniment phosphoré*, Fr.; *Phosphorhaltiges Oel*, G.

Preparation.—Take of Phosphorus, Oil of Almonds, each a sufficiency. Heat the oil in a porcelain dish to 300° F., and keep it at this temperature for about fifteen minutes; then let it cool, and filter it through paper. Put four fluidounces of this oil into a stoppered bottle, capable of holding four and a half fluidounces, and add to it twelve grains of phosphorus. Immerse the bottle in hot water until the oil has acquired the temperature of 180° F., removing the stopper two or three times to allow the escape of extended air; then shake the oil and phosphorus together until the latter is entirely dissolved. *Br.* By heating the oil as directed, air and moisture which may be contained in it are expelled. The phosphorus, before it is introduced, should be rapidly dried between bibulous paper. The finished preparation contains three-quarter per cent. of phosphorus. The solubility of phosphorus in fixed oils is generally stated to be 1 in 100.

Properties.—Phosphorated oil is a clear yellowish oil, having the odor of phosphorus. In contact with air, it produces white fumes, and is phosphorescent in the dark. Since the phosphorus is readily oxidized, the oil should be kept in well filled vials, as directed by the French Codex, or prepared extemporaneously according to the German Pharmacopœia. Both these authorities order saturated solutions of phosphorus in almond oil.

Medical Action and Uses.—In so far as phosphorus is useful as a medicine, it may be conveniently administered in this oil, which contains three grains of phosphorus in each fluidounce, and may be prescribed in the *dose* of from five to ten minims. It is very convenient as an addition to cod-liver oil in cases of *scrofula*, *chronic phthisis*, *paralysis* without central lesion of substance, sexual *debility*, and diseases referred to under Phosphorus.

OLEUM PIMENTÆ, *U. S.*, *Br.*—OIL OF PIMENTO.

Essence de piment de la Jamaïque, Fr.; *Nelkenpfefferöl*, G.

Preparation.—The volatile oil is obtained from the ground fruit of Eugenia pimenta, *D. C.*, by distilling it with water. The average yield appears to be about four per cent., but is often much lower. Bonastre (1827) states that the seeds contain five per cent., and the remaining part of the fruit ten per cent. of volatile oil.

Properties.—Oil of pimento is colorless, or pale yellow, becoming darker by age. Gladstone (1872) gives its specific gravity as 1.0374 at 10° C. (50° F.). In taste and in behavior to solvents and chemicals, it closely resembles oil of cloves; its odor, however, is more pleasant.

Composition.—Gladstone has corroborated the observation of Bonastre concerning the presence of eugenic acid, and the close similarity of this oil to oil of cloves.

Medical Uses.—The oil of pimento is used for the same purposes, local and general, as other aromatic stimulants. The *dose* is from two to six drops.

OLEUM RICINI, *U. S.*, *Br.*—CASTOR OIL.

Oleum Palmæ Christi.—*Huile de ricin*, Fr.; *Ricinusöl*, G.

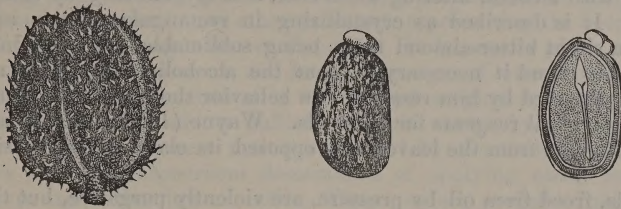
The fixed oil obtained from the seeds of Ricinus communis, *Lin.* Bot. Mag., plate 2209; Bentley and Trimen, Med. Plants, 237.

Nat. Ord.—Euphorbiaceæ.

Origin.—The castor oil plant appears to be indigenous to Southern Asia, but was early introduced into all tropical and subtropical countries, in many of which it has become naturalized, attaining in the tropics the size of a tree thirty to forty feet high. It is often cultivated in temperate countries for ornament and other purposes, remaining an annual, varying in size from four to fourteen feet. Numerous varieties are now known, differing from one another in size and color of the stem and foliage, as well as of the fruit and seeds. The leaves are alternate, peltate, palmately seven- or nine-lobed; the inflorescence is paniculately spicate, terminal, finally axillary; the flowers are monœcious, apetalous, the staminate ones at the base of the panicle. The fruit is a subglobular, somewhat triangular and grooved tricoccous capsule, which is sometimes nearly smooth, but mostly spinescent; each cell incloses a single oval, somewhat flattened seed, which is smooth, shining, of a gray color variegated with yellowish, brown, or reddish spots and lines, with a slightly raised raphe along the flattish side, and a prominent caruncle near one end. The embryo is straight, has foliaceous heart-shaped cotyledons, and is imbedded in an oily albumen, having a bland and scarcely acrid taste.

Preparation.—Nearly all the castor oil which is at the present time consumed in the United States is manufactured from seeds grown in the country. While in the year ending June 30, 1867, the importation of castor oil was 82,800 gallons, and of the seeds 60,588 bushels, the quantities imported ten years later were 612 gallons and 29,255 pounds respectively. The seeds, after having been crushed and freed from the integuments, or without removing the latter, are kiln-dried and subjected to powerful pressure; the oil thus obtained is heated with water to remove albuminous matters, and when clear, drawn off into barrels or other suitable vessels. More oil, but of inferior quality, is obtained by again expressing the marc, and using a higher temperature and greater power. The older method of obtaining the oil by boiling the seeds with water and skimming it from the surface has probably been abandoned in most countries. L. Boerner (1876) extracted from the presscake with ether fourteen per cent. of oil having a light yellow color, while alcohol dissolved twenty-one per cent. of dark oily matter.

Fig. 122.



Ricinus communis, *Lin.* Fruit, seed, and longitudinal section of seed; natural size.

Purification.—Cold-pressed castor oil is nearly transparent, and requires no further purification. If opaque, the oil is filtered, either through paper or felt, or, as recommended by Pavesi (1857) is previously treated for several days with 1 per cent. of magnesia, and 2.5 per cent. of purified animal charcoal, which treatment renders it nearly colorless and inodorous.

Properties.—Castor oil is viscid, transparent or nearly so, almost colorless or pale greenish-yellow, of a faint, mild odor, and a bland, slightly acrid taste. Its specific gravity is about 0.96. At a low temperature it becomes thicker, and usually deposits white granules of solid fat; near —18° C. (near 0° F.) it congeals to a yellowish mass. It is only partly soluble in petroleum benzin, but soluble in all proportions in absolute alcohol, ether, and glacial acetic acid, and at 15° C. (59° F.) in about 4 parts of alcohol, spec. grav. 0.835. When exposed to the atmosphere in thin layers, it slowly dries to a transparent varnish. Polarized light is by some samples turned to the right, by others to the left. It commences to boil at about 265° C. (509° F.), and yields an oily distillate; at a higher temperature it becomes black. Heated with dilute nitric acid, or with potassium bichromate and sulphuric acid, *œnanthylic acid* $C_7H_{14}O_2$, having an agreeable aromatic odor, is obtained.

Composition. 1. THE OIL.—Castor oil is composed of several fats, the acids of which have been the subject of repeated investigations. The solid, fatty acid is probably identical with, or closely related to, *palmitic acid;* the liquid one has been named *ricinic* or *ricinoleic acid*, $C_{18}H_{34}O_3$, and forms a wine-yellow, inodorous liquid, of a disagreeable acrid taste, solidifying below 0° C. (32° F.) to a granular mass, and under the influence of nitrous acid is converted into *ricinelaidic acid*, which has the same composition, and crystallizes in silky needles. The acrid principle of castor oil has not been isolated.

2. THE SEEDS.—Besides the oil, of which the seeds contain about one-half their weight, a considerable amount of protein compounds, some sugar and mucilage are met with in them. Among the proteids is one which H. Bower (1854) regards as related to *emulsin*, inasmuch as it generates, with amygdalin, the odor of hydrocyanic acid. This observation was confirmed by Boerner (1876). The proteid is obtained by agitating the emulsion of the seeds with ether, and precipitating the aqueous liquid with alcohol.

In 1864, Tuson announced the discovery of an alkaloid *ricinin*, which is isolated by preparing an extract with boiling water, freeing it from the fat, exhausting with alcohol, filtering when cool, and crystallizing by concentrating the liquid. It is described as crystallizing in rectangular prisms and scales, possessing a slight bitter-almond taste, being sublimable, and containing nitrogen. Boerner found it necessary to treat the alcoholic liquid with magnesia; the crystals obtained by him resembled in behavior those of Tuson, but did not react with the usual reagents for alkaloids. Wayne (1874) isolated apparently the same principle from the leaves, and opposed its claim to be considered an alkaloid.

The seeds, freed from oil by pressure, are violently purgative, but the principle to which this action is due has not been isolated. On mixing the marc with water, and allowing the mixture to ferment, Boerner obtained butyric, and probably other volatile acids, but no acetic acid.

Off. Prep.—Collodium cum cantharide, *U. S.;* Collodium flexile, *U. S.*, *Br.;* Liniment. sinapis comp., Pilul. hydrarg. subchloridi comp., *Br.*

Physiological Action.—Castor oil derives its purgative properties chiefly from an acrid principle contained in castor beans, which, when taken designedly or accidentally, have repeatedly occasioned violent pain, vomiting, purging, collapse, and even death, after which evidences of severe inflammation have been found in the mucous membrane of the stomach and intestines. When castor oil was injected into a vein, its taste was presently perceived in the mouth, and there followed nausea, eructation, rigidity of the muscles of the tongue, loss of speech, anxiety, and faintness, with general dulness and depression. At the end of three hours an unsuccessful motion to evacuate the bowels occurred, followed by feverishness, and an indisposition of several weeks' duration. Rubbed upon the skin of the abdomen in young children it has procured one or two loose stools. Taken in medicinal doses it sometimes nauseates, seldom gripes, but is apt to cause a tendency to sleep. The first evacuations which follow are generally liquid, and contain more or less of the oil, either unchanged, or converted into cheesy flakes or a soap-like scum floating on the surface of the dejection. It has long been observed that, when used as an habitual laxative, the dose may be progressively diminished. Indeed, unless this is done, it is very apt to occasion constipation and all its attendant evils. In a case of hydræmia with venous pulsation, castor oil, given by the mouth, did not purge, but exuded through the skin.

Medical Uses.—Castor oil is used as a purgative whenever the intention is simply to overcome *constipation*, or, on the other hand, to cure *diarrhœa* depending upon the presence of irritating substances in the bowel, or upon congestion, irritation, and excessive secretion, produced by cold. In not a few cases, especially of infantile diarrhœa, the intestine is irritated at once by the presence of undigested food and by the vitiated secretions of its lining membrane, the patients are distressed by colic, tenesmus, and frequent stools which are watery, mucous, and bloody in different proportions, the mouth is aphthous, and the anus inflamed. In such cases the first step should be thoroughly to cleanse the intestine by means of castor oil in small and repeated doses, preceded or not by a small dose of calomel or of mercury with chalk. The rest of the treatment may be confided to medicines of a different kind, and to dietetic regimen. This purgative has the advantage over most others of analogous qualities, that it has no tendency to exhaust the strength. Hence it is much used during *pregnancy*, and especially immediately before *labor*. There is a popular notion that it tends to relax the maternal organs. Castor oil has been highly recommended in *colica pictonum*, or Poitou colic, produced by acid drinks containing lead, and in *colica pictorum*, or painter's colic, caused by the habitual absorption of the metal. In the former affection it affords prompt relief; in the latter it has no superiority over other, and especially more active, cathartics. It sometimes suffices to expel *lumbricoid worms*, but cannot be at all depended upon for the removal of *tæniæ*, unless they are previously killed by a proper tæniacide. In the forming stage of *laryngeal* or *bronchial inflammation* a laxative dose of castor oil is far superior to any other evacuant in promoting the bronchial secretion, and thereby tending to hasten the cure. It is usually given after parturition when *milk fever* threatens, and later when signs of *mammary abscess* arise. It is also commonly prescribed after wounds and surgical operations to mitigate *traumatic fever;* it is said to palliate the pain caused by *renal calculi*. The local uses of castor oil were mainly suggested by the custom among African aborigines and their American descendants of applying castor leaves to the mammæ to excite the flow of *milk*. They produce a slight irritation of the skin. A fluid extract prepared from the leaves and applied in the same manner is said to have a like effect; and a decoction has been used for the cure of *amenorrhœa*. The oil enters into numerous liniments, etc., for the cure of *alopecia*. Of these one of the best is composed of suet, ℥ij; castor oil, ʒvj; gallic acid, ʒss. Mix, and scent with essence of vanilla. Castor oil is often prescribed in emulsion with yelk of egg, mucilage, etc., but its activity is thereby diminished. Its taste may be disguised by giving with it an equal quantity of glycerin to which a few drops of oil of cinnamon have been added. It should not be taken in milk, coffee, hot soup, or any other articles of food, lest they become repugnant afterwards. If the mouth and fauces are washed with an alcoholic liquid, or even with glycerin, the oil will not adhere, and, therefore, not excite disgust. Or it may be floated upon fresh orange-juice in a wineglass, and covered with another layer of the juice, and so tossed down the throat without its taste being perceived. Probably the best expedient of all is to envelop the oil with the froth of beer, ale, or porter in a wineglass; it may then be swallowed without even its presence being detected. The average *dose* of castor oil for an adult is from half an ounce to an ounce, taken at once or in several portions, according to the nature of the case. The *dose* for an infant is about a fluidrachm. For an enema one or two fluidounces may be given in half a pint of mucilage or soap and water.

OLEUM ROSÆ, *U. S.*—Oil of Rose.

Oleum rosarum.—Attar, Otto of rose, E.; *Essence de rose*, Fr.; *Rosenöl*, G.

Origin and Production.—Roses are largely cultivated in India and various parts of Northern Africa for the production of rose-water and attar, which, however, are consumed in those countries. Large quantities of rose-water are distilled in Southern France, but little oil is obtained there. Commerce is almost exclusively supplied with oil of rose from the southern slope of the Balkan Mountains in Rumelia, the principal depot, previous to the recent war between Russia and Turkey, having been the town of Kizanlik. The species of rose cultivated in that district, according to Baur (1867), is a variety of Rosa damascena, *Miller*, which grows to the height of over six feet, and is raised in hedge-like rows. The flowers appear in May and June, and are collected before sunrise for distillation on the same day. The still used is made of copper, conical in shape, and has its globular head connected with a straight tin tube, passing through a tub filled with water. The charge for each still is about 10 okes (or 27 pounds) of flowers and 20 okes of river water, and the distillation is completed in two hours. The distillates are again distilled, the first sixth being set aside, to allow the oil to separate, while the remainder, together with the water pressed from the exhausted flowers, is used for fresh roses in place of water. The average annual production of oil of rose is about 4000 pounds, of which quantity over 10,000 ounces are imported into the United States; in the year ending June 30, 1877, the importation amounted to 17,539 ounces.

Properties.—Oil of rose is pale yellow, transparent, solidifies if slowly cooled above 10° C. (50° F.) to a perfectly transparent mass, composed of scale-like crystals, and fuses again at a somewhat higher temperature. Congealing and fusing point vary to some extent; the former is given by Baur at between 11° and 16° C. (51.8° and 60.8° F.), the latter, by Hanbury (1859), as lying between 16.1° and 18.3° C. (61° and 65° F.), and for English oil of roses was found as high as 32.8° C. (91° F.). Zeller observed the fusing point of German oil of rose to be even 37.5° C. (99.5° F.). Oil of rose has the odor of the flowers in a high degree, and when suitably diluted with alcohol is very fragrant. Its taste is sweetish and rather mild.

Composition.—When oil of rose is mixed with about 3 parts of alcohol, and the undissolved portion repeatedly dissolved in a little ether, and reprecipitated by alcohol, it is finally obtained as transparent iridescent inodorous scales, which, according to Blanchet (1833) and Flückiger (1868), have the formula C_nH_{2n}, fuse at 35° C. (95° F.), distil above 280° C. (536° F.) (Blanchet), and require about 500 parts of alcohol for solution (Saussure). This stearopten is present in Turkish oil of rose to the amount of 6 or 7 per cent. (Hanbury), but in much greater proportion in oil obtained from roses grown in other parts of Europe. Flückiger found the stearopten to fuse at 32.5° C. (90.5° F.), to emit vapors at 150° C. (302° F.), and to be decomposed at and above 275° C. (525° F.). The elæopten of oil of rose contains oxygen, but its exact composition has not been ascertained.

Adulterations.—The oil which is mostly employed for adulterating oil of rose is known in commerce as *Turkish oil of geranium*, and was shown by Hanbury (1859) to be entirely different from the volatile oil of pelargonium. It is obtained in India from Andropogon schœnanthus, *Lin.*, known as *roshé* or *rosé oil*, and in English commerce also as *oil of gingergrass;* it is imported into Turkey for the purpose of adulterating oil of rose. The most certain criteria of the purity of the latter are, according to Baur, 1, the odor, by which oil of rosewood, sandal-wood, and others, may be detected; 2, the temperature at which it congeals; and 3, the manner of crystallizing. Pure oil of rose exposed to a temperature of 12.5° C. (54.5° F.) should congeal in a few minutes; the crystals should be transparent, scaly, and float in the liquid, while spermaceti, being heavier, is deposited as a solid crust.

Medical Uses.—It is used in medicine exclusively for perfuming ointments and lotions.

OLEUM ROSMARINI, *U. S.*, *Br.*—OIL OF ROSEMARY.

Oleum anthos.—Essence de romarin, Fr.; *Rosmarinöl*, G.

Preparation.—The volatile oil is obtained from the flowering tops, or, more frequently, the entire plant of Rosmarinus officinalis, *Lin.*, by distilling them with water. Commerce is chiefly supplied with oil of rosemary from Southern France and Italy.

Properties.—Oil of rosemary is a colorless or yellowish limpid liquid, varying in specific gravity between 0.88 and 0.91, has a pungent somewhat camphoraceous odor, boils at 165° C. (329° F.), and is soluble in less than its own weight of 80 per cent. alcohol; old oil requires a larger quantity for solution. Mixed with iodine, it gives off reddish vapors, and strong sulphuric and nitric acid render it thick and brown-red. Fröhde's reagent colors it yellowish-brown. The oil deviates polarized light to the left.

Composition.—The presence of oxygen in oil of rosemary was proven by Saussure (1820). Gladstone (1863) regards it as consisting almost entirely of a hydrocarbon very similar to that contained in the oil of Myrtus communis, *Lin.* Lallemand (1859), however, obtained by fractional distillation a liquid boiling at 200° C. (392° F.), from which a stearopten was obtained having the composition and most of the properties of camphor.

Off. Prep.—Linim. saponis, Spiritus (Tinctura) lavandulæ comp., *U. S.*, *Br.*; Spiritus rosmarini, *Br.*

Medical Action and Uses.—This oil is poisonous to rabbits in the dose of twenty grains. A case is recorded in which, along with oil of wormwood, it caused the death of a child. Internally, it may be employed for the same purposes as other stimulant oils, to relieve *colic*, promote *menstruation*, and allay *nervous disorder* due to debility. In ointments and liniments, it is a useful ingredient for relieving *rheumatic* pains; it promotes the removal of swellings due to *rheumatism*, *sprains*, *bruises*, etc.; and promotes the growth of the hair in *alopecia* following febrile affections. Its vapor cautiously allowed to act on the conjunctiva sometimes improves *vision* impaired by nervous exhaustion. Internally, the *dose* is one or two drops.

OLEUM RUTÆ, *U. S.*, *Br.*—OIL OF RUE.

Essence de rue, Fr.; *Rautenöl*, G.

Preparation.—This volatile oil is distilled with water from the herb of Ruta graveolens, *Lin.* The yield from dry herb is about $\frac{1}{4}$ per cent., from fresh herb $\frac{1}{20}$, and from the seeds 1 per cent. (Zeller.)

Properties.—Oil of rue is a colorless or greenish-yellow liquid having the peculiar odor of the plant and congealing at a low temperature in shining scales. The freezing point varies in different samples, according to Geiss (1861), between —2.5° and —22.5° C. (27.5° and —8.5° F.), that obtained from the seeds congealing first. Iodine dissolves quietly in the oil; sulphuric acid dissolves it with a brown-red color; and sodium bisulphite yields with it a crystalline compound. By the action of nitric acid, *caprinic*, *pelargonic*, *caprylic*, and *œnanthylic acids* are produced, the products varying with the strength of the acid and its prolonged action.

Composition.—Aside from a small quantity of a hydrocarbon, oil of rue consists mainly of an oxygenated portion, which Cahours and Gerhardt (1845) stated to be *caprinic aldehyd*, $C_{11}H_{22}O$. Harbordt (1862) showed that it could not be an aldehyd, and regarded it as *methyl-caprinol*, $C_{10}H_{19}.CH_3.O$, and Strecker as a ketone having the formula $CH_3.CO.C_9H_{19}$. The latter view has been proven to be correct by the simultaneous observations made by Gorup-Besanez, F. Grimm, and A. Giesecke (1870). This *methyl-nonyl ketone*, when pure, is a colorless liquid with a bluish fluorescence, boiling at 225° C. (437° F.), crystallizing in scales near 5° C. (41° F.), and fusing again at 15° C. (59° F.).

Medical Action and Uses.—An experimenter having taken within an hour three doses of oil of rue, of ten minims each, suffered uneasiness in the stomach, oppression and confusion of mind, aching in the loins, an urgent desire to urinate—the urine smelling of the oil—flushes of heat, unsteadiness of gait, a tendency to sleep, and increased frequency, with diminished tension of the pulse. These phenomena are essentially those produced by oil of wormwood and numerous other essential oils, and the therapeutic uses of oil of rue are the same as theirs, viz., in the treatment of *colic*, *amenorrhœa*, *dysmenorrhœa*, *uterine hemorrhage*, and *verminous complaints*. It may be given in *doses* of from one to five drops.

OLEUM SABINÆ, *U. S.*, *Br.*—OIL OF SAVIN.

Essence de sabine, Fr.; *Sadebaumöl*, G.

Preparation.—Oil of savin is obtained by distilling the fresh branches of savin with water. The yield is between 1½ and 2½ per cent.; Voget obtained from the berries nearly 10 per cent. of volatile oil.

Properties.—The crude oil has a yellowish or yellow color, and is obtained colorless on rectification. Its specific gravity is about 0.91, but varies somewhat. It commences to boil near 160° C. (320° F.), and dissolves in absolute alcohol in all proportions, but yields an opalescent solution with 3 parts of 80 per cent. alcohol. Mixed with powdered iodine, a brisk detonation results, and on the addition to the oil of an ethereal solution of bromine, the color of the latter disappears instantly. The oil does not appear to yield a solid compound with hydrochloric acid gas. It rotates polarized light to the right.

Composition.—Dumas (1835) found it to agree with oil of turpentine in elementary composition. Its formula is $C_{10}H_{16}$.

Physiological Action. *On Animals.*—It first excites, perhaps by the stimulus of pain, the movements of the heart and the respiratory muscles, occasions vomiting, sometimes of a bloody liquid, causes bloody urine to be frequently voided, then produces insensibility, paralysis, a rapid pulse, and gradual death; after which the odor of the oil can be detected in the cavities of the body and in the blood and urine. The intestines are congested, and their epithelium exfoliated; the kidneys are greatly congested, and the urinary bladder injected.

On Man.—Applied to the skin, oil of savin does not vesicate nor produce any marked redness. Internally, small and repeated doses produce more or less vascular excitement, with heat of head and flushed face; and larger, but not poisonous doses increase the secretion of urine and cause vesical and rectal irritation, while the odor of the oil exhales from the skin, breath, and urine. In cases of poisoning by this oil, these symptoms occur in an aggravated form, together with violent and continuous vomiting, and in pregnant females it may produce abortion and the death of the mother. The case of an infant is related who died from inhaling the fumes of oil of savin, from a bottle which had been left open near its cradle, after having been used to bathe the child's hip.

Medical Uses.—Oil of savin is an appropriate medicine in all of the cases to which savin itself is applied, that is to say, in *amenorrhœa* depending upon a torpid condition of the organs of generation, and in *dysmenorrhœa* occurring under similar conditions. Its repute as a remedy for *sterility* arises from its stimulant influence upon those organs, and the same is true of its power to control passive *uterine hemorrhage* and *leucorrhœa*, especially of uterine origin. In all of these cases, its efficacy depends upon its power of stimulation. Locally, oil of savin has been applied to benumb the sensibility of exposed nerves in *dental caries*, and to promote the shrivelling of *condylomata*.

The *dose* of this oil is from two to ten drops. It may be given in emulsion, pill, or alcoholic solution.

OLEUM SASSAFRAS, *U. S.*—OIL OF SASSAFRAS.

Essence de sassafras, Fr.; *Sassafrasöl*, G.

Preparation.—Oil of sassafras is distilled in Maryland and various other parts of the United States, mostly in the neighborhood of those places where a supply of the root may be obtained without requiring much transportation. The stills used are made of copper or iron, and usually connected with a lead condenser. The roots, together with the adhering bark, are cut into chips, about ten bushels of which constitute a charge, and yield on an average about four pounds of the oil, the distillation requiring about twelve hours (Procter, 1866). If the root is dug up shortly after the tree has been cut, it appears to yield a colorless or yellow oil, but if the stumps are permitted to remain in the ground for some time they acquire a red color and yield a brown-red oil.

Properties.—As stated, oil of sassafras is either colorless or more frequently of various shades of yellow or brown-red, a difference which does not affect its quality. When carefully rectified, it may be obtained colorless, but on exposure again becomes colored. It has the odor of sassafras in a high degree, a warm aromatic taste, and a slightly dextrogyre rotary power. Its specific gravity is usually about 1.090, and increases somewhat by age. It dissolves small quantities of water, becoming lighter thereby. It is soluble in four or five parts of 80 per cent. alcohol, acquires with cold nitric acid a dark-red color, being finally converted into a red resin, and is violently acted on by bromine, but dissolves iodine quietly.

Composition.—According to Grimaux and Ruotte (1869), potassa solution extracts from oil of sassafras a body which appears to be a phenol, has the odor of eugenic acid, and assumes a bright-green color with ferric chloride. By fractional distillation, a hydrocarbon, *safrene*, $C_{10}H_{16}$, is obtained, which boils between 155° and 157° C. (311° and 314.6° F.), and is dextrogyre. The oxygenated portion, *safrol*, $C_{10}H_{10}O_2$, constitutes nine-tenths of the oil, is without action on polarized light, distils between 230° and 235° C. (446° and 455° F.), remains liquid at —20° C. (—4° F.), and yields with bromine crystals of $C_{10}H_5Br_5O_2$. On cooling the oil in a freezing mixture, Saint-Evre (1843) obtained crystallized *sassafras-camphor*, $C_{10}H_{10}O_2$, which remained solid at 5° C. (41° F.), and after being fused, congealed again at 7.5° C. (45.5° F.).

Off. Prep.—Syrup. sarsaparillæ comp., Trochisci cubebæ, *U. S.*

Medical Action and Uses.—The action and uses of this oil do not differ materially from those of numerous other essential oils. It is alleged, however, to prevent the usual effects of tobacco when mixed with it and smoked, and the narcotic action of hyoscyamus when associated with that drug. The *dose* is from two to ten drops.

OLEUM SESAMI, *U. S.*—BENNE OIL.

Huile de sésame, Fr.; *Sesamöl*, G.

Preparation.—Oil of benne is obtained by subjecting benne seeds to pressure; the yield is in the neighborhood of 50 per cent. of the weight of the seeds. About 14,000 gallons of this oil are annually imported into the United States.

Properties.—Benne oil has a yellow color, usually of a deeper hue than expressed almond oil, is nearly inodorous, has a bland and agreeable taste, and the specific gravity 0.923 at 15° C. (59° F.). Near the freezing point of water, it congeals to a yellowish-white mass, and when heated to between 150° and 200° C. (302° and 392° F.) it is decolorized. At 300° C. (572° F.) it assumes a brown color, and at 335° C. (635° F.) it commences to boil. It is a non-drying oil, and on exposure to air does not readily turn rancid. Concentrated sulphuric acid converts it into a brown-red gelatinous mass, nitric acid specific gravity 1.18 colors it gradually orange-yellow, and when of greater strength, red.

Composition.—Flückiger (Pharmacographia) found benne oil prepared by himself to contain 76 per cent. of olein; the acids of the solidifying portion appear to be stearic, palmitic, and myristic acids. A small quantity of a peculiar, probably resinous substance may be extracted from the oil by agitation with glacial acetic acid or with alcohol; the acetic solution acquires a greenish-yellow, the alcoholic solution a blue, afterwards greenish-yellow color on the addition of a cold mixture of equal weights of sulphuric and nitric acids. (See also p. 950.)

Medical Action and Uses.—In Hindostan the natives use the expressed oil for the same purposes for which olive oil is employed elsewhere; but, according to some of the native practitioners, it possesses emmenagogue virtues, and is capable, if incautiously employed, of producing abortion.

OLEUM SINAPIS, *P. G.*—OIL OF MUSTARD.

Oleum sinapis æthereum.—*Volatile oil of mustard,* E.; *Essence de moutarde,* Fr.; *Ætherisches Senföl,* G.

Preparation.—Black mustard seeds are ground, deprived of most of their fixed oil by pressure, macerated with water at the common temperature, and then distilled. A small quantity of ground white mustard seed is usually added to supply any possible deficiency of myrosin and insure the decomposition of all the myronic acid. Since oil of mustard is soluble in water, the aqueous portion of the distillate is used in macerating a fresh portion of mustard. The yield is usually about $\frac{1}{2}$ per cent., but occasionally as high as one per cent.

Properties.—The crude oil has a yellow color; after rectification it is colorless, or nearly so. It is neutral to test-paper, has the specific gravity 1.017, boils at 150° C. (302° F.), is somewhat soluble in water, freely so in alcohol and ether, and has a very pungent and acrid odor and taste. The oil dissolves completely in three times its volume and more of concentrated sulphuric acid without coloration; in the presence of other volatile oils a brown or red color is produced.

Composition.—Oil of mustard is *sulphocyanide of allyl*, $C_3H_5.CNS$. Sometimes it contains also allyl cyanide, which has a lower boiling point. It is artificially prepared by decomposing allyl bromide or iodide by means of an alcoholic solution of potassium sulphocyanide. Using an allyl iodide, obtained from glycerin and phosphorus iodide, Gerlich (1875) obtained a mustard oil which consisted of *isopropyl sulphocyanide*, $C_3H_7.CNS$, the density of which is 0.974. Mylius (1877) found in the artificial oil of commerce, besides 92.2 per cent. of allyl-mustard oil, some hydrocyanic acid, carbonsulphide, and polysulphides.

Pharmaceutical Uses.—SPIRITUS SINAPIS, *P. G.*, Spirit of mustard, *E.*, Senfspiritus, *G.*, is a solution of one part of oil of mustard in 50 parts of alcohol.

Medical Action and Uses.—Oil of mustard is a powerful and almost caustic irritant, which, for fear of accident, should never be prescribed internally. It is said that this oil may sometimes be applied as an external counter-irritant upon parts to which a blistering plaster cannot readily be adapted; but there are none upon which cantharidal collodion cannot as readily be painted as the oil. As a rubefacient it may be used dissolved in olive oil or alcohol in the proportion of about five drops to the fluidrachm.

OLEUM SUCCINI, *U. S.*—OIL OF AMBER.

Huile volatile de succin, Fr.; *Bernsteinöl*, G.

The volatile oil obtained by the destructive distillation of amber.

Origin.—Amber (*succinum*) is a fossil resin, which is principally obtained on the southern coast of the Baltic, where it is cast ashore or dug out of beds. It has also been found in the interior of Europe, and in Greenland and North America. It is hard, brittle, whitish-yellow or red-brown, semi-transparent or translucent, breaking with a conchoidal fracture, fragrant when heated, fusible at about 287.5° C. (550° F.); soluble in chloroform, but insoluble in water, alcohol, ether, and oils. Its density is 1.070. According to Goeppert, it is the exudation of *Pinitis succinifer*, an extinct coniferous tree.

Preparation.—The oil is obtained by the dry distillation of amber, succinic acid being formed at the same time (see page 77).

Properties.—Crude oil of amber is a thick, brown liquid, of a strong empyreumatic odor, and variable specific gravity approaching the density of water. Very similar products are obtained from copal, dammar, and other resins. In this state it is rarely employed in medicine, but is used in preparing

OLEUM SUCCINI RECTIFICATUM, *U. S.; Rectified oil of amber.*—This is directed to be made by mixing the crude oil with six times its volume of water, and distilling as long as oil is found in the distillate. The yield is usually stated to be from sixty to seventy per cent. of the crude oil; but Ebert (1865) prepared the crude oil, obtaining from twenty-nine troyounces of amber twenty-one fluidounces of oil, specific gravity 0.985, and on rectifying this with water, only two and a half fluidounces or nearly twelve and a half per cent. of rectified oil, specific gravity 0.903, while the density of the residue had increased to 1.019. Döpping (1847) observed that the crude oil, after having been treated with potassa solution, dilute sulphuric acid, caustic potassa, and calcium chloride in succession, distilled between 140° and 170° C. (284° and 338° F.) and left a dark-brown residue. On again treating the distillate with burned lime, and repeating the distillation, the liquid had a higher boiling point (up to 190° C., 374° F.), and was colorless.

Rectified oil of amber is colorless or yellowish, becoming darker on exposure, varying in density between 0.88 and 0.99, and in the boiling point as stated above. It has a warm acrid taste, yields, with 15 parts of alcohol, specific gravity 0.85, a turbid solution, is readily soluble in ether, fixed and volatile oils, and when heated dissolves sulphur and caoutchouc.

Composition.—In its purest state oil of amber appears to be a mixture of several oils having the composition of oil of turpentine, $C_{10}H_{16}$.

Medical Action and Uses.—Oil of amber is a powerful irritant of the skin. When taken internally it is said to be stimulant and antispasmodic. It has been given internally in *retrocedent gout* and *rheumatism*, *eruptive fevers*, *hysteria*, *whooping cough*, and *amenorrhœa*. Externally it may be employed in stimulating liniments for *rheumatism* and *paralysis*, and rubbed upon the spine in the *convulsive disorders* of children. It has been applied as a stimulant discutient to *hemorrhoidal tumors*. The *dose* is from five to ten drops, and on account of its acrid and offensive taste the oil should be inclosed in gelatin capsules.

OLEUM TABACI, *U. S.*—OIL OF TOBACCO.

Huile pyrogénée de tabac, Fr.; *Brenzliches Tabaksöl*, G.

Preparation.—Take of Tobacco in coarse powder twelve troyounces. Put it into a retort of green glass, connected with a refrigerated receiver, to which a tube is attached for the escape of the incondensable products. Then, by means of a sand-bath, heat the retort gradually to dull redness, and maintain it at that temperature until empyreumatic oil ceases to come over. Lastly separate the dark oily liquid in the receiver, from the watery portion, and keep it in a well-stopped bottle. *U. S.*

Properties and Composition.—The so-called oil of tobacco is a brown-black tarlike liquid, of a strong and very peculiar empyreumatic odor. Unverdorben (1826) recognized in it the presence of an alkaloid, which, on being boiled with diluted sulphuric acid, yields among other products *odorin* or *picolin;* it is not unlikely that others of the ternary bases, contained in animal oil (see page 961), may likewise be present in this tarry product. Zeise (1843) demonstrated the presence of butyric acid, ammonia, paraffin, empyreumatic resin, and a pale yellow oil of the formula $C_{11}H_{22}O_2$, which boils at 195° C. (383° F.). Melsens (1843) proved the presence of nicotina in the tarry matter separating in tobacco pipes, and it is most likely present in the officinal oil.

Physiological Action and Medical Uses.—In animals poisoned by this oil, the blood is uncoagulated. From two to five grains of it given to dogs two or three times a day produced gradual but complete marasmus, partial paralysis of the hind legs, loss of venereal power with softening and shrivelling of the testicles, shedding of the hair, sloughing of the eyelids, and blindness. The gums were swollen, spongy, and bleeding, and the teeth became loose. The oil of tobacco, in the form in which it accumulates in the bowls of smoking-pipes, is a virulent poison even when applied to eruptions upon the skin. The immediate effects are pallor, vertigo, faintness, nausea, vomiting, cold sweating, diarrhœa, and paralysis of the lower limbs. It is remarkable that there appears to be no fatal case of poisoning by this oil, on record, except in the case of a child in whom the oil from a tobacco pipe was applied to an ulcer on the lip. The oil of tobacco has been used to cure various chronic local *affections of the skin;* but considering its doubtful utility and the unquestionable danger of its use, it were far better that it should not be used at all.

OLEUM TEREBINTHINÆ, *U. S.*, *Br.*—OIL OF TURPENTINE.

Essence de térébenthine, Fr.; *Terpentinöl*, G.

Preparation.—Oil of turpentine is obtained by distilling the oleoresinous exudation of various species of Pinus (see Terebinthina). The crude turpentine is put into a large still, heat is applied, and water added from time to time to the contents of the still. The distillation is continued as long as oil passes over, when the resinous mass is run off through a stopcock placed at the bottom of the still, is passed through several strainers, and then constitutes *rosin* (see Resina). On condensing the distillate, the oil of turpentine separates from the water and is dipped into barrels in which it enters commerce.

Properties.—Oil of turpentine is a colorless thin volatile oil, the density of which varies between 0.86 and 0.87. When recently rectified it boils at about 150° C. (302° F.), but the temperature usually rises as the distillation progresses, and old oil does not generally commence to boil below 155° or 160° C. (311° or 320° F.). As procured from different sources, oil of turpentine shows great differences in its optical behavior, and on fractional distillation with or without water, oils are obtained differing in the degree of their influence upon polarized light. American and German oil of turpentine are dextrogyre, while the French oil has a lævogyre action. Odor and taste are peculiar, strongly terebinthinate, differing to some degree according to the source from which the oil has been obtained. When recently distilled, particularly after rectification with water, the odor is rather mild, but after exposure to air it becomes stronger, more unpleasant and pungent; the oil then contains ozone, and gradually acquires a yellowish color and thicker consistence; at the same time resin and formic and acetic acids are produced, and, in the presence of moisture, also a hydrate of the oil. Oil of turpentine dissolves in ten or twelve parts of alcohol of specific gravity 0.835, and in a much smaller quantity of stronger alcohol. Bromine and powdered iodine act violently upon oil of turpentine; nitric acid oxidizes it, the violence of the action and the final products being influenced by the strength of the acid. Gaseous hydrochloric acid unites with oil of turpentine, forming two compounds: one, having the composition $C_{10}H_{16}HCl$, is known as *artificial camphor*, is crystallizable, and has the odor and taste of ordinary camphor, but is less pungent and somewhat terebinthinate. Three compounds with water are known; one, which is called *turpentine camphor* or *terpin*, has the composition $C_{10}H_{20}O_2$, and is obtained by leaving the oil in contact with alcohol and nitric acid.

Purification.—Only rectified oil of turpentine should be used internally. The partially resinified oil is best purified by rectification with water; or it may be repeatedly agitated with small portions of alcohol, which dissolves the resin, and afterwards with water.

Composition.—When perfectly pure, oil of turpentine is free from oxygen, and has the composition $C_{10}H_{16}$. On being distilled in the presence of sulphuric acid, it is converted into several isomeric or polymeric oils, of which *tereben* has a thyme-like odor, and boils at 156° C. (312.8° F.), and *colophen* boils at 310° C. (590° F.) and shows a blue fluorescence; the latter is also obtained on the dry distillation of rosin.

Off. Prep.—Confectio terebinthinæ, Enema terebinth., *Br.;* Linim. cantharidis, *U. S.;* Linim. terebinth., Linim. terebinth. aceticum, Unguent. terebinthinæ, *Br.*

Physiological Action.—Numerous experiments upon animals prove that oil of turpentine, however applied, is rapidly absorbed, and produces, according to the quantity employed, more or less of its characteristic effects, *e. g.*, stimulation of the nervous system when relatively small doses are used, and paralyzing effects when large quantities are administered. The urine is increased and may be rendered bloody, the animals lose their muscular force and coördination, the breathing is laborious, and the action of the heart quickened. Death takes place by exhaustion and asphyxia. Its local operation is that of an irritant, causing pain, redness, and even vesication. In man the prolonged inhalation of the vapors produces vertigo, impaired vision, pain in the loins, strangury, and bloody urine, and, if very concentrated, a state of collapse. In females, menorrhagia and dysmenorrhœa are sometimes added. The internal administration of large doses of the oil has produced heat in the stomach, vertigo, confusion of mind, extreme thirst, strangury, and a frequent discharge of urine exhaling an odor of violets. The bowels are not disturbed. Sometimes it causes itching and diaphoresis. Excessive or poisonous doses occasion graver symptoms. Thus, when six ounces were taken by a woman, her body was found in a state of opisthotonos, the pupils were dilated, and the brain, lungs, stomach, and heart gorged with blood. Yet a child aged fourteen months has recovered after swallowing four ounces of the oil. It is recorded that the air of a cellar where turpentine was stored, and in which a boy was nearly asphyxiated, was found to be nearly deprived of its oxygen.

Medical Uses.—It has been used with success in almost every form of *hemorrhage*, but most successfully when the bleeding was passive. The special affections include *epistaxis*, *hæmatemesis*, *hæmaturia*, *menorrhagia*, *post-partum* hemorrhage, *purpura*, and the multiple hemorrhages occurring under the influence of the *hemorrhagic diathesis.* Even in external and traumatic hemorrhages it has proved efficient. Its efficacy justifies the opinion of John Hunter, who termed it "the best, if not the only, true styptic."

In *puerperal fever* this medicine once enjoyed a high repute, which it has in a great measure lost at the present time. For this varying estimate of its value a reason may probably be found in the indiscriminate manner of its employment. When it was prescribed in cases marked by a typhoid state in which excessive tympanites existed, there is no reasonable ground for doubting that it often successfully combated the nervous and cardiac depression of the disease, and, by lessening the distension of the abdomen, diminished the mechanical hindrances to hæmatosis. For the latter purpose it was applied as an epithem to the abdomen, as well as administered internally. This judgment appears to be justified by its recognized effects in other febrile affections of a typhoid type. In *typhus*, for example, it is of great utility both internally and externally; not only for its power of arousing the sluggish functions generally, but especially for combating the pulmonary congestion which is the gravest of the usual incidents of the disease. In *typhoid fever*, besides the general influences already mentioned, it is not only one of the most efficient remedies for intestinal tympanites, as in the cases referred to, but it also favorably controls the bronchial catarrh, and, in the advanced stages, probably exerts a local stimulant action upon the intestinal ulcers, and checks the tendency to hemorrhage from them. So, too, in *yellow fever* of a low type, it may operate not only by its general stimulation, but also by its direct action upon the stomach, tending to control the hemorrhage which is so grave a symptom in that disease. Its possible action in promoting the urinary secretion in this fever should not be overlooked. In *tympanites*, from whatever cause arising, it may become a valuable auxiliary in the treatment, whether administered by the mouth or rectum, or applied to the skin of the abdomen. When given internally for the relief of this symptom it should generally be associated with a purgative, especially with castor oil. It is most efficient in the treatment of *tænia*, and, indeed, in that of other *intestinal worms*, when a full dose of it is shortly followed by one of castor oil.

Oil of turpentine has been supposed to dissolve *biliary concretions*, and in some cases it has, when associated with sulphuric ether, appeared to favor their discharge. It seems more probable that it should tend to prevent the formation of gallstones than to dissolve them when once formed. Its diuretic virtues have caused it to be occasionally used to promote the expulsion of *urinary concretions*. Impregnating the urine, it becomes a suitable remedy for *catarrh of the urinary passages*, and in debility or *paralysis of the bladder;* and, very probably, in females this stimulation has served to cure *amenorrhœa* and to excite *uterine contractions* during labor. For these purposes, however, the oil is best administered by the rectum.

Although the *modus operandi* of this medicine in *sciatica* is totally unknown, its curative power is none the less certain. It has stood the test of a century's experience. Probably no other remedy is comparable with it in chronic examples of this painful and crippling affection. Some difference of opinion exists concerning the proper dose which should be given; some prescribing half an ounce of it at bedtime for several successive nights, and others a dose of thirty drops three times a day. The latter dose is to be preferred at first. It may be gradually increased if necessary. It has also been used in *facial neuralgia*, but apparently with inferior results. Its utility in *syphilitic iritis* is well established; it has generally been employed as a substitute for mercury in cases for which this medicine was ill adapted.

In all forms of *chronic bronchitis*, oil of turpentine has, like other terebinthinates, been largely used, formerly by internal administration, and more recently by inhalation. It is especially useful, in both ways, in cases of *fetid bronchitis* and *gangrene of the lung*, in both doubtless by stimulating the tissues to a more healthy action rather than by any disinfectant virtue. The superiority of oil of turpentine, in the latter affection, over other terebinthinates, consists in its greater stimulant virtues. The accidental discovery of the power of oil of turpentine to prevent *phosphorus poisoning* has saved many lives. The immediate administration of the antidote is, of course, desirable, not only to check the local action of the phosphorus, but also to prevent its absorption in a dangerous form. About twelve hours has been assigned as the limit within which the oil is efficacious. It is alleged that oil of turpentine which has become oxygenated by long exposure to the air is the most efficient; but results do not entirely agree upon this point. The oil must not be prescribed in any oily or albuminous vehicle, such as white of egg, milk, soup, etc., and neither mucilaginous nor alcoholic drinks should be allowed, but only water. If possible the oil should be given pure; floated on water, or in capsules. If it cannot be retained by the stomach, it may be thrown into the rectum; and its absorption by the skin from liniments and epithems, and by the lungs from an atomized preparation, or simply from the air of the chamber saturated with the fumes of the oil, may be employed as a supplementary means. The *dose* of oil of turpentine in the cases now considered is about ten drops every hour.

Oil of turpentine has long been employed *externally* as a stimulant, rubefacient, and counter-irritant in *chronic rheumatism.* It is generally mixed with olive oil, chloroform, camphor, narcotic extracts, etc. Baths of the vapor of the oil are the most efficient means of applying it; but warm water baths, in which has been dissolved a mixture of eight ounces of oil of turpentine and two pounds of washing soda, have also been used with good effect. The oil is of singular virtue in relieving *tympanites* and *colic* in various diseases, but especially when the intestinal distention is owing chiefly to atony of the bowels, as in typhoid fever. It is best applied, mixed with olive oil, to the skin, which should then be covered with flannel dipped in hot water and wrung nearly dry. In the treatment of *burns* this oil is most efficient. The affected part should first be bathed with the oil and then covered with soft lint saturated with liniment of turpentine, or ointment of turpentine, so as thoroughly to exclude the air. Traumatic *erysipelas* has been treated advantageously by the ointment just mentioned, and also by simple lotions of oil of turpentine. The same method is equally applicable in cases of *frost-bite*, and of superficial *gangrene.* An emulsion containing equal parts of oil of turpentine and tincture of camphor is said to be an efficient dressing for *carbuncles.* Indeed, there are few *ulcers* of an indolent character that are not benefited by this oil, applied either alone or in an ointment or cerate, as in the simple or compound resin cerate. Ulcers resulting from *mercurial salivation* tend to heal after being touched by the pure oil, or washed with an emulsion containing it. It has been used successfully in the treatment of *scabies.*

The *dose* of oil of turpentine as a stimulant is from five to twenty or thirty drops three times a day. Such doses are conveniently administered in gelatin capsules. As an anthelmintic from two to four fluidrachms may be given at intervals of half an hour, until three or four doses are taken. These doses are usually prescribed in an emulsion, with the addition of oil of cinnamon, cajeput, or rosemary, to diminish nausea. Besides the rubefacient preparations above mentioned, a very efficient one may be made with equal weights of oil of turpentine, acetic acid, and liniment of camphor.

OLEUM THEOBROMÆ, *U. S.*, *Br.*—OIL OF THEOBROMA.

Oleum (Butyrum) cacao, P. G.—*Butter of cacao*, E.; *Beurre de cacao*, Fr.; *Cacaobutter*, G.

Preparation.—In the manufacture of chocolate a portion of the cacao seeds are deprived of their fat by heating them gently, removing the shells, and pressing them between hot iron plates; the expressed fat is usually run into rectangular moulds, and allowed to congeal. The yield from different varieties of cacao is from 40 to 45 per cent.

Properties.—Cacao butter is a yellowish-white fat, sufficiently hard at the ordinary temperature to be broken into smaller pieces, but softens by the warmth of the hand, and melts when taken in the mouth. It has an agreeable odor, and a bland chocolate-like taste, dissolves in ether, acetic ether, and by the aid of heat in strong alcohol, separating again from the latter solution on cooling, with the exception of a small portion which remains dissolved. The specific gravity of cacao butter appears to be usually near 0.90, but is given by some authors as high as 0.961. The fusing point of cacao butter obtained from different commercial varieties of seeds has been determined by Trojanowski (1875) and Lamhofer (1877), and found to vary between 30° C. (86° F.) and 33° C. (91.4° F.). Pelouze and Boudet found it in one instance as low as 29° C. (84.2° F.).

Composition.—When saponified, cacao butter yields glycerin, oleic, stearic, and a little palmitic acid (Stenhouse, Specht, and Gössmann). It probably contains also arachic acid (Pharmacographia).

Adulterations.—When mixed with other solid fats, the fusing point and specific gravity do not afford reliable tests for determining such admixtures. Björklund (1864) proposed to dissolve 2 grams of the fat in 4 grams of ether at 17° C. (62.6° F.), and to immerse the test-tube containing the solution in water of 0° C. (32° F.); if pure, cacao butter will separate granules in not less than three minutes, but usually in five or eight minutes; if adulterated with tallow or suet, a turbidity will appear at once or within two and a half minutes, according to the quantity of the adulterant, of which 5 per cent. may thus be detected. When the congealed mixture is exposed to a temperature of about 14.5° C. (58° F.), it will gradually become clear again, if the cacao butter was pure, but not if it was adulterated.

Trojanowski and Lamhofer proved the value of this test. According to the latter, petroleum-benzin may be substituted for the ether with nearly identical results, except that the pure oil separates rather more slowly, and is always granular, while other fats render the entire liquid cloudy.

Off. Prep.—Cacao butter is an ingredient of all officinal suppositories, except three admitted by the "Additions to the British Pharmacopœia."

Medical Action and Uses.—Oil of theobroma has been used internally as a nutrient and emollient remedy in cases of chronic affections of the *lungs* and *bowels*, and externally as a dressing for excoriated surfaces, *wounds*, etc. Its mildness renders it superior to lard for the latter purposes, and it is more emollient than spermaceti. It is the most eligible material for making suppositories. Its slight tendency to become oxidized fits it to protect surgical and other steel instruments from being corroded by exposure to the air.

OLEUM THYMI, *U. S.*—OIL OF THYME.

Essence de thym, Fr.; *Thymianöl*, G.

Preparation.—The volatile oil is obtained by distilling the flowering herb of Thymus vulgaris, *Lin.*, with water. It is largely produced in France, and enters commerce either in the crude state as *huil rouge de thym*, *red oil of thyme*, or rectified as *huile blanche de thym*, *white oil of thyme*. During the year 1876–1877 the United States imported 32,707 pounds of the former, and 863 pounds of the latter kind. The red oil is frequently sold as *oil of origanum*.

Properties.—Crude oil of thyme is of a deep reddish-brown color; the rectified oil is colorless or yellowish. It has a strong aromatic odor, and a pungent, warm, and afterwards cooling taste, dissolves readily in alcohol, and varies in density between 0.886 and 0.905. It does not fulminate with iodine.

Composition.—The more volatile portion of oil of thyme consists of two hydrocarbons, *cymene*, $C_{10}H_{14}$, and *thymene*, $C_{10}H_{16}$. The former is also a constituent of oil of cumin (see p. 475). The latter boils between 160° and 165° C. (320° and 329° F.), is lævogyre, and yields with hydrochloric acid gas a liquid compound. The stearopten is *thymol*, $C_{10}H_{14}O$ (see Oleum monardæ, p. 979), and is obtained by fractional distillation of the oil, collecting only that portion which distils at about 230° C. (446° F.). By agitating the commercial oil with soda solution, Gerrard (1878) obtained only variable quantities of an oily liquid, but no solid compound, and on exposure to a low temperature, no thymol could be obtained; he concludes from this that the thymol is probably frequently extracted from the oil. He also ascertained that the strongest aqueous solution of thymol available is 1 in 1000, and that a solution of four grains of it in a fluidounce of alcohol is miscible with water without becoming turbid. Three grains of thymol are dissolved by one grain of caustic soda, and one and a quarter grain of caustic potassa. Fats and oils, when heated, are excellent solvents of thymol.

Physiological Action and Uses.—Experiment has proved that oil of thyme in the proportion of one part per thousand arrests saccharine fermentation; that it powerfully retards lactic fermentation, and checks the various processes of decomposition, even when used in relatively small quantities. It is comparatively harmless when administered internally, not disturbing digestion, but arresting gastric fermentation. It is ten times less poisonous than carbolic acid, and hence may be used even in equal quantities with a very inferior risk. Some persons find its taste and smell as repulsive as those of carbolic acid, but others claim for it an agreeable aromatic odor and taste. When taken internally by sensitive persons it causes ringing in the ears, and even deep somnolence, and collapse. It has been employed chiefly, but not exclusively, for its topical effects, to correct the *fetor* of suppurating and gangrenous *wounds* and *ulcers*, and, in atomized solution, the odor of the breath in *fetid bronchitis*. Injected into dead tissues it preserves them from decomposition; applied pure to *warts* it causes them to shrivel and disappear. In *skin diseases* it has been found useful in the same cases for which tar has so long proved to be the best topical remedy, that is to say, in *psoriasis* and chronic *eczema*, but especially in the former, and it has the advantage over tar of not staining the bed and body clothing. It is recommended to apply it in an ointment consisting of one ounce of soft paraffin, and from five to thirty grains of thymol; or in a lotion consisting of thymol, five grains; rectified spirit and glycerin, each one ounce; water, to make eight ounces.

As a substitute for the antiseptic surgical dressing prepared with carbolic acid, a solution is recommended as follows: Thymol 1 gram; alcohol 10, glycerin 20, water 1000 grams. This solution has no corrosive action on instruments immersed in it; it causes, however, a lively sensation of burning, accompanied with redness of the skin, but not with anæsthesia, and not followed by desquamation of the epidermis. Being substituted for carbolic acid in the antiseptic method of dressing wounds, the results are reported to be excellent. After forty-one out of fifty-nine operations the secretion was serous in only eight, and purulent in two; in the remainder there was absolutely no secretion. Many of these operations involved large surfaces, or were for diseased joints, etc. According to Ranke, the results obtained with thymol (antiseptically considered) are as good as those with carbolic acid; while the former presents these advantages, that the secretion of wounds treated by it is much less, and their rate of healing much quicker. Moreover, it produces no bad effects upon the system at large, and does not irritate the parts to which it is applied in solution. (*Medical Times and Gazette*, March, 1878).

OLEUM TIGLII, *U. S.*—Croton Oil.

Oleum crotonis, Br.—*Huile de croton, Huile de graines de tilly*, Fr.; *Crotonöl*, G.

The fixed oil obtained from the seeds of Croton tiglium, *Lin.*, s. Tiglium officinale, *Klotzsch.* Woodville, vol. v.; Bentley and Trimen, Med. Plants, 239.
Nat. Ord.—Euphorbiaceæ.

Origin.—This species of croton is common in the wild state as well as cultivated throughout Hindostan, and some of the East Indian and Philippine Islands, and has been introduced into Japan and other countries. It is about 15 or 20 feet high, has alternate petiolate, acutely-ovate, serrulate leaves, and terminal racemes of unisexual flowers. The fruit is a tricoccous capsule, nearly three-quarters of an inch long, each cell containing a single seed. The latter are about half an inch long, oblong, flattened upon the ventral surface, and marked longitudinally by the slightly elevated raphe. The dorsal surface is rounded. Externally the seed is of a gray-brown color, mostly more or less mottled, or of a nearly uniform blackish color, where the outer coat has been removed. The testa is brittle and incloses an oily albumen of the shape of the seed, and the foliaceous embryo. The seed is without odor, and has an oily afterwards very acrid taste.

Fig. 123.

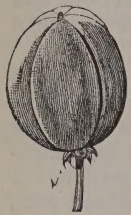
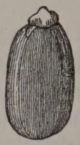


Fig. 124.



Croton tiglium, *Lin.*
Fruit. Seed.

Preparation.—The fixed oil is obtained in India and in Great Britain by subjecting the seeds to pressure. The yield is between 50 and 60 per cent. About 3700 pounds of croton oil are annually imported into the United States.

Properties.—Croton oil from India is of a pale-yellow color, that made in England is of a more or less deep reddish-brown hue, the darker color being probably due to the greater age of the seed and to the higher temperature at which the oil is expressed. It has a rather viscid consistence, is somewhat fluorescent, dissolves freely in ether, fixed and volatile oils, and varies in its behavior to alcohol, according to Warrington (1865) being more soluble in that menstruum when old and partly oxidized. At a low temperature it separates white granules of fatty acid; exposed to air it becomes more viscid, perhaps from the separation of fatty acids, and not from the presence of a drying oil, although, like the latter, it is not solidified when in contact with nitrous acid.

Composition.—The fats present in croton oil are glycerides of stearic, palmitic, myristic, and lauric acids, and of several volatile acids of the same series, like acetic, butyric, and valerianic acid; also the volatile *tiglinic acid* $C_5H_8O_2$, which was recognized by Geuther and Frölich (1870), but had previously been observed by Schlippe (1858), who considered it to be identical with angelicic acid. The chemists first named supposed tiglinic acid to be identical with methylcrotonic acid; it boils at 201.1° C. (394° F.), and in the fraction boiling above that temperature capronic, œnanthylic, or similar acids are probably present. They did not succeed in obtaining from croton oil an acid having the composition of Schlippe's *crotonic acid*, $C_4H_6O_2$. Schlippe's *crotonol*, $C_{18}H_{28}O_4$, has likewise not been obtained by other chemists; it was stated to be a yellowish viscid mass of a faint odor, and to be the rubefacient principle of croton oil. The drastic principle has not been isolated.

Tests.—The process of Schlippe for preparing crotonol has afforded us (1860) the means of detecting croton oil in other oils. The suspected oil is agitated with a solution of soda or potassa in dilute alcohol, the alcoholic liquid is separated, neutralized with hydrochloric acid, and a little of the oily layer separating is applied upon the arm, when in a few hours redness and the peculiar pustular eruption will appear. Should the quantity be small, the acidulated liquid is agitated with ether, the ether evaporated, and the residue applied.

Allied Oils.—See Curcas, page 483. The oil obtained by bisulphide of carbon from the seeds of Euphorbia lathyris, *Lin.*, has been recommended by Zander (1878) as a cheaper substitute for croton oil.

Off. Prep.—Linimentum crotonis, *Br.*

History.—Our knowledge of this medicine was derived from the Orientals through the Arabians; it having been used from time immemorial in Hindostan as a purgative and external irritant. It was introduced into Europe in 1820.

Physiological Action. *On Animals.*—The seeds, reduced to a paste and administered to dogs, produce painful purging, and after death evidences of violent inflammation of the mucous membrane of the stomach and intestine are discovered. In Java the seeds are employed for killing fish. The oil given to dogs acts rapidly as an emeto-cathartic. When injected into a vein, by one experimenter, five drops caused vomiting and purging, and death in two hours. The stomach and intestine were inflamed. The same experiment performed by others indicated an action of the oil in depressing the heart and the nervous system, but gave no evidences of irritation of the alimentary canal before or after death.

On Man.—A croton seed, when chewed, has a sweet and oily taste, followed by a bitter and acrid savor, and salivation; nausea, eructation, flatulent distension of the abdomen, colic, and diarrhœa follow. A single seed is reported, in one case, to have proved fatal. The oil, in the dose of one drop, occasions more or less of an acrid and burning sensation in the fauces and œsophagus, a sense of warmth in the stomach, nausea, and sometimes vomiting. In an hour or two some gurgling or slight colic is perceived in the bowels, followed somewhat suddenly by a watery stool with tenesmus, and heat about the anus. Within twenty-four hours, eight or ten more stools follow, and there is but little general disturbance of the economy, except considerable weakness. Sometimes, instead of producing a purgative effect, the oil causes epigastric uneasiness and oppression, palpitation of the heart, headache, feverishness, perspiration, and sleep. It would appear that the acrid principle of this oil is not the sole cause of its purgative operation, for even after being thoroughly washed with alcohol, and rendered mild to the taste as well as incapable of pustulating the skin, it is still strongly purgative. When given in enema, in the dose of three or four drops, croton oil acts purgatively.

In excessive doses this oil may act as a violent and fatal poison, producing severe pain, and general collapse, without loss of consciousness. After death no lesion of the stomach or intestines may be found. There are, on the other hand, cases in which recovery has followed excessive doses. For example, a girl six years old, having swallowed about forty-six grains of croton oil, mixed with milk and coffee, and when the stomach was empty, suffered acute gastric pain and violent and profuse vomiting. The emesis probably saved her life.

Externally, croton oil rubbed upon the skin occasionally produces purgation. Its ordinary effects are, however, local. In general, it brings out, after a few hours, an eruption of minute red pimples, which are always more numerous in proportion to the vascularity and delicacy of the skin, and are gradually converted into pustules, generally of an acuminated or rounded shape, while others are flattened and umbilicated. Many are confluent. A red areola surrounds them, and they cause severe burning and itching. They augment for three or four days and then remain stationary. Some break and others wither away. If numerous, they may form thick and extensive crusts. These are thrown off between the sixth and the twelfth day, and leave no cicatrix behind them. The endermic inoculation of the oil causes small but painful abscesses.

Uses.—In obstinate *constipation* of the bowels, and when there exists no contraindication arising from inflammation or structural alteration, croton oil is an appropriate purgative. But the observance of these conditions is very important. The oil is most appropriate when bulky doses are objectionable, and when the patient resists the administration of more usual cathartics. Of the former sort are cases of intestinal obstruction from accumulated feces, produced by simple torpor of the bowels, diseases of the nervous centres, the poison of lead, etc. Of the latter, are the frequent instances of a refusal to take medicine, among children and insane persons; but the oil should rarely be given to children. It is customary to administer it to the insane in milk or broth: a most vicious and inhuman practice, since it causes an aversion to those articles upon which the patients' lives may depend. In *lead colic* it has, to a great extent, superseded other purgatives. It should be given in the dose of one drop daily, or twice a day, and need not interfere with the simultaneous use of narcotics internally and externally. Like other active purgatives, it has been used to expel *tæniæ;* and it is even said to have produced this effect when mixed with olive oil and rubbed upon the abdomen; but many surer remedies for these parasites exist. In like manner, it has been used successfully as a drastic purgative in different forms of *dropsy;* but it is unnecessarily harsh. Its irritant substitutive action has been invoked in *dysentery;* but safer and less harsh remedies are to be preferred. In *apoplexy*, it is customary to employ it for its depletory revulsive action and for the convenience of its administration during the stupor of the attack. If the attack is one of congestive apoplexy, denoted by turgor of the face, laboring heart and pulse, etc., purgation is generally indicated; but in an opposite condition it is contraindicated.

Externally, croton oil has been used to relieve cerebral symptoms following the suppression of a cutaneous eruption and other causes; and in the various forms of *meningitis* it is the most efficient mode of counter-irritation of the scalp. It is less painful than tartar-emetic pustulation, and more permanent in its action than cantharides. It is much used as a counter-irritant in spinal *neuralgia*, but is objectionable on account of the difficulty of restricting its action to a very limited area. It has been more successful in *sciatica* than in any other form of neuralgia. For this affection it has also been recommended internally, but upon less substantial grounds. It has been applied locally in chronic articular *rheumatism*, and is undoubtedly one of the best of the topical remedies for this disease. Its moderate but steady counter-irritation renders it peculiarly valuable in cases of *chronic bronchitis* and *chronic laryngitis.*

Tinea tonsurans, or ringworm of the scalp, has been treated successfully by croton oil, which is applied pure until the characteristic eruption appears, when a poultice is used to soften and remove the crusts of the original disease, and those produced by the oil. It is recommended, when a large portion of the scalp is involved, that a small portion only should be treated at a time, on account of the irritation and fever which usually are excited.

Administration.—Croton oil may be given in emulsion, or mixed with some other oil, or in pill. Of these forms the last is to be preferred. The *dose* is from one-quarter of a drop to two drops. The following is a safe and convenient prescription: Add to two drops of croton oil enough alcohol to dissolve them, and then bread crumb in sufficient quantity. Make from four to eight pills, and direct one to be taken every hour or two. Externally, the oil may be applied by means of a feather, brush, or other convenient instrument, and friction made with a rag until the skin becomes dry. It may be used pure or mixed with castor oil, olive oil, soap liniment, alcohol, or ether; or a piece of adhesive plaster may be moistened with the oil to within a quarter of an inch of the edges, and then applied to the skin. A mixture of one part of croton oil with seven of oil of turpentine is more rapid in its action than the oil alone.

As antidotes to the *poisonous* effects of this oil, milk, olive oil, mucilage, gelatin soup, etc., may be given to envelop the acrid substance, and if it cause a tendency to collapse, opium and alcoholic liquids and warm stimulating baths should be employed.

OLEUM VALERIANÆ, *U. S.*—OIL OF VALERIAN.

Essence de valériane, Fr.; *Baldrianöl*, G.

Preparation.—The volatile oil is obtained by distilling the crushed root with water. The yield varies between ½ and 2 per cent., and is largest from valerian grown in dry localities. 5 pounds of oil of valerian were imported into the United States in 1876, and 103 pounds in 1877.

Properties.—When recently distilled from fresh root, the oil of valerian is of a greenish or yellowish color, limpid, and of a mild odor. On exposure to air, it becomes deeper yellow and brown, viscid, and acquires a strong odor. Old roots yield at once a dark and strongly odorous oil. Its taste is aromatic, somewhat camphoraceous, not burning; its density is near 0.94. It is readily soluble in alcohol, does not fulminate with iodine, and becomes purplish-black with ethereal solution of bromine, dark red with sulphuric acid, purplish-red with hydrochloric acid gas, and blue with nitric acid.

Composition.—The latest investigation is by G. Bruylant (1878), who ascertained some new facts. The hydrocarbon $C_{10}H_{16}$ was named *borneene* by Gerhardt (1841) and *valerene* by Pierlot (1859). The *valerol* of the latter differed from Gerhardt's valerol, $C_6H_{10}O$, which he believed to become oxidized in contact with air to *valerianic acid*, carbonic acid being given off at the same time. Bruylant explains the generation of valerianic acid in old oil of valerian from the decomposition of $C_{10}H_{17}C_5H_9O_2$, which is the valerianic ether of borneol. Besides this one, it contains the corresponding ethers of formic and acetic acids, the alcohol *borneol*, $C_{10}H_{18}O$, and its ether, $(C_{10}H_{17})_2O$. Gerhardt assumed the production of borneol from the hydration of borneene. (See Oleum camphoræ, page 966.)

Medical Action and Uses.—In experiments upon animals with poisonous doses of this oil, it appeared to blunt the reflex excitability after having primarily stimulated it, and to produce a similar effect when the same function was previously excited by strychnia. It has been used with advantage in *hysteria*, *chorea*, and even in *epilepsy*; but it is most efficient in the first-named disease, and in the various functional nervous derangements which, without constituting hysteria, are nevertheless hysterical. It may be prescribed in *doses* of one drop and upwards in pill, emulsion, or alcoholic solution.

OLIBANUM, *P. G.*—FRANKINCENSE.

Gummiresina olibanum, *Thus.*—*Oliban*, *Encens*, Fr.; *Weihrauch*, G.

From Boswellia Carterii, *Birdw.*, and other species of Boswellia. Trans. Linn. Soc., XXVII. t. 29, 30, 31; Bentley and Trimen, Med. Plants, 58.

Nat. Ord.—Burseraceæ.

Origin.—The genus Boswellia is confined to India, Southern Arabia, and Eastern Africa. It comprises trees with impari-pinnate leaves, serrate leaflets, small, racemose, decandrous flowers, and three-celled drupaceous capsules containing three seeds. The different species are still imperfectly known. B. Carterii may possibly be a polymorphous species, or several forms at present regarded as mere varieties may be distinct species, which grow only in two limited districts in Southeastern Arabia and in the Somali country of Eastern Africa. B. papyrifera, *Richard*, indigenous to Nubia and Abyssinia, yields a similar product, which, however, is not collected. B. thurifera, *Colebr.* (B. serrata and B. glabra, *Roxb.*), affords a soft odorous resin which is used in India as incense. The fragrant resin of B. Frereana, *Birdw.*, of the Somali country, is used in the East as a masticatory.

Collection.—The collection of olibanum in the Somali country was described by Cruttenden (1846), and in Arabia by Carter (1847), who had visited these countries three years previously. Deep incisions are made from which a milk-white exudation flows, which gradually hardens, and is then collected. Olibanum enters commerce by way of Bombay.

Description.—Olibanum consists of roundish, oblong, or irregular shaped separate tears. These vary in diameter between one-eighth and one-half inch or more, and are nearly colorless, pale yellowish, or of a reddish hue, and covered with a whitish powder, resulting from the attrition of the pieces. When broken they exhibit a flat scarcely conchoidal fracture and a waxy lustre. Olibanum has a balsamic somewhat terebinthinate odor, softens between the teeth, and has a balsamic and slightly bitter taste. Triturated with water, it yields a white emulsion; alcohol dissolves the greater part of it. When heated, it becomes soft and burns, diffusing an aromatic odor.

Olibanum of inferior quality is more deeply colored, often opaque, and more or less mixed with fragments of bark and other impurities.

Constituents.—By distilliation with water, a volatile oil is obtained, varying in quantity from 4 (Stenhouse, 1840) to 7 per cent. Kurbatow (1871) found it to consist of *olibene*, $C_{10}H_{16}$, and an oxygenated portion boiling above 175° C. (347° F.). Olibene is the chief constituent of the oil, boils at about 157° C. (314.6° F.), has a turpentine-like odor, and yields with hydrochloric acid gas a crystalline compound. The resin amounts to 56 (Braconnot, 1808) or as much as 72 per cent. (Kurbatow), and, according to Hlasiwetz (1867) has the composition $C_{40}H_{30}O_6$. The gummy matter contained in olibanum was found by Hekmeijer (1858) to agree in behavior with gum arabic.

Pharmaceutical Uses.—Olibanum is a constituent of most *fumigating powders*, for which there are a large number of formulas in existence; they contain also benzoin, storax, mastic, amber, cascarilla, orris root, sandal wood, or other odoriferous drugs, which are reduced to a coarse powder, and when used thrown upon a heated surface. *Fumigating pastilles* are made of a similar composition, and should contain about 40 per cent. of ligneous material or charcoal, and from 5 to 8 per cent. of potassium nitrate; the finely-powdered ingredients are well mixed, formed into a mass with mucilage of tragacanth, and then made in the desired shape.

Medical Action and Uses.—Although no longer officinal in either the United States or the British Pharmacopœia, olibanum is one of the most ancient, as it once was one of the most valued, of medicines. It was the frankincense of which so much is said in the Old Testament, and which was used by the Egyptians in embalming; it is spoken of in the Hippocratic writings as an expectorant in bronchial catarrh and in infantile asthma, as useful in expelling the lochia and promoting menstruation, as an ingredient of injections for leucorrhœa, and of ointments for various ulcers, including those caused by burns. Later it was applied in ointments to *chilblains*, *cutaneous eruptions*, and *inflammations of the eyes*. More recently it was an ingredient of various stimulating plasters, and its fragrant fumes were used to conceal unpleasant smells. The *dose* is stated to be from thirty to sixty grains given in emulsion.

OPIUM, *U. S.*, *Br.*—OPIUM.

Meconium, *Succus thebaicus.*—*Opium*, E., Fr., G.

The concrete juice obtained from the unripe capsules of Papaver somniferum, *Lin.*, by incision and spontaneous evaporation.

Origin and Production.—The poppy capsule, which is described elsewhere (see Papaver), contains under the epidermis a large number of laticiferous vessels which are variously branched and interlaced, and, in the unripe state of the fruit, are filled with a white milk-juice which escapes when an incision is made. For its successful cultivation the poppy requires a deep, rich, and well-manured soil, and considerable attention until the plant has sufficiently matured to permit of the collection of the milk-juice. A few days after the petals have fallen, the green capsule is scarified, with the precaution of not cutting entirely through the capsular integuments, as the juice would then flow into the capsule and be lost. In Asia Minor and Egypt one or two incisions are made transversely near the middle of the capsule, so as to run spirally around it. In India three or four vertical incisions are made from the base to the apex, and on different sides of the capsule, the instrument used for the purpose, called *nushtur*, being a three- or four-bladed knife, protected by means of twine, so as to prevent the blades from penetrating too deeply. The scarifications being made in the afternoon, the milk-juice is ready for collection the next morning, when its color will have changed from white to brown. The juice is then carefully scraped off with a knife, which is moistened from time to time with water, or, in Asia Minor, by drawing it through the mouth; in Persia oil is used to prevent the juice from adhering to the scraper.

In *Asia Minor* the juice is transferred to a poppy leaf and formed into cakes varying greatly in size—from a few ounces to two pounds or more in weight. These soft cakes are subsequently often mixed together, for the purpose of obtaining larger cakes, which are surrounded by one or two wilted poppy leaves, afterwards packed with a considerable quantity of the dry fruits of a species of Rumex, thus preventing the cakes from adhering to one another, and then transported to Smyrna or Constantinople, whence the European and American markets are chiefly supplied.

In *Egypt* opium is collected and prepared for the market in a manner similar to that just described. The production in that country at one time considerably declined, but has increased since Gastinel Bey (1865) proved that opium equal in quality to that of Asia Minor could be gathered by bestowing sufficient care upon the cultivation of the plant.

The juice gathered in *India* is usually quite soft, in consequence of dew, and after collection separates a dark-colored fluid, called *passewa*, which, together with the washings of vessels and some opium, is evaporated to a thick liquid, called *lewa*, and this is employed in agglutinating the poppy petals together, so as to form an envelope, and, after drying, a rather hard shell for the protection of the opium. The opium, which is moulded into spherical balls, requires much attention until it has been sufficiently dried for preservation. Each ball weighs a little over four pounds; forty of these are packed in separate compartments in a case, and are mostly exported to China. In the commerce of India this is known as *provision opium;* for home consumption the juice is evaporated by the heat of the sun, and formed into square or sometimes circular cakes, which are wrapped in oiled paper.

Persian opium is formed into cylindrical sticks about six inches long, each of which is wrapped in paper; or into cones or small balls about one and a half inch in diameter, the wrapper of which is sometimes marked with Chinese characters. Since 1856 Persian opium has been sent to Constantinople, and there worked over so as to resemble that of Asia Minor. At the present time it is frequently seen in European commerce, and it is imported in considerable quantity into the United States to be used in the manufacture of morphia. It often comes in cakes weighing one or one and a half pound, which are oily and always packed in *poppy trash*, *i. e.*, the dried stalks and capsules ground into coarse powder.

China produces a large quantity of opium, all of which is consumed in that country: in addition it consumes notable quantities imported from Persia as well as by far the largest portion of the opium which is exported from India. The samples which we have seen were flattish-globular in shape, and wrapped in white paper; one specimen was oily, though less so than Persian opium, and another, to judge from its black-brown color, was prepared by the aid of artificial heat, though free from empyreuma.

In *Japan*, the milk-juice is obtained by the longitudinal scarification of the poppy capsules, and the opium is formed into flat cakes which are wrapped in paper.

Numerous experiments have been made in *Europe*, and opium of excellent quality has been obtained as far north as Sweden; but European opium is not an article of commerce, and its production appears to be very limited. It is stated that Aubergier calls the opium raised by him in France *affium*, and that it is formed from the agglomeration of tears, exuded from the incisions, and entirely free from foreign admixture.

In *Algeria*, opium has been produced since 1828, in limited quantities however, and insufficient to be of any commercial importance. Rohlfs (1865) found an extensive culture of opium in the oasis of Tuat, in the northern part of the great African desert.

Opium has also been raised experimentally in Victoria, *Australia*, and was stated by Mr. Bosisto (1876) to be of good quality.

About the year 1812 opium of fair quality was produced in the *United States*, chiefly if not exclusively in New England. After the close of the war, the cultivation had to be abandoned, as it appears, mainly because the product became unsalable in consequence of extensive adulterations; more recently, however, opium culture again attracted attention, more particularly during the late civil war, when it was successfully prepared in Virginia, Tennessee, and South Carolina. Prof. Porcher (Resources of the Southern Fields and Forests, p. 26) states that in the climate of South Carolina and Georgia, the poppy should be planted in September; the plants are not killed during the winter, they thrive in the early spring, and the capsules are ready for incision in May. Several attempts made to obtain the poppy by planting in April and May failed, the seeds not coming up. A "garden square" yielded him 330 drachms of very dry opium of excellent quality.

In Asia Minor the poppy seed is sown at intervals from November to March. By following this course, failure from frosts or other causes is guarded against, and the maturing of the poppy heads is extended over a certain length of time. Since by the circular incisions made there, all or nearly all laticiferous vessels are cut, a second scarification is generally unprofitable, while an additional quantity of milky juice is usually obtained on repeating the vertical incisions after a day or two.

The *variety of poppy* cultivated in Asia Minor is the black, which has usually purple flowers and black, though occasionally white, seeds. This variety is that also which, in the experience of Aubergier in France, and of Behr and Biltz in Germany, yields opium richer in morphia than that produced from the white-flowering and white-seeded poppy. The latter is, however, by some persons considered more advantageous for collection, and appears to be the only kind cultivated in Egypt, Persia, India, China, and Japan.

The *importation* of opium by the United States has of late years been steadily increasing; it amounted to 135,305 pounds in 1867, and rose to 230,102 pounds in 1877. Of opium prepared for smoking 12,603 pounds entered the United States in 1870, and 47,428 pounds in 1877.

Description.—Opium is a more or less dark red-brown, internally sometimes yellowish-brown mass, which bears on the surface the impressions of the veins of the poppy leaf in which it has been enveloped and fragments of which are always adhering to it. When broken, some tears are usually observed in the interior, together with fragments of vegetable tissue which have been detached in scraping off the milk-juice. The interior is always moist. The cakes are either globular or more or less flattened and irregular in shape, and weigh from about 4 ounces to 2 pounds. The odor of opium is heavy and narcotic, its taste disagreeable and bitter. Examined under the microscope, some needle-shaped crystals are observed; but most of it consists of an amorphous or granular mass, aside from the vegetable tissue present. The crystals are best observed after the dry opium has been well moistened with benzol.

Smyrna, Turkey, or Constantinople opium is the only variety met with in American commerce. It has been stated above that Persian opium is often imported for the manufacture of the alkaloids. It is oily from the manner in which it has been collected. Its other distinctive characters and those of East Indian opium have already been briefly described. Both varieties contain usually a larger number of crystals than Turkey opium, and these crystals may not unfrequently be seen with the naked eye or by the aid of a lens.

Adulterations.—The principal admixtures observed by us in Turkey opium were pebbles, shot, and lead balls introduced into the interior of the cakes. When present, these admixtures generally amount to several ounces, but are only occasionally seen. Of greater importance appears to be the introduction of excessive quantities of vegetable tissue during the collection of the juice; but it is impossible to estimate its quantity or state its allowable limits. Coarse adulterations, such as the aqueous extract of the poppy plant and of the herb *Glaucium luteum*, which, according to Landerer, are sometimes made in Turkey, are rarely, if ever, seen in the imported opium, and are readily detected by the darker color and the hygroscopic nature of the product, and by the uninterrupted streak which it leaves on being drawn over paper, while good opium makes an interrupted mark. Such partly factitious opium, or fraudulent substitution of an extract having a narcotic odor, for opium said to have been of American origin, was noticed by Procter (1869) and Ebert (1873). Various kinds of resinous, saccharine, mucilaginous, and amylaceous substances, ashes, clay, gypsum, litharge, and sand have been employed for like purposes, and occasionally opium has been met with in the market which contained so little morphia and other alkaloids as to lead to the inference that these principles had been extracted. Another impurity is an excessive amount of moisture. Squibb (1860) estimated the average loss in drying to be 19.5 or 20 per cent., and in drying and powdering 20 to 21 per cent. From a record of nearly 12,000 pounds of opium, nearly the whole of which was directly obtained from importers, we find the average loss to have been 21.2 per cent.; in some exceptional cases as high as 28, or as low as 15 per cent. Bengal provision opium contains 30 per cent. of moisture.

Examination.—Hager has suggested the following course for determining the presence of adulterations: The sample is dried and powdered, and 25 grains of the powder are triturated with $\frac{1}{2}$ ounce of boiling water; the formation of a stiff paste or mucilaginous liquid would indicate the presence of starch, flour, gum, or salep. 2 ounces of water are added, and the liquid filtered; the filtrate should be of a wine-yellow color, indicating the absence of liquorice or other aqueous extracts, which would impart to the filtrate a brown color; the liquid should likewise have an acid reaction, otherwise the admixture of chalk, litharge, or ashes may be inferred. On evaporating the filtrate to one ounce, ferrocyanide of potassium or the addition of twice its bulk of alcohol should not cause any precipitate; the former test would indicate the presence of salts of heavy metals; the latter, an adulteration with gum or certain salts. The insoluble residue of opium left on the filter, after washing and drying, should weigh between 10 and 12 grains; should it weigh more, sand, clay, or other insoluble substances may be present; and, in case it weighs less, sugar, gum, or other soluble impurities are indicated. On agitating powdered opium with chloroform, the mineral impurities and starch settle to the bottom, and the latter acquires a blue color on the addition of a little iodine. Mineral impurities are likewise indicated by the amount of ash left, which for genuine powdered opium is about 6 per cent., varying, however, between 4 and 8 per cent.

Constituents.—Opium is entirely free from starch and tannin. Among the principles ordinarily found in plants, the following have been observed in opium: An odorous principle, soluble in ether, benzol, and petroleum-benzin; glucose, gum, pectin, a compound resembling caoutchouc, wax, fat, a small amount of resin, coloring matter, and that indefinite substance usually designated as extractive. The mineral constituents average 6 per cent.; and 55 or 60 per cent. of dry opium is soluble in water, but the pure milk-juice, entirely free from vegetable tissue, yields a larger percentage to water.

The most important, as well as the most interesting constituents of opium, however, are the alkaloids; in fact, the first vegetable alkaloid discovered was obtained from opium. In 1816, after a patient investigation extending over eleven years, Sertürner, apothecary at Eimbeck, in Northern Germany, announced the discovery of *morphium.* He recognized this principle as a salifiable base, in some respects related to ammonia. A crystalline powder, probably morphia, or containing it, was obtained by Ludwig as early as 1688, and was named *magisterium opii*, and in 1803 Derosne obtained this principle by precipitating the aqueous infusion of opium with ammonia, but regarded it as identical with his *salt of opium* (narcotina), which crystallized from the concentrated infusion. Seguin (1804) had likewise observed it. Since Sertürner's discovery a large number of alkaloids have been isolated from opium, which, arranged in the order in which their isolation was announced, are as follows:—

1. NARCOTINA, $C_{22}H_{23}NO_7$, discovered by Derosne (1803). This may be extracted with ether from the precipitate produced by ammonia in the aqueous infusion of opium, and from the insoluble residue of the latter by exhausting it with hot acetic acid. It crystallizes in shining prisms, yields mostly uncrystallizable salts, is a weak base, insoluble in cold dilute acetic acid, and gives a blood-red color with a mixture of sulphuric and nitric acids. When boiled for a long time with water, or heated with nitric acid, it is decomposed into *meconin*, $C_{10}H_{10}O_4$, and *cotarnia*, $C_{12}H_{13}NO_3$, which is a stronger base, soluble in ammonia, fusible in boiling water, and, on being boiled with very dilute nitric acid, is converted into *cotarnic* and *apophyllic acids*, the latter containing nitrogen. On heating narcotina with binoxide of manganese and dilute sulphuric acid, cotarnia is obtained, and in addition thereto *opianic acid*, $C_{10}H_{10}O_5$, which crystallizes in needles, and fuses at 140° C. (284° F.). When heated with hydrochloric or hydriodic acid, it parts with one, two, or three methyl groups (CH_2), and yields new bases.

2. MORPHIA, $C_{17}H_{19}NO_3$, discovered by Sertürner (1816), is described in another place (see page 913); also its derivative *apomorphia* (page 190). On heating its hydrochlorate with silver nitrate to 60° C. (140° F.), *oxymorphia*, or *pseudo-morphia*, is formed (see below).

3. CODEIA, $C_{18}H_{21}NO_3$, discovered by Robiquet, 1832. In preparing morphia by Gregory's process (see p. 914), after precipitating with calcium chloride, the chlorides of morphia and codeia crystallize together, and on redissolving them in water, and adding ammonia, morphia alone is precipitated. Codeia is easily soluble in hot water, alcohol, and ether, as well as in ammonia, but it is nearly insoluble

in potassa, and is separated by it from its salts as an oily liquid, which gradually crystallizes. It yields, with pure sulphuric acid, a colorless solution, but a blue solution in the presence of a trace of ferric salt. A similar reaction is produced with *Erdmann's reagent* (1861) (consisting of 20 grams pure sulphuric acid, and 10 drops of a mixture made with 6 drops of nitric acid, spec. grav. 1.25, and 100 grams of water). Fröhde's test liquid dissolves the alkaloid with a dingy green color, changing to bright blue, and slowly to pale yellow. Nitric acid gives a yellow solution.

4. PSEUDOMORPHIA, also called *phormia*, and oxymorphia, $C_{17}H_{19}NO_4$. This was discovered in opium by Pelletier and Thiboumery (1835), and may be obtained from morphia (see above). It is a fine crystalline powder, is insoluble in water, alcohol, ether, and chloroform; does not unite with acetic acid; yields, with hydrochloric acid, a salt sparingly soluble in cold water, and is colored red by nitric acid, and blue by ferric chloride, in which behavior it resembles morphia.

5. THEBAINA or *paramorphia*, $C_{19}H_{21}NO_3$, was discovered by Thiboumery (1835). It forms silvery scales; is soluble in ether, but insoluble in water and alkalies; and is colored red, afterwards yellow, by sulphuric acid; yellow by nitric acid; orange-red by Erdmann's test; and is rendered orange-yellow, and finally colorless by Fröhde's reagent.

6. NARCEIA or *narceina*, $C_{23}H_{29}NO_9$, discovered by Pelletier (1835), is in white silky needles, which are insoluble in ether and sparingly soluble in cold alcohol and water. Fröhde's reagent renders it brown-yellow, yellowish, and finally colorless. Erdmann's test produces a deep yellow, brown-yellow, and finally a deep orange color. Iodine not used in excess produces a blue color, nitric acid a rapidly fading yellow color. The blue color obtained by Pelletier, on the addition to narceia of strong hydrochloric acid and a small portion of water, is not observed with the pure alkaloid, according to Winckler, Anderson, and others.

7. PAPAVERINA, $C_{21}H_{21}NO_4$, discovered by Merck (1848), forms colorless needles or prisms, which are slightly soluble in cold ether and alcohol. Nearly all its salts are sparingly soluble in cold water and dilute acids. Sulphuric acid colors it deep purple or violet blue, which changes to green on the addition of potassium nitrate. Fröhde's reagent renders it bright violet, blue, then yellowish, and finally colorless. According to Hesse (1871), pure papaverina yields with warm sulphuric acid a faintly blue solution.

8. RHŒADINA, $C_{21}H_{21}NO_6$, discovered by O. Hesse (1865), is in white tasteless prisms, which are nearly insoluble in ether, alcohol, benzol, chloroform, water, and ammonia, and which yield with dilute acids tasteless and colorless solutions, acquiring an intense purple color on the addition of strong hydrochloric or sulphuric acid. Besides the coloring matter, an isomeric bitter base, *rhœagenina*, is formed in this reaction. The color produced by acids with Merck's *porphyroxin* (1837) depends on the presence of some rhœadina.

9. CRYPTOPIA, $C_{21}H_{23}NO_5$, was discovered by T. and H. Smith (1867). It crystallizes in minute prisms, is sparingly soluble in water, ether, benzol, and cold alcohol, dissolves in potassa and chloroform, and forms bitter salts, which have a pungently cooling taste, and usually produce a jelly-like mass when dissolved in hot water. Sulphuric acid colors it blue, the color changing to orange-yellow on the addition of potassium nitrate.

The following alkaloids were discovered by O. Hesse (1870 and 1871), and may be prepared from the mother liquors left in the preparation of morphia by Gregory's method :—

10. LANTHOPIA, $C_{23}H_{25}NO_4$, is crystalline, tasteless, sparingly soluble in acetic acid, alcohol, ether, and benzol; is readily soluble in chloroform; is colored orange-red by nitric and pale violet by sulphuric acid, the latter color changing to dark brown on heating.

11. MECONIDIA, $C_{21}H_{23}NO_4$, is amorphous, easily soluble in alcohol, ether, benzol, chloroform, and aceton. It yields very bitter unstable salts, and is

dissolved by sulphuric acid with an olive-green, and by nitric acid with an orange-red color.

12. Laudania, $C_{20}H_{25}NO_4$, is crystalline, sparingly soluble in ether and cold alcohol, soluble in benzol, chloroform, and alkalies; in ferric chloride with an emerald-green, in nitric acid with an orange-red, and in sulphuric acid with a rose-red color, the latter changing to violet on heating. The hydriodate is sparingly soluble.

13. Codamia, $C_{19}H_{23}NO_3$, crystallizes from ether in large six-sided prisms, is easily soluble in chloroform, benzol, ether, alcohol, and boiling water; forms amorphous bitter salts, and dissolves in nitric acid with a dark green, and in sulphuric acid with a blue color, changing to green and dark violet on warming.

14. Deuteropia, $C_{20}H_{21}NO_5$, homologous with cryptopia, requires further investigation.

15. Laudanosia, $C_{21}H_{27}NO_4$, is soluble in alcohol, ether, and warm benzol; the crystals fuse at 89° C. (192.2° F.). It neutralizes acids, and yields with hydriodic acid a sparingly soluble salt.

16. Protopia, $C_{20}H_{19}NO_5$, resembles cryptopia, and is with difficulty soluble in ether and alcohol. The solutions of its salts do not gelatinize.

17. Hydrocotarnia, $C_{12}H_{15}NO_3$, crystallizes in large colorless prisms, fuses at 50° C. (122° F.); volatilizes, partly unchanged, at 100° C. (212° F.); is easily soluble in ether and alcohol, and forms readily soluble salts.

From many of the above alkaloids derivatives have been obtained, which are highly interesting in a scientific point of view, and which prove that at least between some of them there exists evidently a close relation. It is not unlikely that some of those enumerated above are the decomposition products of others. This may most likely be affirmed to be true of Wittstein's *metamorphia* (1860), which was obtained in preparing morphia by Mohr's process (page 915), but has not been observed since. It liberated iodine from iodic acid, was colored red by nitric acid, but was not affected by ferric chloride. Hinterberger's *opiania* was proved by Hesse to be impure narcotina.

The *proportion* in which the alkaloidal constituents of opium are present in the drug is, without doubt, largely influenced by the climate, the nature of the soil, and the treatment to which the milk-juice is exposed in obtaining the opium. Most of the Pharmacopœias require dried opium to contain not less than 10 per cent. of morphia; good Smyrna opium frequently contains between 12 and 15 per cent. of it; but cakes taken from the same case are apt to vary considerably. Egyptian opium usually contains a smaller amount of morphia, varying from 6 to 12 per cent. Persian opium varies to a still greater extent, but much of that found in commerce is equal to the ordinary qualities of Turkey opium. East Indian opium, as a rule, is weak in morphia. It is sometimes as low as 2.5 per cent., more frequently perhaps between 3.5 and 5 per cent., but occasionally as high as 8 or 9 per cent. Most of the opium made in Europe has been of good and even of excellent quality. French opium yielded 14.4 to 22.8 (Guibourt), German opium 16.5 to 20, and from white poppy 6.8 per cent. (Biltz) of morphia. Opium made in Algiers from red poppy yielded 10.4 to 17.8 per cent., and from white poppy 1.5 to 8.5 per cent. of morphia. Several morphiometric assays of opium grown in the United States have been recorded; the lowest percentage of morphia, 4, was observed by Grahame; Procter obtained from other samples, 7.4 and 9.15, Flint 9.34, and Wayne 10.2 per cent.

The other alkaloids have been observed in the following proportions:—

Narcotina 1.3 to 10.9 per cent.
Pseudomorphia 0.02 per cent.
Narceia 0.02 to 0.1 (0.7) per cent.
Rhœadina minute.
Lanthopia 0.005 per cent.
Codamia 0.003 per cent.

Codeia 0.2 to 0.4 per cent.
Thebaina 0.15 (to 1.0) per cent.
Papaverina 1.0 per cent.
Cryptopia minute.
Laudania 0.005 per cent.

Meconic acid, $C_7H_4O_7$, was discovered by Sertürner, and is obtained by precipitating the concentrated infusion of opium with calcium chloride, and decomposing the calcium meconate by treating it repeatedly with warm diluted hydrochloric acid. It crystallizes in micaceous scales or rhombic prisms containing $3H_2O$, dissolves in four parts of boiling water, and is also soluble in alcohol. Opium yields 3 to 4 per cent. of it. It is a tribasic acid and imparts to ferric salts a deep-red color, which does not disappear on the addition of dilute hydrochloric acid (difference from formic and acetic acids) or by the chlorides of gold or of mercury (difference from sulphocyanides). When boiled with water, or more rapidly when boiled with dilute hydrochloric acid, meconic acid is decomposed into carbonic acid gas and crystallizable *comenic acid*, $C_6H_4O_5$, which on being heated yields a sublimate of *pyrocomenic acid*, $C_5H_4O_3$. The two new acids likewise redden ferric salts, the last one less deeply than the former.

T. and H. Smith (1862) exhibited *thebolactic acid* as one of the constituents of opium. This acid has the composition and physical properties of lactic acid, and, according to Buchanan (1870), is identical with the latter. It is present to the extent of about 1¼ per cent., and is probably the decomposition product of another constituent of poppy-juice.

Meconin is obtained from narcotina (see page 1012), exists also in opium, and forms colorless shining prisms, which are inodorous, bitter, soluble in alcohol, ether, and slightly soluble in water. It was discovered by Dublanc (1832), and is also known as *opianyl*. It melts in water at 77° C., and in the air at 110° C. (230° F.), and, when evaporated with slightly diluted sulphuric acid, gives a green color.

Meconoiosin, $C_8H_{10}O_2$, was obtained by T. and H. Smith (1878) from the mother liquors left in the isolation of meconin, from which it separates in an impure state as brown leaf-like crystalline masses. When pure it is colorless, is freely soluble in alcohol, ether, and hot water; fuses at 88° C. (190.4° F.), and on evaporation with dilute sulphuric acid yields a red color, changing to purple.

Morphiometry.—In view of the variable quality of opium, and of its liability to adulteration, the determination of the amount of morphia in it is frequently necessary, and must not be neglected if uniformity of strength of the pharmaceutical opium preparations is desired. The U. S. Pharmacopœia requires dried opium to yield not less than 10 per cent. of morphia by the officinal process; 100 or 150 grains (10 grams) of opium should be used for the purpose. The British Pharmacopœia has adopted the method of Thiboumery and Mohr, and accordingly gives the following directions:—

"Take of Opium one hundred grains; Slaked Lime one hundred grains; Distilled Water four ounces. Break down the opium, and steep it in an ounce of the water for twenty-four hours, stirring the mixture frequently. Transfer it to a displacement apparatus, and pour on the remainder of the water in successive portions, so as to exhaust the opium by percolation. To the infusion thus obtained, placed in a flask, add the lime, boil for ten minutes, place the undissolved matter on a filter, and wash it with an ounce of boiling water. Acidulate the filtered fluid slightly with diluted hydrochloric acid, evaporate it to the bulk of half an ounce, and let it cool. Neutralize cautiously with solution of ammonia, carefully avoiding an excess; remove by filtration the brown matter which separates, wash it with an ounce of hot water, mix the washings with the filtrate, concentrate the whole to the bulk of half an ounce, and add now solution of ammonia in slight excess. After twenty-four hours collect the precipitated morphia on a weighed filter, wash it with cold water, and dry it at 212° F. It ought to weigh at least from six to eight grains."

Mayer (1863) recommended a similar method, but substituted baryta for lime, and, instead of weighing the morphia, estimated it by his test solution.

The following method is recommended by Flückiger and Hanbury (Pharmacographia, p. 59). Mix seven to ten grains of well-dried powdered opium with thrice its weight of coarsely powdered pumice stone, pack the mixture in a percolation tube, and extract the narcotina, wax, and coloring matter by boiling ether. Moisten the residue in the tube with a very little spirit, and exhaust with water, if necessary very slightly acidulated with acetic acid. The percolate should be equal to about twenty times the weight of the opium, and is mixed with a very slight excess of ammonia. After the repose of a day or two, the morphia will be found in crystals attached to the sides and bottom of the glass. It may be dried and weighed as *crude morphia*, yet it should be recrystallized from boiling spirit of wine (0.822), at least once.

Numerous other processes and modifications have been recommended. The principal difficulties encountered in most of them are (1) the large quantity of water required for extracting the morphia, frequently rendering the concentration of the solution necessary, which should always be accomplished at a moderate heat; and (2) the impurities which are always precipitated with the morphia, and which consist of coloring matter with or without narcotina; the latter may be removed by ether, but, in decolorizing the precipitate either by alcohol or with the aid of animal charcoal, there ensues inevitable loss.

Off. Prep.—Containing opium, extract or tincture of opium. Acetum opii, *U. S.;* Emplast. opii, *U. S.*, *Br.;* Enema opii, *Br.;* Extract. opii, *U. S.*, *Br.;* Extract. opii liquid., Liniment. opii, *Br.;* Pilulæ opii, *U. S.;* Pil. ipecacuanhæ cum scilla, Pil. plumbi cum opio, *Br.;* Pil. saponis comp., *U. S.*, *Br.;* Pulv. cretæ arom. cum opio, *Br.;* Pulv. ipecacuanhæ comp., *U. S.*, *Br.;* Pulv. kino comp., Pulv. opii comp., *Br.;* Suppos. opii, *U. S.;* Suppos. plumbi et opii (plumbi comp.), Tinct. opii, Tinct. opii camphorata (camphoræ comp.), *U. S.*, *Br.;* Tinct. opii acetata, *U. S.;* Tinct. opii ammoniata, *Br.;* Tinct. opii deodorata, Trochisci glycyrrhizæ et opii, *U. S.;* Troch. opii, Unguent. gallæ cum opio, *Br.;* Vinum opii, *U. S.*, *Br.*

History.—Although opium was known to the Greeks, they appear to have been but slightly acquainted with the virtues which in later times secured its pre-eminence as a medicine; and although its uses were subsequently multiplied, they were not generally recognized until the Arabian school became supreme in the middle ages, nor was opium commonly employed until the seventeenth century. So many ages were required to establish the use of a medicine of which it has been said that "a physician without opium is a soldier without weapons"!

Physiological Action. *On Animals.*—In the lower animals opium affects the spinal marrow more than the brain, and the latter organ in proportion to the rank of the animal among organized beings. Experiments upon frogs prove that opium throws these animals into tetanic spasms, however it may be introduced, and whether the brain is detached or not. The same effects are produced in lizards. Birds will bear enormous doses of opium in comparison with those which may be given to man; but its effects are by no means uniform, for in individual cases the narcotic exceeds the tetanizing or paralyzing influence of the drug. Not infrequently a pigeon, for example, will survive the ingestion of twenty grains of opium, a dose far exceeding that which would be fatal to the strongest man; yet the same bird will, under the influence of the hypodermic injection of a relatively small dose of morphia, succumb, and usually with a predominance of spinal phenomena. A similar illustration is presented by herbivorous quadrupeds; for while even thirty grains of opium produce no effect when introduced into a rabbit's stomach, sleep and contracted pupils are produced by throwing laudanum into the pleural cavity, or a solution of morphia into the connective tissue. Unless we suppose that the active constituents of opium are decomposed in the stomach of these animals, such opposite results appear to be quite inexplicable.

On Man.—In doses varying from a quarter of a grain to one grain, opium produces usually a soothing and luxurious calm of mind and body, followed, in the course of forty or fifty minutes, by a disposition to sleep; or, if sleep does not take place, the body and mind enjoy a sense of repose from external impressions, while the mind is filled with dreamy and generally pleasant ideas. The pulse at first is quickened, but gradually becomes slower, the mouth grows dry, and the skin moist. Excited consciousness is followed by sleep, which is natural in its phenomena, and from which one awakes refreshed. Larger doses, as from one to three grains, occasion turgor and redness of the face, heat and fulness of the head, flashes of light before the eyes, and contraction of the pupils. The mind is excited, even to delirium; the pulse full, tense, and frequent; the skin is hot and dry, and often there is vomiting. Depression follows, with a slow and sometimes irregular pulse; dulness oppresses all the functions of relation, and the mind is torpid; the muscles lose their co-ordinating action, and the gait is sluggish and staggering. Deep sleep, or rather coma, succeeds; the breathing is stertorous, the skin pale and damp, and the hands and feet cold. The return to consciousness is attended with depression of mind and body, headache, thirst, nausea, and constipation. In narcotism by opium, when an excessive dose has been taken, no stage of excitement occurs; giddiness is speedily followed by insensibility and immobility, the respiration is slow and stertorous, and then scarcely perceptible; deglutition is suspended; the pupils are extremely contracted; the face is pale and cadaverous; the muscles of the limbs are relaxed. Vomiting sometimes occurs, but more usually in fatal cases coma continues until death, which is sometimes preceded by convulsions. After death from opium poisoning the convolutions of the brain are flattened; the vessels of the cerebro-spinal axis gorged with black blood, and the capillaries of the brain on section give out minute drops of the same fluid. A serous liquid is usually found in the ventricles of the brain and beneath the cerebral surface of the arachnoid. The lungs, heart, liver, and spleen are in most cases distended with dark and fluid blood.

To render more intelligible the operation of opium, it is necessary to point out the details of its action upon several of the organs. Contraction of the pupil is attributed, on the one hand, to its sedative action upon the sympathetic nervous system, in consequence of which the capillary bloodvessels of the iris become dilated and distended, and the pupil consequently contracted; on the other hand, it is ascribed to a stimulation of the oculo-motor centres. The former opinion seems the more probable of the two. Opium affects the digestive function by blunting the gastric sensation to which we give the name of hunger, and diminishing the demand for food by checking all the tissue changes which create that demand. At the same time it increases thirst, probably by rendering the gastric mucous membrane dry, as well as by accumulating solid effete matters in the blood. In the same manner it impedes digestion and retards absorption. The vomiting which it sometimes occasions, even when administered by the rectum or when morphia is given hypodermically, appears to be of cerebral origin. Opium tends to constipate the bowels by benumbing their muscles, as well as by diminishing their proper secretions, and those of the liver and pancreas. When habitually used these effects of the drug become less marked. As already mentioned, the primary effect of a medicinal dose of opium is to render the pulse fuller and more frequent; but, as the soporific operation is developed, the pulse becomes slower without losing its fulness. The ultimate narcotic effects upon the pulse are to render it small, weak, and irregular. That these phenomena arise through the action of opium upon that portion of the nervous system which regulates the movements of the heart and arteries must be taken for granted; but the attempts made to explain it by defining the special nervous centres upon which it depends, and their mode of action, are more ingenious than satisfactory. The same remark is measurably applicable to the action of opium upon the respiration. That action is rendered progressively slower, until in complete narcotism it is scarcely perceptible. Hence the blood is but partially oxygenated, and, being unfit for a return to the heart, it stagnates in the lungs. Hence, too, the blood of those who perish in opium narcosis is intensely black, and death occurs by gradual asphyxia. Hence, moreover, the most direct remedy for this condition is the introduction of oxygen into the lungs. Upon the kidneys, as upon all other glands, the action of opium is to check secretion, and at the same time to prevent the discharge of what is secreted by paralyzing the bladder. Its power of diminishing renal secretion is strikingly exhibited in diabetes and hydruria. While diminishing glandular and mucous secretions, opium greatly augments the perspiration, so that a conspicuous symptom among its toxical effects is profuse sweating, and it may be used as one of the surest and most perfect of all diaphoretic medicines. It is very apt to excite itching of the skin, and often produces an erythematous eruption.

The attempts to explain the operation of opium have not been much more satisfactory than in the case of other really efficient medicines. Its local anæsthetic action, and that which its internal use manifests when less than soporific doses are administered, are absolutely unintelligible. Its soporific action, it can scarcely be doubted, depends in part upon this same anæsthetic virtue exercised upon the brain tissue. In part, also, it seems to be explicable by the power, several times above referred to, which opium exerts in contracting the capillary bloodvessels, and thereby diminishing the supply of the natural stimulant of the organ, the blood. This view is rendered more probable by the consideration that belladonna, which prevents sleep, dilates the capillary bloodvessels as much as opium contracts them. It is further supported by the fact that poisonous doses of opium, producing not sleep but narcotism, dilate the capillaries by paralyzing them. Yet, after all, nothing known of the action of opium can dispense with that innate quality of the drug, our ignorance of whose nature used to be concealed under the delusive phrase "vis dormitiva."

It must be constantly borne in mind that the action of opium, like that of all agents which especially influence the nervous system, is greatly modified by numerous causes besides its mere dose. Thus it acts with extreme energy in the very young, because their nervous systems are highly susceptible; and ordinary doses are unsafe in the old, because, their eliminating functions being feeble. the medicine remains in their blood. For the former reason, probably, females are, as a rule, more readily affected than males by opium. All nervous, susceptible persons feel its influence speedily, and often in an abnormal manner, being unduly excited by ordinary doses. On the other hand, as in the case of alcohol, there are persons who can take with impunity doses of opium which to others would be distressing or even fatal. There are those, also, in whom the habit of using opiates has created a relative insensibility to the action of medicinal doses. In other cases extreme pain, like that of tetanus, or biliary and nephritic colic, may neutralize the narcotic operation of the largest medicinal doses.

The several constituents of opium which have been isolated by chemical analysis manifest various modes of action, which differ more or less widely from that of opium itself. While morphia, as we have shown elsewhere, very nearly represents the crude drug, and codeia, meconina, papaverina, cryptopia, and narceia share with it a certain soporific virtue, the remaining elements, narcotina, papaverina, thebaina, etc., are almost, if not entirely, destitute of this quality. The following statements represent the ambiguous condition of existing knowledge on these subjects:—

Narcotina was first introduced as an antiperiodic, and, although freely given, was not suspected of possessing narcotic properties. Experiments upon animals prove it to be eminently a tetanizing agent, and productive at the same time of great depression; yet some observers report its possession of a slight narcotic power. According to others, this power is distinctly manifested in man by doses of from ten to twenty or thirty grains; yet it is certain that it has been administered as a tonic and antiperiodic in thirty grain doses, without producing any narcotic effects. The conclusion almost necessarily is, that the alkaloid was not pure in the former case, but contaminated with morphia. *Papaverina* is, on the one hand, alleged to be hypnotic, even the "prime hypnotic element of opium," an arterial and nervous sedative; and, on the other, it is by turns pronounced inert, tetanizing, relaxing, and a heightener of reflex action. Physiological experimenters have demonstrated that *thebaina* is eminently a convulsifying agent, "the most potent of all the poisonous constituents of opium." In man it is anodyne and soporific in the hypodermic dose of a grain and a half, which is nearly equivalent to a quarter of a grain of a salt of morphia, and it does not occasion headache and nausea. *Cryptopia* appears to be closely analogous in its action to thebaina, tetanizing some of the lower animals, convulsing others. In man it acts like morphia, but without the unpleasant consequences due to the latter alkaloid. It is stated to be about one-fourth as strong as morphia. *Meconin*, when administered even in large doses, hypodermically to large animals, and by the mouth to man, appears to be quite inert; but hypodermically, in doses of from half a grain to a grain and a half, it produces in man a moderately hypnotic effect. The action of *codeia* upon animals seems to differ with the dose and mode of administration; one grain injected hypodermically into a rabbit producing rapidly fatal tetanus, while ten grains introduced into the stomach of a similar animal occasioned only a peaceful and prolonged sleep, from which, however, it was easily aroused. By the former method it is much more speedily fatal to these animals than an equal dose of morphia. On awaking spontaneously from the sleep produced by codeia, animals are neither paralyzed nor dull, as they are after morphia sleep. Given to man in the dose of a grain and a half, it has produced marked gastric disturbance, congestion of the head, dulness of the mind, and tremor; but in the dose of one-third of a grain it causes calm and refreshing sleep, does not produce perspiration, cutaneous eruptions, nausea, vomiting, or constipation.

Finally, *narceia* was once proclaimed as possessing all of the virtues, without any of the defects, of morphia, and as being operative in an equal dose. The usual contradictions of physiological experiment and therapeutical observation have only left the fact to survive, that, being a feeble though pure hypnotic in the dose of five grains and upwards, and being, at the same time, rare and costly, it is practically useless as a medicine.

Medical Uses.—The different modes of action of opium, according to its dose, upon the two great vivifying elements of the animal economy, its stimulant and sedative operations upon the nervous and circulatory systems, and its directly anæsthetic influence in all doses, render it the most useful of all medicines, as well as the most multifarious in its applications. It relieves pain, allays agitation, delirium, and spasm, restrains tissue change, secretion, and hemorrhage, and both directly and indirectly supports the powers of the system. By the possession of these manifold virtues, it becomes the most fitting associate of numerous other medicines, the operation of which it moderates, exalts, or directs.

Fevers.—It is an old precept, which all judicious experience has confirmed, that opium ought not to be prescribed at the onset nor at the climax of a continued fever, but during the augment to appease its violence, and during the decline to support the strength and calm the nervous symptoms which denote exhaustion. In *typhus*, its greatest usefulness is not when the strongest tendency to stupor exists, but when muttering delirium, jactitation, tremor, and spasm denote exhausted nervous power; but even then it must be used in such doses only as revive, and not in such as tend to oppress, the brain. In the rarer cases of this disease presenting violent delirium, a furious aspect, suffusion of the eyes, constant raving and muttering, and perfect sleeplessness, moderate doses of a liquid preparation of opium, associated with tartar emetic, according to a former practice, or with veratrum viride or digitalis, as more recently employed, will often render the patient tranquil and induce refreshing sleep. These remarks are equally applicable to all forms of disease when the *typhoid state*, characterized by the above phenomena, is present, and especially to *typhoid fever*, and to *smallpox*, as it occurs in adults. But opiates in the diseases of children, and especially in their eruptive fevers, are seldom useful, and often involve serious risk. Another object of employing opium in the exanthematous fevers is to hasten the development of the eruption when it is tardy and imperfect. Under such circumstances, the medicine should be given in small and repeated doses, and associated with external heat and rubefacients, and internal diffusible stimulants. Before the introduction of cinchona, opium was generally used to prevent the paroxysms of *periodical fevers*, which it did by creating a vascular excitement opposed to the formation of the chill, and inducing artificially a diaphoresis which also prevented that stage of the attack. In the same manner, it is often now associated with quinia, whose specific operation it favors. Another mode of using opium in intermittent fever is to administer it in so large a dose as to hold the nervous system in a state of immobility, and so prevent the formation of the paroxysm.

Inflammation is less directly under the control of opium than idiopathic fever, yet its judicious employment, by lessening pain, tends to prevent an aggravation of the disorder, and to allow the natural recuperative powers their full operation. In chronic inflammations, also, attended with constitutional irritation and hectic fever, opium exerts a salutary restraining influence. After severe operations, it tends to prevent the irritative fever which the shock of pain and loss of blood, and the consequent reaction, tend to excite. As a rule, the dose required is large and sedative. In *hemorrhage*, even of the active sort, opium is sometimes of service by diminishing the agitation upon which its continuance depends, and especially by allaying the excitability of the nervous system of the heart; but its greater utility is in cases of passive hemorrhage accompanied by a similar excitability. Possibly, also, it may directly contract the capillaries. In senile *gangrene* it is generally employed, probably on account of its analgesic and stimulant operation.

Pain.—All forms of pain are palliated by opiates, but the more independent pain is of material lesions, as in pure *neuralgia*, the more efficient are these remedies, unless, perhaps, when the narcotic operation suspends the action of the physical cause of pain. All forms of *spasmodic pain*, of the bowels, bladder, uterus, gall and urinary ducts, etc., are lessened by suspending the spasm in which the pain arises. Pain due to movements of the affected part is directly palliated by opium, and indirectly by promoting rest. In nearly all painful disorders, the dose of opium must be proportioned to the degree of pain. The tolerance of large doses of the drug during severe pain, and also in prolonged spasmodic attacks like tetanus, is a remarkable fact. Opium is seldom appropriate for pain within the head; it may dangerously mask this symptom in other cases where pain is the chief indication of the disease. Of the latter strangulated *hernia* is an example.

Sleeplessness is relieved by the direct action of opium, and also indirectly, in so far as opium removes the cause that prevents sleep, whether it be pain, mental excitement, or exhaustion, etc., but very often it fails of its effect, although given in large doses, in such excessive excitement as occurs in *mania a potu*, acute *insanity*, *meningeal inflammation* in some of its forms, etc. Moreover, if long continued, its utility as a hypnotic is more than counterbalanced by the derangement of digestion, secretion, etc., which it induces, particularly as its original effects can only be maintained by largely increased doses of the drug. In *puerperal insanity*, it is more beneficial than in other forms of mental disorder, particularly when morphia is used hypodermically. The treatment of *delirium tremens* by large doses of opium, which at one time prevailed, was most unfavorable in its results; and if the drug is used at all in this disorder, its doses should be small and repeated, so as to produce a primary stimulant and not a narcotic operation. In *epidemic cerebro-spinal meningitis*, opium is probably the most efficient of all the remedies that have been employed. But its utility is most conspicuous in those cases of the disease in which spasm (*i. e.*, spinal irritation) predominates over septic phenomena, and when it is administered steadily from the commencement of the attack. *Sunstroke*, marked by nervous symptoms, such as convulsions, twitchings, delirium, and general excitement, is greatly benefited by the hypodermic injection of morphia. This medicine may be used as a palliative in *epilepsy*, *hysteria*, *eclampsia*, and *spasm of the glottis;* and although it is contraindicated in obstruction of the kidneys, as in Bright's disease, it is nevertheless of great value in *uræmic convulsions*, especially when used in the form of hypodermic injections of morphia.

In obstinate cases of *chorea* the sustained use of opium has sometimes been followed by a great reduction of the spasmodic movements, and even by cure. Hardly any remedy has effected as much good in *traumatic tetanus* as opium, even when given by the mouth, although a large portion of the drug is wasted by this mode of administration. The liquid preparations are preferable, and superior to these again is the hypodermic injection of morphia. Neither method should exclude the due employment at the same time of other remedies, and especially of counter-irritation of the spine, and the use of alcohol. In this disease larger doses of opiates are required than in any other. In the somewhat analogous affection produced by *strychnia poisoning*, subcutaneous injections of morphia have proved curative. The use of opiates in *neuralgia* is most efficient when the salts of morphia are injected hypodermically, as is elsewhere at greater length described. (See Morphia.) This statement applies to internal as well as external neuralgia.

In diseases of the respiratory organs *pain* and *cough* are the symptoms which especially call for the use of opiate preparations, which relieve the former directly as well as by diminishing the violent movements accompanying the latter symptom. So far as the pain caused by coughing depends upon pleural inflammation or upon the action of muscles affected with rhumatism, opium affords certain relief, while it palliates also the painful sensations accompanying acute bronchitis. But as coughing is largely a conservative act, tending to prevent the accumulation of secretions in the bronchia, opium must not be employed in such doses as tend to prevent this salutary operation; hence it must be cautiously used, if at all, when the bronchia are filled with their secretions. In the forming stage of *pulmonary catarrh*, or *bronchitis*, when the air tubes are dry and irritable, and coughing painful, opium, especially with ipecacuanha, as in Dover's powder, will sometimes mitigate or even terminate the attack by promoting the pulmonary and cutaneous secretions. Opium has been used in the form of morphia, hypodermically, with reported advantage in arresting the development of *autumnal catarrh*. In *pneumonia* and *pleurisy* its use should be restricted to moderating cough and pain; and the same may be said of chronic *phthisis*. In the latter, if habitually used, it is very apt to impair digestion, and hasten the patient's decline, but is nevertheless almost indispensable when the cough is harassing. It may sometimes be given in an atomized solution more efficiently than when otherwise administered. In *asthma* hypodermic injections of morphia are efficient palliatives. In the various affections of the heart, of which *angina pectoris* is a more or less frequent symptom, opium, but still more morphia, is an invaluable palliative, and that without too closely regarding the special lesion upon which the pain and the disordered action of the heart depend. Of heart lesions which accompany such attacks those of the mitral valve are the most frequent.

Among diseases of the digestive organs the symptoms most appropriately treated by opium are *vomiting*, *pain*, and *diarrhœa*. All forms of vomiting are more or less under its control, as that of *sea-sickness*, of *pregnancy*, of *reflex irritation* generally, and of diseases affecting the stomach itself. In the last opium is often given in the form of an old or hard pill; but the hypodermic injection of morphia is usually more efficient. *Simple ulcer* of the stomach as a cause of vomiting is sometimes treated with opium and its preparations; but they are unnecessary when a proper regulation of the diet, with bismuth or lime-water, is employed. In pure *gastralgia* these medicines are often extremely valuable as palliatives, but other means are required to cure the disease through the removal of its cause. When used, they should be administered ten or fifteen minutes before meals, as well as when a paroxysm is imminent. Of the use of opiates in *diarrhœa*, it may be remarked that the less this symptom depends upon material lesions or upon irritating crude ingesta, the more efficient are they as remedies. Indeed they only hasten somewhat the natural cure by moderating the peristaltic action, and diminishing the secretions of the intestine. Otherwise they act only as aids to absorbents and astringents, as chalk, tannin, etc. In *dysentery* opium is of less value for its curative properties than as a palliative of the tormina and tenesmus, which belong to the active forms of this disease; but even these symptoms are more successfully relieved by the evacuant method, either alone or in alternation with the administration of opium by the mouth, and by the rectum in enemata or suppositories. When once the violence of the disease is subdued, moderate doses of opium greatly hasten its termination. In the chronic form of dysentery the main reliance must be upon diet, especially upon a milk diet, but opium with astringents is the best medicinal remedy. In *lientery* opium, with or without astringents, is almost indispensable. It is by far the best remedy in *cholera morbus*. No evacuant medicines need be first administered. A grain of opium should be given every half hour in severe cases, the patient refraining from the use of liquids as much as possible. Enemata of laudanum should also be employed; or the treatment may be confided to the hypodermic use of morphia. Care should be taken not to exceed the needful quantity of the drug administered, on account of the depression which is apt to follow the use of large doses. In *epidemic cholera*, depending as it does upon a specific poison, opium cannot be as confidently relied upon; indeed the records of its use in this disease are extremely discouraging. But in the forming stage, or that of premonitory diarrhœa, when that stage exists, opium with chalk and vegetable astringents is invaluable. The tender age and great susceptibility to the influence of opium of the ordinary subjects of *cholera infantum* render opium an unsafe remedy for that affection, notwithstanding the apparently clear indications for its use in the nature of the disease. If used at all it should be in the form of Dover's powder alone, or along with gray powder, or calomel. The symptom *colic*, as a form of pain, is of course amenable to a treatment by opiates, but it is a symptom connected with very numerous and dissimilar conditions. In the ordinary form due to flatulent distension of the bowel, opium with diffusible or carminative stimulants affords prompt relief. In *painter's colic*, which is attended with intestinal contraction and spasm, opium is the best remedy, especially in alternation with purgatives. *Biliary* and *nephritic colic* are most efficiently treated by opium; and when the pain arises from any of the various forms of intestinal displacement (*invagination*, *hernia*), the moderate but sustained use of opiates is infinitely preferable to the too common method of attempting to force an evacuation by means of purgatives. In all of these cases the hypodermic use of morphia is preferable to opium internally. Of the several forms of *peritonitis* those only which are due to traumatic causes, such as external violence and perforation or irritation of the peritoneum by diseases of the organs which it covers, are favorably influenced by opium; but in these it is indispensable, for by its means alone can that repose of the abdominal organs be secured which is necessary to control the degree and extent of the inflammation. In *puerperal peritonitis*, although it has been employed in heroic doses and emphatically praised, it has not been generally recognized as appropriate.

Among diseases of the genito-urinary organs opium is an efficient palliative in *nephritic colic*, already referred to, and in all the spasmodic affections of the *ureters*, *bladder*, and *urethra*, such as arise during calculous disorders, and inflammation of these several parts. Thus it is a usual remedy for *chordee*, although generally associated with camphor. In all these cases it is best administered by the rectum. It is an efficient palliative for the *grinding pains* which precede actual labor, and for those uterine contractions which so often lead to *abortion* or premature labor. Hypodermic morphia injections are more efficient than opium in such cases. The same means are frequently employed in *dysmenorrhœa*. In these various affections, and in all others within the pelvis for which opium is appropriate, suppositories containing this drug or its derivatives, and enemata with laudanum are especially indicated. In constitutional *syphilis* opium has been erroneously represented as a means of cure. It only allays constitutional irritability and procures rest from nocturnal pains. In the primary forms of the disease it is useful as a dressing for irritable sores. Opium is superior to any other single medicine in diminishing the quantity and the saccharine quality of the urine in *diabetes*, when administered in full and progressively increasing doses until a partial tolerance of the drug is induced. At the same time it lessens the thirst and hunger, renders the skin softer, and the mind less despondent. Its most efficient coadjutors are exercise and appropriate food.

Muscular rheumatism may generally be relieved by opium used so as to produce free diaphoresis, and especially in the form of Dover's powder. It is much more efficient in the forming stage of the attack than later. In *articular rheumatism* it has sometimes been used as an exclusive treatment, but with very unfavorable results, in that it augments the frequency and the gravity of the cardiac complications. It is, however, valuable as an anodyne and soporific, thereby husbanding the patient's strength while the disease is removed by eliminative medicines. In the same manner it is useful in *gout*, and particularly its liquid preparations. When this disease becomes *retrocedent*, and especially when it attacks the stomach, opiates associated with diffusible stimulants are the most reliable remedies. Wine of opium or laudanum should then be administered in doses of from forty to sixty drops every hour, by the mouth or rectum; or morphia may be employed hypodermically.

As a *local remedy* opium has already been noticed in connection with various painful affections; the uses of morphia in this respect are even more numerous. But the liquid preparations of opium in liniments, epithems, poultices, etc., as topical anodynes, are more habitually employed. A watery solution is used as a dressing for irritable *ulcers;* the wine of opium is an admirable anodyne and stimulant in granular *conjunctivitis* and *ulcers of the cornea;* in *earache* laudanum and sweet oil are applied on cotton to the auditory canal; in *toothache* a small piece of opium may be introduced into the hollow of a carious tooth, or, still better, a solution of morphia in chloroform, saturating a plug of cotton, may be similarly applied; or, in rheumatic toothache, the gums may be bathed with laudanum. In *paronychia*, and numerous other forms of painful local inflammation, the anodyne operation of opium and its preparations lessens the inflammation by assuaging the pain.

There is no specific antidote to *poisoning by opium*. The rational and habitual method of treating it consists in emptying the stomach of whatever portion it still contains of the poison, and in keeping the nervous system stimulated and the respiratory apparatus active, and so preventing or diminishing narcotism, until the poison is eliminated from the system. For the first purpose emetics are indicated, *e. g.*, large draughts of warm salt and water, mustard water, or water containing ipecacuanha, sulphate of zinc, or sulphate of copper. Tartar emetic should never be prescribed, unless other evacuants fail. It has been successfully employed by the rectum and also by the veins. Vomiting should be favored by tickling the fauces. If these means are not promptly and completely efficient, the stomach-pump should be resorted to. When solid opium has been taken, which, however, is rarely the case, the stomach-pump is of secondary importance. To counteract narcotism, stimulants of the general nervous system and of the respiratory apparatus are employed, both internally and externally. One of the best, as well as the most accessible, is a strong infusion of coffee, given without sugar or cream, but with a small proportion of brandy or whiskey. A strong infusion of green tea is nearly as efficient. The mydriatics (belladonna and stramonium) have been employed as direct antidotes. Their value is estimated in the articles devoted to those medicines. Of external means for stimulating the nervous system, one of the best is to cause the patient to walk, as long as he is able, supported between two assistants, while his attention is kept aroused by conversation, or by flagellating the back with a whip of fine cords or a bundle of birch twigs. Unless the impression made is sharp, it is almost useless. Hence the electrical brush answers remarkably well for this purpose. Cold, or alternate hot and cold, affusions, made to the upper part of the body, produce a powerful impression, and excite the respiratory act. The partial restoration of consciousness by these means is sometimes accompanied by a renewal of the susceptibility of the stomach, and the emetics it may contain excite vomiting. Ammonia may be held to the nostrils occasionally, and mustard applied over the epigastrium and heart; but the irritation produced by these agents makes it necessary to watch their action. Artificial respiration, although inferior to the other means described, has occasionally been used with success. In infants the natural resiliency of the ribs renders this agency especially useful.

The cure of *opium eating* consists either in gradually diminishing the quantity of the drug consumed, and the substitution for it of aromatic and stimulant tonics, such as ginger, black pepper, columbo, quassia, etc., or in the abrupt cessation of the practice. Both methods count a few successful cases; but the latter, while the more efficient, is the more arduous. In certain inveterate cases it is claimed that a cure has been effected by prescribing forty minims of dilute phosphoric acid and eighty minims of tincture of lupulin an hour before meals, in a wineglassful of water. At night sleep may be promoted by tincture of cannabis and Hoffmann's anodyne. The exhausted digestive function should be allowed to revive under simple food, such as milk and rich broths, in small quantities at a time. Exercise and bathing should be insisted upon, and zinc, quinia, and iron may be cautiously administered.

Administration.—The average *dose* of opium for an adult is one grain. This is usually an objectionable form of its administration, when the medicine must be repeated. In that case a liquid preparation should always be preferred. When a gradual operation is intended, an old opium pill is the best, since its slow solution prolongs its action and extends its local influence over a larger surface. It is also much less apt than freshly made opium pills to occasion nausea. The after effects of opium are supposed to be mitigated by bromide of potassium in a full dose administered along with the opiate. This apparent operation is rather due to the fact that with a full dose of the bromide, a smaller one of opium is necessary. Owing to the extreme susceptibility of children to opium, it should rarely be prescribed for them in the solid form. Suppositories of opium for the rectum and vagina are very useful in local disorders of the pelvic organs; and the rectal forms may also be used when for any reason the drug cannot be administered by the mouth. But they are less prompt in action than enemata of liquid opiates.

OPOPANAX.—OPOPANAX.

A gum-resin, obtained from Opopanax chironium, *Koch*, s. Pastinaca opopanax, *Lin.*

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The opopanax plant is a perennial herb, with a long thick and fleshy root, a tall stem, large pinnately decompound leaves, yellow flowers, and dorsally flattened fruit containing many oil tubes. It is indigenous to Southern Europe. On wounding the root or lower part of the stem, a yellowish milk-juice exudes, which, after hardening, constitutes opopanax.

Description.—The best quality of opopanax is in irregular angular or subglobular pieces, from the size of a pea to that of a walnut, red-brown or yellowish-brown, friable, breaking with a flat somewhat waxy fracture, and frequently with vegetable fragments adhering. It has a strong, unpleasant odor, a balsamic bitter taste, yields with water a yellowish emulsion, and when heated, softens and exhales a rather alliaceous odor. An inferior quality comes in larger irregular masses, which contain many impurities, and are of a less bitter taste.

Composition.—According to Pelletier, opopanax contains 42 per cent. resin, 33.4 per cent. gum, besides volatile oil, a little wax, starch, etc.

Allied Gum-Resins.—SAGAPENUM, obtained from a Persian species of Ferula, is met with in yellowish-brown, somewhat translucent small tears, and is frequently agglutinated to larger pieces, of a bitter acrid taste and a faint alliaceous odor, which becomes prominent on heating. Cake sagapenum is soft, adhesive, brown, nearly free from tears, mixed with foreign matters. A mixture of galbanum and asafœtida is sometimes sold in place of sagapenum. Pelletier and Brandes found in sagapenum 50 to 54 per cent. of resin, 32 per cent. gum, with small quantities of volatile oil, bassorin, etc.

GUMMIRESINA HEDERÆ, *ivy gum*, is in the Levant and Southern Europe obtained from the common ivy, Hedera helix, *Lin.* It is in irregular yellowish or reddish-brown pieces, translucent on the edges with a garnet-red color, of a slightly bitter and somewhat acrid taste, and when heated of an agreeable balsamic odor. Pelletier found in a sample nearly 70 per cent. of wood fibre.

Medical Action and Uses.—Opopanax (the all-healing juice) is one of the numerous gum-resins, including galbanum and ammoniac, which were anciently most esteemed. Galen speaks of it and of the root-bark of the plant as stimulating and cleansing when applied to ulcers, and of the seeds as diuretic. Dioscorides describes its internal uses in fever and ague, pleurisy, cough, dysury, and amenorrhœa, and its topical applications in sprains, headache, gout, toothache, and carbuncle. Arabian writers advise it in nervous exhaustion, for promoting the expulsion of the dead fœtus, for paralysis, and inflammation of the eyes. In modern times, it has been used like ammoniac, for *chronic bronchitis* with profuse secretion, and externally in stimulating plasters, but is now very seldom employed.

ORIGANUM, *U. S.*—ORIGANUM.

Origan, Marjolaine sauvage, Fr.; *Dosten, Wilder Majoran*, G.

The herb of Origanum vulgare, *Lin.* Bentley and Trimen, Med. Plants, 204.

Nat. Ord.—Labiatæ, Satureieæ.

Origin and Description.—Origanum or *wild marjoram* is a perennial herb, growing in dry soil throughout a large portion of Asia, Europe, and Northern Africa. It has been introduced into the United States, where in some places it is now quite common. The stem is about two feet high, quadrangular, often purplish, branched above. The leaves are opposite, petiolate, roundish ovate, obtuse, entire, or slightly toothed, hairy on the veins beneath, and pellucid punctate. The flowers are terminal on the branches, forming a corymbose panicle, have a purple, ovate bell-shaped and five-toothed calyx, a purplish somewhat two-lipped corolla, and four didynamous exserted stamens. The herb has a strong aromatic, marjoram-like odor, and a warm aromatic and bitterish taste.

Constituents.—The herb contains volatile oil (see Oleum origani, p. 986), a little tannin, bitter principle, etc.

Allied Plants.—ORIGANUM MAJORANA, *Lin.*, s. Majorana hortensis, *Mœnch*, *Sweet marjoram*, is frequently cultivated for culinary purposes, and is indigenous to Western Asia and Southeastern Europe. The leaves are spatulate or oval, very obtuse, entire, gray-green, soft, hairy, and pellucid punctate. The flowers are aggregated in small heads, and have a small whitish corolla. The plant is agreeably and pungently aromatic.

ORIG. CRETICUM, *Lin.*, indigenous to Southern Europe, has hairy ovate or nearly cordate and somewhat five-nerved, pungently aromatic leaves, and whitish flowers. In Europe, the volatile oil is distilled from it, and is used like allied oils.

ORIG. DICTAMNUS, *Lin.*, is found in the Levant, has woolly-tomentose, obtusely quadrangular branches; roundish-ovate tomentose leaves, partly purple-colored bracts, and a dark purplish corolla. It is pungently aromatic.

Medical Action and Uses.—Marjoram is chiefly used as a condiment in cooking, to diminish, by its excitant qualities, the indigestibility of pork, goose, and other fatty food. It is sometimes employed in warm infusion to promote the eruption in exanthematous fevers, allay *colic*, *dysmenorrhœal pains*, etc., and the fresh bruised herb is applied as a cataplasm to assuage local pains.

OS, *U. S.*—BONE.

Os, Fr.; *Knochen*, G.

Description.—Bones form the skeleton of the vertebrate animals, and consist of a dense organic tissue, which is filled with a calcareous deposit. They are white, externally smooth, insoluble in water, partly soluble in acids, leaving a gelatinous mass behind, and when heated, are partly decomposed, an empyreumatic animal odor being given off and a porous charcoal left (Carbo animalis, p. 345). On continuing the heat in contact with air, the organic matter is entirely consumed and a white earthy residue remains.

Composition.—The organic portion of bones which is left undissolved on treatment with hydrochloric acid, has been called *ossein*, and on continued boiling with water is converted into gelatin (see p. 661). The inorganic portion varies in different bones of the same individual, and in the bones of different species, and in different layers of the same bone; it is smaller in the inner layers, amounting sometimes to 40 per cent., and in the outer layers it may reach 67 per cent. The ash contains phosphate (usually about 57 per cent. of the bones) and carbonate (about 5 to 10 per cent.) of calcium, phosphate of magnesium (1.1 to 2.7 per cent.), fluoride of calcium (nearly 1 per cent.), and traces of silica, iron, manganese, and probably also sodium chloride. Æby (1874) considers the principal inorganic constituents of bones to be united to a chemical compound having the formula $3(Ca_32PO_4).CaCO_3$, probably united with water and mixed with calcium carbonate. Ivory, including the fossil kind, has the composition $6(Ca_32PO_4).Ca2HO.CaCO_3.4H_2O$. When old bones free from organic matter are dried at 200° C. (392° F.), the residue, on being moistened with water, becomes warm and increases to its original weight again. Above 250° C. (482° F.), more water and carbonic acid are given off.

Pharmaceutical Uses. Os ustum, *Br.*—Bone ash is the inorganic residue left on burning bones to whiteness, and consists principally of phosphate of calcium with about 10 per cent. of carbonate of calcium and a little calcium fluoride and magnesium phosphate. It is used in the manufacture of glacial phosphoric acid, and in preparing Calc. phosphas and Sod. phosphas, *U. S.*, *Br.*

OVUM, *U. S.*—Egg.

Œuf, Fr.; *Ei*, G.

The egg of Phasianus gallus, *Lin.*, s. Phas. banckiva, var. domesticus, *Temminck.* *Class* Aves. *Order* Gallinæ.

Origin and Description.—The domestic fowl is regarded as having originated from the Javan fowl, *G. banckiva.* At the present time numerous varieties of it are found in all civilized countries. The eggs, which are the part employed for pharmaceutical and medical purposes, consist of the shell and lining membrane 10.7 parts, albumen 60.4 parts, and yelk 28.9 parts (Prout, 1822).

Composition.—1. Egg-shell, *Testa ovi*, consists, according to Prout, of 97 parts calcium carbonate, 1 part calcium and magnesium phosphates, and 2 parts organic matter. Vauquelin's results were 89.6, 5.7, and 4.7 respectively.

2. White of egg, *Albumen ovi*, Br.—It consists of 2 or 3 laminæ, the total average weight being 23.01 grms. (Lehmann), or 24.8 grms. (Poleck), and contains 82 to 88 per cent. water, and on the average 13.32 solid constituents, including 0.65 ash, as well as minute traces of fat, sugar, and extractive. The ash of the egg albumen consists of 42 per cent. chloride of potassium, 9 of chloride of sodium, 12 of carbonic acid, the remainder being phosphates and sulphates of the alkalies, silica, iron, lime, and magnesia. The organic portion of the white, the *albumen* proper, is a protein compound; the average elementary composition is 53.7 C, 15.5 N, 7.1 H, 22.1 O, and 1.6 S. Its aqueous solution rotates the plane of polarized light to the left, may be evaporated in thin layers below 50° C. (122° F.) without change, but on being heated to near 75° C. (167° F.) it is coagulated and becomes insoluble in water. Albumen is precipitated from its solutions by most mineral and by some organic acids, but not by phosphoric or acetic acid. It is soluble in caustic alkalies, and precipitates the salts of most heavy metals, hence its value in cases of poisoning by salts of mercury, copper, etc. Albumen is also precipitated by volatile oils, camphor, and by tannin, the last precipitate being soluble in an aqueous solution of tannin. Alcohol coagulates albumen, and ether precipitates it, the precipitate being only partially soluble in water. Farsky (1878) has succeeded in obtaining what appears to be a definite compound of salicylic acid with albumen, by stirring the two together for some time, washing with ether and hot water, and drying in an air-bath at about 120° C. (248° F.); it was found to contain 14.16 per cent. of salicylic acid and 85.84 of albumen, and to be as easily digestible as the uncombined albumen. When boiled with *Millon's reagent* (mercury dissolved in an equal weight of warm nitric acid, and the solution diluted with twice its bulk of water, and decanted from the precipitate), the precipitate as well as the liquid turns red. Other protein compounds show a like behavior.

3. Yelk of egg, *Ovi vitellus*, Br.—The *yelk* is a viscid yellow or reddish-yellow opaque liquid, which is without odor, has a bland taste, an alkaline reaction, and must be regarded as a dense emulsion consisting of oil suspended in water by means of albumen. When triturated with water, a whitish emulsion is obtained; the addition of alcohol causes it to coagulate, and when agitated with ether, it separates a white mass and yields to ether an orange-yellow fat. Yelk is coagulated by heat. It contains 48 to 55 per cent. of water, 16 to 18 per cent. of *vitellin*, which is probably a proteid closely related to casein, and

mixed with about one-fourth of albumen; 29 to 31 per cent. of fat, 21.3 parts of which are olein and margarin, according to Gubley; 1.5 per cent. inorganic salts, coloring matter, a small portion of sugar, and 0.42 of cholesterin. Gubley has separated from the ethereal extract of yelk a substance, which he named *lecithin*, and is evidently a mixture; it is said to contain *oleophosphoric acid*, which under some conditions yields oleic and *phosphoglyceric acids*.

Preservation.—Eggs may be preserved for a considerable length of time by covering the shell with a substance impervious to water, and closing the pores so as to exclude the air. This may be done by wax, fat, paraffin, gum, or by similar substances. Packing them with the small end downward in dry salt, milk of lime, etc., has likewise been recommended.

Pharmaceutical Uses.—The white of egg is used for the clarification of syrups, honey, and other liquids. The yelk is employed in emulsionizing fixed and volatile oils and in preparing Mistura chloroformi, *U. S.*, and Mist. spir. vini gallici, *Br.*

Medical Action and Uses.—*Egg-shells* were long used for the various purposes to which chalk is now applied internally. Like crab's eyes and claws, corals and oyster-shells, which were formerly employed, they contain a certain proportion of animal matter which mitigates the action of the calcareous constituent. They were an ingredient of a secret remedy for *gravel*, for a knowledge of which the British Parliament paid an extravagant sum of money. The *white of egg* forms with solutions of corrosive sublimate and of sulphate of copper compounds which are nearly insoluble, and hence it has been used in *poisoning* with these salts, first to neutralize and then to evacuate them. Its demulcent and protective action is also advantageous. It is applied in the treatment of *burns* and *erysipelas*, either alone or emulsified with oil, or coagulated by alum in the form of alum curd. The latter is an excellent application in acute *conjunctivitis*. Diluted with water, sweetened, and flavored, it forms an agreeable and useful drink in numerous cases of *gastro-intestinal* inflammation and irritation. Albumen is sometimes used as a substitute for starch in the application of fixed *bandages*. The *yelk of egg* is more nutritious and digestible than the white, and is habitually employed whenever it is desired to give the largest amount of nutriment in a small bulk, and in the most digestible form. The yelk of a hard-boiled fresh egg readily crumbles, and is, therefore, easily acted upon by the gastric juice. The fresh yelk, beaten with sugar, and mixed with hot water, and with the addition of a little brandy and nutmeg or cloves, forms a customary draught at the commencement of catarrhal and rheumatic (muscular) affections. It is used also to form emulsions for the administration of castor oil, cod-liver oil, oil of turpentine, etc., either by the mouth or the rectum. Externally, it is sometimes, and very usefully, employed as a dressing for *burns*, *scalds*, *abrasions*, etc., and to soften the crusts of *cutaneous eruptions*, *cerumen* in the auditory canal, etc.

OXALIS.—Wood-sorrel.

Alléluia, *Surelle*, *Pain de coucou*, Fr.; *Sauerklee*, *Hasenklee*, G.

Nat. Ord.—Geraniaceæ, Oxalideæ.

Description.—The following species indigenous to North America and Europe have been used:—

O. acetosella, *Lin.*—The plant has a thin thread-like rhizome, which, near the ascending apex, is furnished with a number of crowded reddish fleshy scales and fine brown radicles. The leaves rise upon petioles about two and a half inches long, and have three triangular-obcordate entire leaflets, half an inch long. The scapes are longer than the petioles, and bear a single white, red-veined flower, with ten alternately short stamens. The capsule is five-angled and five-celled, each containing two seeds.

O. stricta, *Lin.*—This is an annual herb, with a stem six to twelve inches high, producing subterranean shoots which survive the winter. The leaves are petiolate, with three obcordate leaflets, and the flowers yellow, forming a small umbel on peduncles longer than the petioles.

Several species, mostly acaulescent and bulbous, and bearing white, purple or yellow flowers, are seen in cultivation. All are inodorous, or nearly so, and have a pleasant acidulous taste.

Constituents.—Besides the principles common to most herbs, these plants contain acid potassium oxalate (see p. 64).

Medical Action and Uses.—Wood-sorrel and yellow wood-sorrel depend for their medicinal virtues upon the oxalate of potassium they contain. They have long been considered antiscorbutic, diuretic, and sedative in febrile conditions. In the last case an infusion of the plant forms an agreeable acidulous fever drink. Sorrel may be eaten as a salad mixed with lettuce, water-cress, etc. In *scurvy*, *purpura*, and some cases of vernal *intermittent fever*, it is reported to have been curative. In Europe it is commonly eaten as a dressing for insipid meats, such as veal and sweet-breads; and it is stated that its habitual use in this way has led to the formation of urinary calculi of oxalate of lime. Externally, the bruised leaves are sometimes applied to cleanse and stimulate foul *ulcers*.

OXYGENIUM.—OXYGEN.

Oxygène, Fr.; *Oxygen*, G.
Symbol O. Atomicity bivalent. Atomic weight 16.

Oxygen was discovered by Priestley (1774) and Scheele (1775). It constitutes about one-fifth of the volume of atmospheric air, the remainder being nitrogen, with a small proportion of carbonic acid gas. Eight-ninths of the weight of water, and one-half the weight of many minerals consist of oxygen, and it is estimated that at least one-third the weight of the solid crust of the earth is made up of this element, which is the most abundant of all.

Preparation.—Oxygen may be obtained by exposing binoxide of manganese, oxide of mercury, or some other metallic oxides, to a strong heat; but it is most conveniently prepared by heating a mixture of four or five parts of chlorate of potassium with one part of binoxide of manganese. At a low red heat the chlorate is completely decomposed into oxygen and potassium chloride, which remains mixed with the manganese; the latter, not being altered, may be recovered by dissolving the potassium chloride in water; $KClO_3$ yields $KCl + O_3$. Care should be taken that black sulphuret of antimony be not used in place of binoxide of manganese, since a violent explosion would take place on the application of heat.

Properties.—Oxygen is a colorless and inodorous gas, having the density 1.1056 as compared with air; one liter of it, at 0° C. (32° F.), and a barometric pressure of 0.76 meter, weighs 1.4303 gram. L. Cailletet and R. Pictet (December, 1877) succeeded in reducing it to the liquid state, when it has the density 1.0. It is slightly soluble in water and alcohol, and combines with all other elements, perhaps with the sole exception of fluorine. These compounds are called *oxides*, and the act of combination *oxidation*, and when attended with heat and light, it is termed *combustion*.

By the action of electricity upon oxygen, or by the slow oxidation of phosphorus in moist air and under various other circumstances, oxygen is converted into *ozone*, which is a colorless gas, of a peculiar odor, somewhat resembling that of chlorine. It is a powerful oxidizing agent, bleaches indigo solution, and liberates iodine from potassium iodide; paper dipped in thin starch paste containing potassium iodide is turned blue by ozonized air, and is a delicate test for the presence of ozone. This body has not been obtained free from oxygen; it is regarded simply as a modification of oxygen, its formula being O_2O, indicating that three vols. have been condensed into two; its spec. gravity is one-half greater than that of oxygen. It is nearly insoluble in water (see also page 731).

Physiological Action.—It was taken for granted that oxygen could be introduced as readily as food is carried into the system through the stomach, and that by its means all the organic operations of the economy could be aroused to an increased activity. Experimenters graphically described the enlivening influence of this increased supply of "vital air" upon the sensations and the organic functions, and were apt at explaining how it not only must, but actually did, cure some of the gravest of diseases. But it was pointed out by Dr. A. H. Smith, and then by Dr. B. W. Richardson, that no more than a certain proportion of oxygen, such as exists in the atmosphere, can be absorbed by the lungs. Their results were subsequently (1875) confirmed by Buchheim, who concludes that "henceforth we must abandon the notion that the course of diseases can be modified by increasing the amount of oxygen in the blood."

Medical Uses.—A critical examination of the reports of *pulmonary consumption* treated by oxygen proves that no ground exists for the belief that the disease is either curable or benefited by this gas; the same may be said of *diabetes;* and it might be added, also, of chronic *bronchitis*, and other affections of the respiratory organs, were it not that in such of them as are attended with symptoms of *asphyxia*, the inhalation of oxygen has certainly appeared to prolong and even to save life. This has been demonstrated in asphyxia from emphysema with bronchitis, in laryngitis of various forms, in compression of the lungs by the gravid uterus, in opiate narcotism, in poisoning by charcoal fumes or by illuminating gas, and in similar conditions. If possible, it should be inhaled from a reservoir or bag containing it, through a tube with a suitable stopcock and valves, as in the case of nitrous oxide gas.

OXYMEL, *Br.*—Oxymel.

Oxymel simplex, P. G.; *Mel acetatum.*—*Oxymellite simple, Acétomel*, Fr.; *Sauerhonig*, G.

Preparation.—Take of Clarified Honey forty ounces; Acetic Acid and Distilled Water each five fluidounces. Liquefy the honey by heat, and mix with it the acetic acid and water. *Br.*

The French Codex orders one part of white wine vinegar to be mixed with four parts of virgin honey, and the mixture to be concentrated and clarified with paper pulp. The German Pharmacopœia directs the mixing of forty parts of clarified honey with one part of acetic acid spec. grav. 1.040; this is certainly the simplest process.

Medical Action and Uses.—This is an officinal form of the popular mixture of honey and vinegar, which is generally used as a gargle in *sore throat.* It may be prescribed as an excipient for various expectorant medicines, and particularly of squill and ipecacuanha in the form of syrup.

OXYMEL SCILLÆ, *Br.*—Oxymel of Squill.

Preparation.—Take of Vinegar of Squill one pint; Clarified Honey two pounds. Mix and evaporate by a water-bath until the product when cold shall have a specific gravity 1.32. *Br.*

Medical Action and Uses.—Oxymel of squill has the medicinal virtues of syrup of squill, neither more nor less. Honey is superior to syrup as a local application to the throat; but there is no known difference between them in their action upon the air-passages. Like the syrup of squill, the oxymel may be prescribed in *catarrhal affections* of the respiratory mucous membrane, and in young children as an emetic in spasmodic *croup*. The *dose*, as an expectorant, is for adults a teaspoonful; for infants from five to twenty drops. As an emetic for children, a teaspoonful may be given at short intervals.

PÆONIA.—PEONY.

Pivoine, Fr.; *Gichtrose*, *Pfingstrose*, G.

Pæonia officinalis, *Lin.* *Nat. Ord.*—Ranunculaceæ, Pæonieæ.

Description.—Peony is a perennial herb from Southern Europe, which is frequently cultivated for ornament. It has an oblique many-headed root-stock, six or nine inches in length, with numerous at first fibrous *roots*, which afterwards enlarge and become fusiform, dark-brown, internally white and mealy, resembling elongated tubers. In commerce, these are generally peeled, are whitish or purplish, and have near the circumference narrow yellow wood wedges. The branched stem is about two feet high, smooth, with large, twice or thrice pinnately dissected and cleft green smooth leaves, and large terminal flowers, having five sepals, five to eight petals, numerous stamens, and two to five ovaries. The *petals* are obovate, entire or crenate, one and a half inch long, dark-red, purple or rose-red, after drying inodorous, and have a sweetish astringent taste. The *seeds* are nearly globular, one-eighth to one-sixth of an inch in diameter, black, glossy, and smooth, inodorous, and contain a yellowish oily albumen and a small embryo. The tuberous roots, petals, and seeds have been used.

Constituents.—Wiggers obtained from the fresh root a distillate having the odor of bitter almonds, and acquiring a blood-red color by ferric chloride; separated by means of ether, the volatile oil had a pale yellow color. The analysis of the fresh root by Morin proved the presence of starch, sugar, fat, malates, oxalates, and phosphates, a little tannin, etc.

Medical Action and Uses.—In the ages of medical faith the virtues of this plant were highly esteemed. Galen described its acrid qualities and emmenagogue virtues, and its astringency, also, which rendered it useful in diarrhœa. A superstition prevailed in his time that peony root inclosed in a bag and hung around a child's neck both prevented epileptic attacks and cured them, and the belief is not extinct among the peasantry of Europe even now. They also believe that the same amulet, or rather one made with the seeds, worn on the arm will prevent the dangers of dentition, and promote menstruation. That the plant is not inert is abundantly proved; its very odor has caused syncope; in one case an infusion of it brought on an attack of convulsions, and in another it produced headache, ringing in the ears, confusion of sight, violent colic, and vomiting. Modern observation has neither confirmed nor condemned the ancient opinions concerning this plant; and although some have reported favorably of it in epilepsy, chorea, and whooping cough, the evidence in favor of its efficacy is very slender indeed.

PANAX, *U. S.*—GINSENG.

The root of Panax quinquefolium, *Lin.*, s. Aralia quinquefolia, *Gray*. *Nat. Ord.*—Araliaceæ.

Origin.—The North American ginseng is a perennial herb growing in rich and cool woods. The stem is a foot high, and bears at the summit three large palmately five-foliate leaves, with long-stalked, obovate-oblong, pointed, doubly serrate leaflets. The greenish-white flowers are in a terminal subglobular umbel, and produce globular scarlet red two-celled and two-seeded berries.

Description.—The root is fusiform, two to three inches long, with a rounded head, closely annulate, and with few wrinkles above; then dividing into two or occasionally three branches of even size. The branches are not, or are but slightly, annulate, and longitudinally wrinkled. The root is externally of a light brownish-yellow color, internally white, breaks with a short and mealy fracture, and has a faint sweetish odor and a sweet slightly aromatic taste. The transverse section shows a thick bark, with numerous scattered brown-red resin cells, and in older roots radially striate from the bast wedges; it is separated by a brown cambium line from the central portion, which consists of linear wedge-shaped yellowish wood bundles and broad medullary rays.

Panax schinseng, *Nees*, the *Chinese ginseng*, has a larger root, four to six inches long, darker in color, and near the head usually with two lateral branches, otherwise resembling the preceding.

Constituents.—Besides starch, gum, albumen, and resin, S. S. Garrigues (1854) isolated a sweet principle, *panaquilon*, $C_{12}H_{25}O_9$, by adding to the syrupy infusion a concentrated solution of sodium-sulphate and dissolving the precipitate in alcohol. It is yellow, amorphous, sweet, insoluble in ether, and precipitated by tannin. Concentrated sulphuric acid dissolves it with a purple-red color, converting it at the same time into *panacon*, $C_{11}H_{19}O_4$, which is white, tasteless, and insoluble in water and ether, but soluble in alcohol.

Medical Action and Uses.—It is unsettled whether or not the American and Chinese species of ginseng are identical. It is, at least, certain that while the former is only agreeable in taste and perhaps useful as a mild stomachic, the latter enjoys in its native country the reputation of a panacea. The affections for whose cure it is most esteemed are such as are usually treated by aromatic stimulants, including *dyspepsia, vomiting, and nervous disorder.* It appears to be a superfluous member of the Pharmacopœia.

PANCREATINUM.—PANCREATIN.

Origin.—The *pancreas* is a gland which is deeply seated in the abdomen, and secretes the *pancreatic juice*, containing the proteid *pancreatin*, to which it owes the property of emulsifying and decomposing fats into glycerin and acid, and of converting starch into sugar. The pancreatic juice is a colorless, clear, somewhat viscid liquid, of an alkaline reaction, and without odor and taste; it contains, besides the ferment, nearly one per cent. of mineral salts, a trace of fat and of organic matters soluble in water.

Preparation.—Prof. Scheffer (1875) recommended the following process: Fresh and finely chopped beef pancreas is macerated for a day in water acidulated with a little muriatic acid; the maceration is repeated with water, the strained liquids filtered, neutralized with calcium carbonate, again filtered, and mixed with an equal volume of 95 per cent. alcohol; the precipitate is washed with dilute alcohol, pressed between bibulous paper, and dried at the ordinary temperature.

Properties.—Thus prepared it is a transparent, brittle, yellow mass, which dissolves in water slowly, but almost entirely, leaving, when prepared in cold weather, only a trace of insoluble matter. The solution is clear, pale yellowish, neutral, and produces white precipitates on heating and on being mixed with alcohol. Muriatic acid likewise precipitates it, but not a saturated neutral solution of table salt.

Composition.—Like other proteids, pancreatin consists of C, H, N, O, and a little S (see Ovum, p. 1027). Bernard assumed the presence in the pancreatic liquid of two ferments, and recently (1878) Defresne announced the isolation of even three, namely, *myopsin*, which digests albumen; *amylopsin*, which saccharifies starch; and *steapsin*, which decomposes fats.

Medical Action and Uses.—The pancreatic juice has the power of forming an emulsion with fatty food, which fits it for absorption and nutrition. It has a digestive action upon starchy aliment. During the first years ot life, when the food consists chiefly of milk and farinacea, a state of *dyspepsia* frequently arises, which often leads to marasmus, and which is not traceable to any organic lesions of the stomach or auxiliary viscera. In this it is claimed that pancreatic emulsion speedily restores the digestive function to its normal condition, and, through improved nutrition, renews the health. In this way also, in certain cases of fatty diarrhœa, is said to have rendered the stools natural and restored the wasted flesh. A few clinical reports of the utility of this preparation, which do not appear to have been corroborated by general experience, have been followed by an apparent oblivion of the whole subject.

PAPAVER, *U. S.*—POPPY.

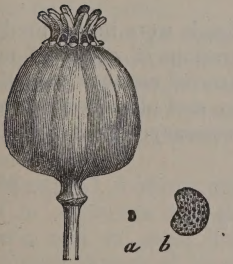
Papaveris capsulæ, Br.; *Fructus s. Capita papaveris*, P. G.—*Poppy capsules*, E.; *Capsules* (*Têtes*) *de pavots*, Fr.; *Mohnkapseln*, *Mohnköpfe*, G.

The nearly ripe capsules of Papaver somniferum, *Lin.*

Nat. Ord.—Papaveraceæ.

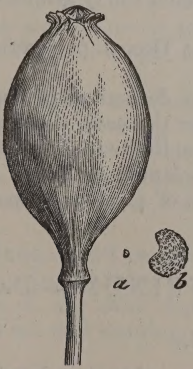
Origin.—The poppy is most likely indigenous to Western Asia and Southeastern Europe, where it is found wild in fields and waste places. It is frequently cultivated in gardens for ornament, and very extensively in several countries for the production of opium (see page 1009). The stem is three or four feet high; the leaves are alternate, five to ten inches long, oval-oblong, sessile, and the upper ones clasping, irregularly dentate, frequently cleft or nearly pinnatifid, rather thick, smooth, and glaucous. The flowers terminate the branches, are about four inches broad, and have two oval blunt sepals, and four broad roundish petals varying in color from white to violet and dark purple, with a darker spot near the base. The stamens are very numerous, and inserted beneath the subglobular ovary, which is crowned by the peltate radiating stigma. The wild form, Papaver setigerum, *D. C.*, has acute teeth, prolonged into a stiff bristle. The white flowering variety, Pap. officinale, *Gmelin*, has white seeds, and its capsules are alone recognized by the British Pharmacopœia.

Fig. 125.



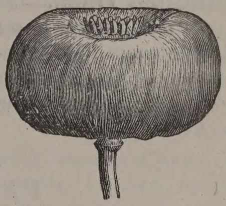
Black.

Fig. 126.



White.

Fig. 127.



Depressed.

Poppy capsules and seeds (*a*, natural size; *b*, magnified).

Description.—Poppy capsules vary in shape and size according to the variety of the plant from which they have been obtained. The black poppy usually has rather small capsules, which are globular-ovate, about an inch and a half in diameter, broadest near the base, and dehiscent by small apertures forming underneath the stigma. The capsules of the white poppy are mostly larger, indehiscent, and more variable, occasionally depressed, and much broader than high, but usually oblong, or in some varieties much elongated, and narrowed towards the base. The sessile and peltate stigma is formed of from eight to twenty rays; and a similar number of longitudinal striæ, marking the sutures, are observed upon the immature capsule, which is smooth, and underneath the epidermis consists of loose parenchyma with a circle of thin fibro-vascular bundles and larger laticiferous vessels. The capsule is one-celled, but internally is furnished with placentas equal in number to the lobes of the stigma, and projecting into the interior, forming incomplete partitions. In the fresh state it has a narcotic odor; after drying it is nearly inodorous; its taste is bitter.

SEMEN PAPAVERIS. Poppy seed, Maw seed, *E.;* Graines de pavot, *Fr.;* Mohnsamen, Magsamen, *G.*—The seeds are very numerous, quite small, about one-twentieth of an inch long, reniform in shape, white, blackish, or bluish, finely netted-veined, and contain an oily albumen, inclosing a curved embryo. They are inodorous, and have a bland oily and scarcely bitterish taste.

Constituents. 1. THE CAPSULES.—Winckler (1837), Merck, and others have demonstrated the presence of *morphia* in ripe poppy capsules; the former chemist obtained as much as two per cent. of this alkaloid and likewise *narcotina* and *narceia.* Groves (1854) found also another alkaloid, which was probably *codeia.* A. Buchner obtained an alkaloid which differed from morphia, and other chemists were unable to find the latter. Deschamps (1864) isolated an alkaloid, *papaverosina,* which crystallizes in prisms, and does not appear to neutralize acids completely; and silky needles of a nitrogenous body, called *papaverin,* which is said to have an acid reaction. Hesse (1866) obtained *rhœadina* from ripe poppy capsules. Besides meconic acid, which could not be detected by several chemists, citric and tartaric acids were found by Deschamps. The capsules contain considerable mucilage and a little waxy matter.

2. THE SEEDS.—Sacc (1849) obtained from white poppy seeds nearly 55 per cent. of fixed oil, 23 pectin, and 12.6 per cent. protein compounds. Accarie (1833) announced that he isolated thirty grains of morphia from six pounds of white seeds.

Off. Prep.—Of the capsules: Decoct. papaveris, Extract. papaveris, Syrupus papaveris, *Br.*

Medical Uses.—Formerly decoctions of poppy heads were much used internally; but such is no longer the case, since preparations of opium of more definite strength have become multiplied. Even for external use such decoctions have been almost entirely supplanted by liquid opiates and plasters containing opium. The officinal retention of papaver seems unnecessary, unless for pharmaceutical purposes.

PARAFFINUM.—PARAFFIN.

Paraffine, Fr.; *Paraffin,* G.

Origin.—The paraffins are produced under various circumstances from fats and other organic compounds, but are chiefly obtained among the products resulting from the destructive distillation of many organic substances, especially cannel and boghead coal. They are a natural constituent in varying proportions of the different kinds of petroleum, and the solid paraffins are found native in Austria and some other countries, constituting the minerals known as *earth-wax, fossil-wax,* and *ozokerite.*

Composition and Characters.—The general formula of the paraffins is the same as that of the lighter coal oils, C_nH_{2n+2}; but in their physical properties they differ from the latter in being at the ordinary temperature either solid, and frequently crystalline, or of an oleaginous consistence and liquid. Those which are liquid at the ordinary temperature are known in commerce as *paraffin oils*, while the name *paraffin* is retained for the solid products. They can be separated from one another only with great difficulty; but it is known that the different members of this homologous series increase in density, viscidity, and in boiling point, and the solid paraffins also in melting point and hardness, as the molecular weight increases. The paraffins obtained in as pure a state as possible show the following differences:—

Nonane (Nonylhydride)	C_9H_{20}	boils near	138° C.	= 280.4° F.	Spec. grav.	.741
Decane (Decatylhydride)	$C_{10}H_{22}$	"	160	= 320	"	.757
Endecane (Undecylhydride)	$C_{11}H_{24}$	"	180	= 356	"	.766
Dodecane (Laurylhydride)	$C_{12}H_{26}$	"	200	= 392	"	.778
Tridecane (Cocinylhydride)	$C_{13}H_{28}$	"	220	= 428	"	.796
Tetradecane (Myristylhydride)	$C_{14}H_{30}$	"	240	= 464	"	.809
Pentadecane (Benylhydride)	$C_{15}H_{32}$	"	260	= 500	"	.825

Galletly (1871) ascertained for paraffins—

Fusing at	32.0°	39.0°	40.5°	53.3°	58.0°	59.0°	80.0° C.
The spec. grav.	.8236	.8480	.8520	.9100	.9243	.9248	.9400

The solubility of paraffins in benzol decreases as the melting point rises, the last one of the table being nearly insoluble therein.

Paraffins are not easily acted on by chemicals; they are freed from hydrocarbons of the *olefin series*, C_nH_{2n}, by strong sulphuric acid, which destroys the latter. By continued boiling with nitric acid the higher paraffins yield nitro-compounds and various acids. Boiling muriatic acid or contact with chlorine gas, ammonia, or potassa has no effect upon paraffin; but the lowest members of the series, which are gaseous at the ordinary temperature, yield substitution products with chlorine.

Paraffin is insoluble in water, alkalies, and cold alcohol, but dissolves in volatile and fixed oils, ether, chloroform, benzol, and carbon bisulphide; the solubility is, however, influenced by the composition. In distilling paraffin, the heat to which the vapors are exposed influences the melting point, and consequently the composition; at a red heat *naphthalin* is produced, and when paraffin is heated for some time in a sealed tube it is split into an *olefin* and a paraffin of a lower boiling point.

J. L. Lemberger and A. W. Miller ascertained (1875) that crude paraffin oils may be deprived of their odor by filtering them through granulated animal charcoal. *Cosmoline*, *vaseline*, and other copyrighted preparations are paraffins of the consistence of ointments. The liquid paraffins are extensively employed for lubricating purposes, and are known in commerce as *lubricating oils* and *neutral oils*.

Medical Action and Uses.—Soft paraffin is much used in a pure state and in ointments as a dressing for *chilblains*, *excoriations*, *bruises*, *indolent ulcers*, and in some diseases of the skin, especially *psoriasis* and *scabies*. Authentic reports of its effects are still wanting.

PAREIRA, *U. S.*—PAREIRA BRAVA.

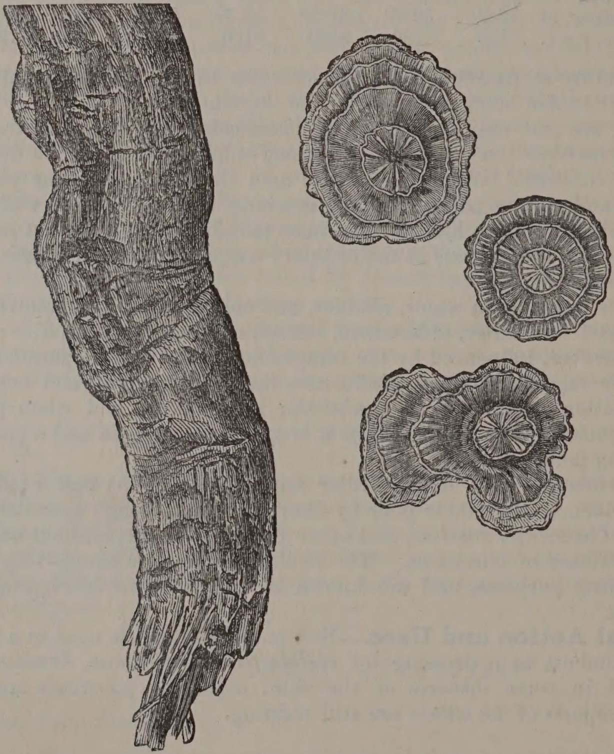
Pareiræ radix, Br.—*Pareira brava*, Fr., G.

The root of Chondodendron tomentosum, *Ruiz and Pavon*, s. Cocculus chondodendron, *D. C.*, s. Cissampelos abutua, *Vell.* Bentley and Trimen, Med. Plants, 11.

Nat. Ord.—Menispermaceæ.

Origin.—The United States and British Pharmacopœias refer pareira brava to Cissampelos pareira, *Lin.*, s. Ciss. microcarpa, *D. C.* (Bentley and Trimen, Med. Plants, 15), which is a woody climber, indigenous to the West Indies and Central America, and probably to other tropical countries. It is medicinally employed there, but is not exported. The root as well as the stem rarely reaches an inch in diameter, and is often not thicker than a goose-quill; both show no concentric rings in transverse section, the wood consisting of about 20 porous wedges, separated by narrower medullary rays, and covered by a gray-brown suberous bark.

Fig. 128.



Pareira brava. Portion of a root, and transverse sections of the same.

The true origin of pareira brava was established by Hanbury (1873), and is the species mentioned above. This is a tall woody climber of Brazil and Peru, having large cordate or ovate-cordate, somewhat five-nerved leaves, very small unisexual flowers and purplish-black ovoid one-seeded drupaceous fruits, which form thick bunches, resembling grapes in appearance.

Description.—Pareira brava comes to us in pieces, three to six inches long or even longer, and from about one to three inches in diameter, more or less tortuous, dark-brown or blackish externally, and marked with transverse ridges and fissures, and with irregular longitudinal furrows. Internally it is of a pale-brown color; when cut, exhibits a somewhat waxy lustre, and on breaking, shows a fibrous fracture. On transverse section are seen under a thin bark, two or more concentric zones separated by wavy circles of a waxy tissue resembling the medullary rays; in each zone are found a varying number of harder porous wood wedges. Each one of the different zones is mostly nearly uniform in width, so that the axis is nearly in the centre of the root. Pareira brava is nearly inodorous and has a bitter taste.

Admixtures and Substitutions.—The *stem* of chondodendron is sometimes found mixed with the commercial root, which it closely resembles. It is distinguished by being rather more woody, but more particularly by the distinct central pith.

Several drugs derived from menispermaceous plants have been sold in place of pareira brava; these consisted of roots or, more frequently, of sections of the stem. The one which was most commonly met with some years ago, consisted of woody more or less flattened pieces, with a thin brown-gray bark, often covered with patches of lichens, and upon transverse section showed numerous woody zones in more or less eccentric layers, so that the axis was removed to one side. This variety of *false pareira brava* is not readily cut with the knife, does not present a waxy appearance of the internal tissue, and, though possessed of a bitter taste, is much less so than the root of chondodendron. A second variety of false pareira, was usually in thinner pieces, of a brown color, very woody and nearly concentrically arranged in the interior, and almost tasteless.

Recently a *yellow pareira brava* has been met with in commerce, and was imported from Brazil. It consists of the flat, often twisted stems, which Bentley and Trimen presume to be obtained from Abuta amara, *Aublet.* This kind is easily recognized by the eccentric arrangement of its woody zones and by its bright-yellow color internally. C. Morrison (1878) isolated from it an alkaloid, which closely resembles berberina, but appears to be distinct from it, since with iodine it gave a reddish-brown crystalline precipitate instead of green spangles.

Hanbury mentions also a *white pareira brava*, derived from Abuta rufescens, *Aublet*, which has numerous concentric layers traversed by very distinct dark medullary rays, the interradial spaces being white and rich in starch. It is not an article of commerce.

Constituents.—Wiggers (1838) obtained an alkaloid from pareira brava, which was named *pelosina* or *cissampelina*, and was found by Flückiger to be identical with beberia (see pp. 271 and 935), and to exist also in the stem and root of Cissampelos pareira, *Lin.*, to the extent of about one-half per cent. Pareira brava contains it in the same proportion. Feneulle (1821) examined a pareira brava, and obtained a yellow bitter principle, soluble in alcohol and ether, a soft resin soluble in alcohol, and brown extractive, soluble in alcohol and water.

Off. Prep.—Decoctum pareiræ, Extract. pareiræ, *Br.;* Extract. pareiræ fluidum (liquidum), *U. S.*, *Br.;* Infusum pareiræ, *U. S.*

Medical Action and Uses.—Pareira appears to be analogous in its virtues to uva ursi, and chimaphila, since they are chiefly manifested in diseases of the mucous membrane of the urinary organs, and especially in those attended with muco-purulent deposits in the urine. In chronic *pyelitis* and *cystitis* it may be advantageously administered in the form of the officinal infusion, the decoction, or the fluid extract. The solid extract is less efficient. The *dose* is represented by thirty and from that to sixty grains of the root.

PARIETARIA.—PARIETARIA.

Pellitory, *Wall pellitory*, E.; *Pariétaire*, *Perce-muraille*, Fr.; *Glaskraut*, G.

Nat. Ord.—Urticaceæ, Urticeæ.

Description.—The following perennial European species have been used:—

Par. officinalis, *Lin.*—The stem is diffusely branched, reddish, rough-hairy; the leaves are petiolate, alternate, about an inch long, short-hairy, elliptic, entire, and acute; the polygamous flowers are in cymose axillary clusters with an involucre of short bracts, which are united at the base. The plant grows on walls and along roadsides.

Par. erecta, *Koch.*—It resembles the preceding, but is nearly simple, and has larger elliptical-ovate and pointed leaves.

Par. pennsylvanica, *Muhl.*, indigenous to the United States, probably possesses similar properties. It is an annual, has thin oblong-lanceolate, rather obtuse and opaquely-dotted leaves, and an involucre which is longer than the flowers. It grows on shaded rocky banks.

These plants are inodorous, and have a mucilaginous saline taste.

Constituents.—No complete analysis of these plants has been made. Among the saline constituents of the European species, nitrate of potassium is named.

Medical Action and Uses.—Anciently common wall pellitory was held to be astringent, cleansing, and cooling, and hence was applied in the first stage of abscesses and other local inflammations, including burns, erysipelas, inflamed hemorrhoids, gouty joints, and scaly eruptions. Its expressed juice was used as a gargle, and in modern times was taken internally, in the dose of one or two fluidounces, as a diuretic and lithontriptic.

PARTHENIUM.—FEVERFEW.

Herba matricariæ.—*Featherfew*, E.; *Matricaire*, Fr.; *Mutterkraut*, G.

The flowering herb of Pyrethrum (Matricaria, *Lin.*) parthenium, *Smith.*

Nat. Ord.—Compositæ, Senecionideæ.

Origin.—Feverfew is a perennial herb growing in waste places in Europe, and cultivated in gardens, where it is often seen with double flowers.

Description.—The stem is about two feet high, furrowed, and has alternate, petiolate, twice pinnately-cleft leaves, about three inches long and with obovate or oblong mostly toothed lobes, the teeth terminating with a white point. The flower heads are in small cymes at the end of the branches, have an involucre composed of linear scales in two rows, a naked hemispherical receptacle, white ligulate obovate and three-toothed ray florets, and tubular yellow disk florets. The herb has a peculiar odor, resembling that of chamomile, but less agreeable, and a bitter, somewhat acrid taste.

Constituents.—The bitter principle of feverfew has not been isolated; the tannin is of that variety which produces dark green precipitates with iron salts. The volatile oil contains, according to Dessaignes and Chatard (1848), a stearopten which has the composition of camphor, $C_{10}H_{16}O$, fuses at 170° C. (338° F.), and turns polarized light to the left; also another oxygenated but liquid portion, and probably a hydrocarbon.

Allied Plants.—PARTHENIUM INTEGRIFOLIUM, *Lin.*, is a North American perennial, growing in dry soil in the Southern and Western States. It is about two feet high, and has oblong or ovate leaves, of which the lower ones are sometimes lobed, and the upper ones merely crenately toothed; and small corymbose flowerheads, with a conical chaffy receptacle, five inconspicuous white pistillate ray florets and sterile disk florets. It has a bitter taste.

PARTH. HYSTEROPHORUS, *Lin.*, indigenous to the West Indies, resembles the preceding, but has bipinnatifid leaves. It is employed like feverfew.

Medical Action and Uses.—The medicinal properties of Matricaria parthenium may be referred to the bitter principle associated with the essential oil which it contains. It has been much used in the treatment of flatulent, or atonic, *dyspepsia*, in *amenorrhœa*, *dysmenorrhœa*, and simple *intermittent fever*, as well as in conditions of *nervous debility* with hysterical symptoms.

The expressed juice has been administered, and also a decoction and an infusion of the herb. The latter is sometimes applied, like chamomile, in fomentations, to allay the pain of local inflammations (toothache, abscesses, rheumatism), and to promote suppuration.

The flowering tops of Parthenium integrifolium are extremely bitter. Many years ago an infusion made from them was reported to be remarkably efficacious in curing intermittent fever. But as no further testimony has been published in confirmation of this statement, it may fairly be assumed to have been exaggerated, and that the alleged cures were only such as occasionally follow the use of various vegetable bitters.

PEPO, *U. S.*—PUMPKIN-SEED.

Semences de potirons, Fr.; *Kürbissamen*, G.

The seed of Cucurbita Pepo, *Lin.* *Nat. Ord.*—Cucurbitaceæ.

Origin.—The plant is indigenous to tropical Asia and America, and often cultivated. It has a rough hollow stem, large five-lobed, serrate leaves, five-branched tendrils, yellow bell-shaped monœcious flowers, and usually large globular or oblong fruits.

Description.—The seeds are three-quarters to one inch long, flat, broadly ovate, somewhat oblique at the pointed end, white or pale yellowish, nearly smooth or finely granular on the surface, near the edge and parallel with it marked with a shallow groove, and frequently covered with fragments of a white membranous tissue. The embryo consists of two flat cotyledons of the shape of the seed, and of a short conical radicle. It is inodorous, and has a bland oily taste.

The seeds of Cuc. melopepo, *Lin.*, the *squash*, are very similar, rather more obtuse, and less plainly margined. (See also p. 474.)

Constituents.—Dorner and Wolkowich (1870) obtained from pumpkin-seeds 44.5 per cent. of fixed oil, 32.75 starch, and traces of volatile oil, resin, and sugar. They also announced the discovery of an alkaloid, *cucurbitin;* this, however, could not be found by Kopylow (1876), who was also unable to establish the presence of a glucoside. He proved the seeds to contain free fatty acids, and the oil to consist of the glycerides of palmitic, myristic, and oleic acids. When triturated with water, the seeds yield a white and bland emulsion; the emulsionizing principle is probably a protein compound.

Medical Uses.—Pumpkin-seeds are among the most efficient remedies for *tapeworm*. Originally referred to as a vermifuge in the last century, it is only within a comparatively few years that their efficiency has been established by numerous and trustworthy witnesses, notwithstanding their neglect by most writers on helminthology. The remedy has the advantage of being free from any unpleasant taste or harsh mode of action. According to Hæckel, the tænifuge virtues reside in the perisperm. The fixed oil of the seeds, extracted by ether, has also been used successfully for the same purpose, in the dose of half an ounce repeated in two hours, and followed in two hours more by a dose of castor oil. For administration, from one to two ounces of fresh pumpkin-seeds should be deprived of their outer envelope and beaten into a paste with finely-powdered sugar, and diluted with water or milk when taken. Three or four hours later one or two tablespoonfuls of castor oil should be administered. Before taking the medicine the patient should fast for twenty-four hours. A fluid extract has also been used.

PEPSIN, *Br. Add.*—PEPSIN.

Pepsine, Fr.; *Pepsin*, G.

A preparation of the mucous lining of a fresh and healthy stomach of the pig, sheep, or calf.

Preparation.—The stomach of one of these animals recently killed having been cut open and laid on a board with the inner surface upwards, any adhering portions of food, dirt, or other impurity are to be removed, and the exposed surface slightly washed with cold water; the cleansed mucous membrane is then to be scraped with a blunt knife or other suitable instrument, and the viscid pulp thus obtained is to be immediately spread over the surface of glass or glazed earthenware and quickly dried at a temperature of not exceeding 100° F. The dried residue is to be reduced to powder and preserved in a stoppered bottle. *Br.*

This product, it will be observed, consists merely of the carefully dried mucous membrane of the stomach. A process for obtaining the digestive principle in a nearly pure state was published by Prof. E. Scheffer (1872), and is as follows: The mucous membrane of the well-cleaned fresh stomach of the hog is dissected off, chopped finely, and macerated in water acidulated with muriatic acid. After several days the liquid is strained, clarified by rest and decantation, and mixed with an equal bulk of a saturated solution of sodium chloride. The pepsin is separated floating upon the surface, drained upon muslin, and strongly pressed to remove the solution of salt. If permitted to dry, it becomes very tough, parchment-like, or leathery. Obtained in this way, it still contains mucus, phosphate of calcium, and table-salt; from the two former of which it is freed by resolution in water, filtering, again precipitating by sodium chloride, and expressing; the table-salt which now remains with it is best removed by allowing the pressed pepsin to dry, when the salt will effloresce upon the surface and will dissolve on short immersion in water. It then constitutes Scheffer's *purified pepsin*, which dissolves in acidulated water to a clear and colorless solution.

To obtain *saccharated pepsin*, the expressed residue, while still damp, is thoroughly mixed with milk sugar, and when the mixture has become air dry, its digestive power is ascertained, and the remainder is then diluted by the addition of milk-sugar, so that ten grains of it will dissolve 120 grains of coagulated albumen at a temperature of 100° F. in five or six hours.

Various other processes for obtaining pepsin have been recommended, but the saccharated pepsin, prepared as above, is most generally employed in the United States, in preference to pepsin reduced to powder by the aid of starch, which has, at least sometimes, been found to be deficient in digestive power.

Properties.—The British Pharmacopœia describes pepsin as being a light yellowish-brown powder, having a faint, but not disagreeable odor, and a slightly saline taste without any indication of putrescence. It is soluble to a very small degree in water or spirit. Two grains of it, with an ounce of distilled water to which five minims of hydrochloric acid have been added, form a mixture in which 100 grains of hard-boiled white of egg, in thin shavings, will dissolve on their being digested together for about four hours at a temperature of 98° F.

The digestive power of this pepsin, it will be observed, is about four times greater than that of *saccharated* pepsin, but much inferior to that of *purified* pepsin, one-half grain of which was observed by Scheffer to dissolve over 1500 grains of coagulated albumen in a few days. Saccharated pepsin is a pale-yellow powder, having but a slight odor and a sweetish taste, and dissolving completely in water. The solution, slightly acidulated with hydrochloric acid, furnishes precipitates on boiling, on the addition of alcohol, tannin, and sodium carbonate or bicarbonate, an excess of the last two precipitants yielding again a clear solution. Except in minute quantities, chloride of sodium impairs the digestive power of pepsin; the same is true of alcohol. When a solution of pepsin is rendered alkaline, and afterwards again acidulated, it has lost its power of dissolving fresh coagulated albumen. An aqueous solution of pepsin will decompose in a short time; after the addition of sufficient hydrochloric acid, it remains clear, but gradually loses its effects on albumen. Glycerin, on the other hand, preserves its virtues in the form of *liquid pepsin*, which is recommended by Scheffer (1870) to be made by dissolving 64 grains of saccharated pepsin in 5 fluidounces of water acidulated with 1 fluidrachm of hydrochloric acid, and adding 3 fluidounces of glycerin. Pepsin, particularly after it has been slightly acidulated, coagulates milk; 80,000 parts of the latter were found by Scheffer to be curdled by one part of purified pepsin.

GASTRIC JUICE.—As taken from the stomach and filtered from the undigested food, this forms a clear, transparent, limpid liquid of a pale-yellow or brownish color, of a slight peculiar odor, and of a somewhat saline and acidulous taste. It is but slightly heavier than water, has a strongly acid reaction to test-paper, and retains its digestive power for a long time, even after it has become mouldy. Lehmann obtained from gastric juice between 0.1 and 0.132 per cent. of free hydrochloric, and between 0.32 and 0.585 per cent. of lactic acid. The latter was observed by Richet (1878) to be identical with *sarcolactic acid* of horseflesh. The total percentage of all solids contained in gastric juice is between 1 and 1.5 per cent., but varies in different animals, and is invariably increased by admixture with saliva. The chlorides amount to nearly $\frac{1}{2}$ per cent., among them small quantities of ammonium and calcium chlorides. Phosphates of calcium, magnesium, and iron amount to $\frac{1}{5}$ or $\frac{1}{4}$ per cent.; but alkaline sulphates and phosphates cannot ordinarily be detected.

VINUM PEPSINI, s. *Vinum pepticum*, s. *Essentia pepsini*, P. G.—100 parts of the peptic mucus scraped off from the stomach of a hog or from the rennet (abomasus or fourth stomach) of an ox are mixed with 50 parts each of glycerin and distilled water, 1000 parts of good white wine, and 5 parts of hydrochloric acid, macerated for three days at or below 20° C. (68° F.), and filtered. The liquid is of a clear yellow color, and has a vinous odor and slightly acid taste.

LIQUOR SERIPARUS, *P. G.;* Rennet wine, Liquid rennet, *E.;* Laabessenz, *G.*—Three parts of the mucous membrane of calves' rennet are macerated for three days with 26 parts of sherry wine and 1 part of chloride of sodium. After filtration liquid rennet is a clear yellowish liquid.

Medical Action and Uses.—On the introduction of pepsin into medical practice it soon acquired a brilliant reputation as a remedy for numberless dyspeptic ailments indirectly engendered by the wear and tear of civilized life, as well as for those directly produced by certain affections of the structural elements of the stomach itself. The introduction into this organ from without of a substance necessary to the solution of the food, but which it was incompetent to furnish by its own power, was a happy thought of the rational therapeutist. The practical results of its application were apparently, and at first, as flattering as possible; but confidence in the remedy began to decline when it became certain that nearly all of the numerous preparations of pepsin were absolutely inert intrinsically, or had become so from the changes they had undergone by the action of time or of the various substances associated with the pepsin they originally contained. It is unnecessary to describe in detail the various *dyspeptic disorders* which might be profitably treated by a really active preparation of pepsin; it will suffice to say that besides those already referred to, there is the common gastric derangement of infants and of children during the period of dentition, induced usually by the pain and irritation of this process, which, being duly corrected, the patients are enabled to bear with comparatively slight disorder of function the continued action of the disturbing cause. Other causes besides teething may induce the same condition, including unwholesome air and food. Under the use of pepsin sometimes the vomiting and diarrhœa cease, the abdominal distension subsides, and the increased flesh and improved complexion testify to the more complete assimilation of the food. In numerous cases occurring during convalescence from exhausting acute diseases, and in the course of chronic affections, more or less of the same effect may be hoped for from the administration of pepsin in a really active condition.

Perfectly fresh pepsin may be prescribed in *doses* of about ten grains immediately before or after each meal. It should be mixed with arrowroot and given in a little sweetened water. Liebreich has found that to preserve the ferment of pepsin in the liquid state glycerin is the only reliable agent.

PERSICA.—PEACH.

Pêcher, Fr.; *Pfirsich*, G.

Persica vulgaris, *D. C.;* s. Amygdalus persica, *Lin.*

Nat. Ord.—Rosaceæ, Amygdaleæ.

Description.—The peach-tree is indigenous to Southwestern Asia, and is at present extensively cultivated in most temperate countries. It is of medium size, and has a nearly smooth brown bark and spreading branches. The *leaves* are alternate, short-petiolate, about four inches long, lanceolate, pointed, closely serrate, green, and smooth on both sides. The *flowers* appear in April, are axillary, have a bell-shaped and 5-cleft calyx; five ovate, reddish petals, about twenty-five stamens and a single ovary, developing into a subglobular drupe, with a hard and furrowed putamen, and containing a seed resembling the almond. The leaves, flowers, and seeds, when bruised, exhale a bitter-almond odor, and have a bitter taste.

Constituents.—The young branches, leaves, flowers, and seeds, after maceration in water and distillation, yield a volatile oil which is chemically identical with oil of bitter almond. Geiseler (1840) proved the presence of amygdalin in the seeds. The fixed oil of the latter is bland, and resembles expressed oil of almond (see p. 960).

Physiological Action and Medical Uses.—The bark, the leaves, the kernels, and even the flowers are endowed with active properties, which they owe, in part, to hydrocyanic acid. The flowers are chiefly laxative, and the leaves are not destitute of this quality. Indeed, they have been used as a substitute for manna, and especially for their *vermifuge* effect; they have also been reputed to cure *intermittent fevers*, and to allay the pain of *nephritic colic*, as well as to promote the discharge of calculi by causing diuresis. Bruised, and applied to the abdomen, they are said to relieve colic produced by indigestion. They are also reported to have cured *whooping-cough*. They have been applied to arrest slight *hemorrhages*. Peach-kernels have frequently produced poisonous effects. A child, three years old, who had eaten a quantity of them, became insensible, with slow, deep, sobbing respiration, slight twitching of the mouth, icy-cold extremities, lividity of the finger-nails, and dilated pupils. It was restored by an emetic (Keating). In other cases active vomiting and purging, with convulsions, have been observed. The possibility of these effects having resulted from the indigestibility of the kernels should not be overlooked. The leaves, and also the flowers, may be prescribed in an infusion, and a syrup prepared from them or from the bark has also been used.

PETROLEUM.—Petroleum.

Rock oil, Coal oil, E.; *Pétrole, Huile minéral*, Fr.; *Steinöl, Bergöl*, G.

Origin.—Petroleum is met with in several parts of North America, on the west coast of the Caspian Sea, and to a limited extent in most European countries. It oozes from the ground, frequently mixed with water, but is obtained in largest quantities from wells sunk in the ground. Its formation in the soil has been the subject of much speculation. H. Byasson (1876) explains its origin from salt water penetrating into cavities of the terrestrial crust and carrying with it limestone and other materials; if these reach a depth where the temperature is sufficiently high, and come in contact with metallic substances such as iron or its sulphurets, hydrocarbons are formed, the properties of which are modified by causes acting after their formation, such as partial distillation, etc.

Properties.—As naturally obtained petroleum varies in consistence from thin limpidity to the thickness of molasses or tar, and in color from pale-yellow to blackish-brown, usually showing a distinct fluorescence. Its specific gravity is generally between 0.8 and 0.9, but some varieties slightly exceed water in density. The heavier and dark-colored kinds yield, on rectification, light and limpid oils, and leave a residue consisting of *paraffin* and solid *bitumen*, a variety of which is found native as *asphaltum*. The latter is black, glossy, and brittle, while the bituminous residues from coal oil distillation are less glossy and scarcely brittle at the ordinary temperature. The solid as well as the liquid fractions of petroleum are inflammable and burn with a bright sooty flame; the vapors of the more volatile kinds, mixed with atmospheric air, are highly explosive.

Barbadoes tar and *Seneca oil* are two varieties of petroleum which were formerly employed; they are viscid and dark-colored, the last named lighter, thinner, and of a less disagreeable odor than the former.

Constituents.—Petroleum consists of a large number of hydrocarbons, belonging to two homologous series, namely, that of *marsh gas* of the general formula C_nH_{2n+2} (see Paraffinum), and of *olefiant gas* (olefin or ethylene series) having the formula C_nH_{2n}. On treating petroleum with strong sulphuric acid, the olefins, coloring matter, and some other constituents are removed, and the hydrocarbons of the paraffin series left. The hydrocarbons of both series exist also in isomeric modifications which differ from the normal compounds in volatility and some other properties. Those containing C_4 and less are gases at the ordinary temperatures; the relation of the others is shown by the following table (see also Paraffinum).

		Normal.	Iso.			Normal.	Iso.
Pentane,	C_5H_{12} boils at	38° C.	30° C.	Pentene,	C_5H_{10} boils at	37° C.	35° C.
Hexane,	C_6H_{14} “	70° C.	62° C.	Hexene,	C_6H_{12} “	70° C.	65° C.
Heptane,	C_7H_{16} “	98° C.	90° C.	Heptene,	C_7H_{14} “	100° C.	——
Octane,	C_8H_{18} “	124° C.	118° C.	Octene,	C_8H_{16} “	125° C.	——

These compounds are to some extent separated by fractional distillation. The portion boiling below 50° C. (122° F.) being collected by itself constitutes *naphtha*, and consists almost exclusively of pentane and pentene; but if the vapors are well refrigerated, the product contains also *butane*, C_4H_{10}, boiling at 1° C. (33.8° F.), and constitutes *rhigolene*, which requires to be kept in strong and well-corked bottles and in a cool place, since it evaporates rapidly at the common temperature. The naphtha freed from the low boiling hydrocarbons is commercially known as *benzin* or *petroleum benzin* (see page 281); its specific gravity is about .70. The portion boiling at a higher temperature is separately collected and furnishes the *coal oil* which is largely employed for illuminating purposes; its safety for that use depends upon the absence of the low-boiling hydrocarbons. At a still higher temperature paraffin oils and paraffin (see page 1035) pass over, and the residue left in the still at a temperature of about 300° C. (572° F.) constitutes the ordinary *asphaltum* or *bitumen.*

Physiological Action.—Taken internally in excessive doses, it has caused oppression, giddiness, palpitation, faintness, and headache, but no tendency to stupor or even sleep. In one case frightful tonic and clonic convulsions occurred; in another the pulse fell from 82 to 48, the pupils were contracted, the skin hot, the respiration hurried, and the voice weak. It is remarkable that it does not produce vomiting, nor, usually, diarrhœa. In only one case is death said to have resulted from it, with symptoms of gastro-enteritis, on the twentieth day after the oil was taken. The urine has a peculiar aromatic odor.

Medical Uses.—The use of petroleum by the Egyptians for embalming dead bodies is well known. Dioscorides and Pliny refer to it as being either liquid or solid. The first of these writers speaks of its application in opacity of the cornea; the Arabians refer to its emmenagogue and diuretic qualities, to its use in (humid) asthma and for cough, to its vulnerary and anthelmintic powers, and especially to its application in suppositories to remove ascarides of the rectum. They speak particularly of its use by friction to relieve rheumatic pains, assuage colic, and expel flatus, and of its efficacy in bringing on uterine contractions and expelling the dead fœtus. In more recent times it was highly esteemed in the cure of *tapeworm* and other verminous affections, and for overcoming *retention of urine* caused by atony of the bladder. It was also credited with singular virtues as an embrocation in *paralysis*, *contraction* and *stiffness* of the *joints*, atonic *rheumatism*, and atonic *tumors*, *chilblains*, etc. Still more recently the popular use of it as a remedy for *itch* has been imitated by physicians, and many cures by its means have been reported. It is said to be one of the promptest of the remedies for this affection; but it is also stated by eminent authorities not only to fail in a majority of cases, but also in some cases to be a painful application, and to produce sleeplessness, intoxication, and eczematous eruptions of the skin. It has also been found curative in *prurigo*. Dr. Frayer used petroleum in the treatment of *wounds*, and regarded it as possessing "some, if not all, of the advantages assigned to carbolic acid for this purpose."

Petroleum may be given internally in doses of from five to ten drops in the same way as oil of turpentine. For the cure of tapeworm larger doses, such as half a fluidrachm, may be used. In liniments its odor may be partially masked by that of some agreeable essential oil. It is sometimes united with cosmoline as an excipient, which renders it easy of application in all the diseases mentioned above.

Rhigolene.—Used with an ordinary hand spray-producer, furnished with metal tubes, it readily produces a temperature of 15° below zero F. It is therefore more reliable than ether for this purpose, although if its application be too long continued, it may cause frost-bite and even mortification. It was used in a great variety of cases in which local anæsthesia was required to render certain surgical operations painless, but it does not seem to have commended itself to general adoption, on account probably of its explosiveness.

PETROSELINUM, *U. S.*—PARSLEY.

Persil, Fr.; *Petersilie*, G.

The root of Petroselinum sativum, *Hofm.;* s. Apium petroselinum, *Lin.*
Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—Parsley is indigenous to Southern Europe, and is much cultivated for culinary purposes. It is a biennial, and has bi- or tri-pinnate smooth and shining leaves, with ovate wedge-shaped three-cleft, toothed or crisp leaflets. The fruit is about one-sixteenth of an inch long, ovate, laterally flattened, brown, each mericarp with five light brown-gray filiform ribs, and six oil tubes.

Description.—The root is six or eight inches long, half to one and a half inch thick, when dry pale brown-yellow externally, annulate above, longitudinally wrinkled below, and marked with transverse corky ridges; it breaks with a short and mealy fracture, upon which is seen a thick white and in the inner layer radially striate bark, a fine dark-colored cambium line, and a yellow, soft meditullium, with irregular medullary rays. The bark and medullary rays contain scattered brown resin cells. The root is faintly aromatic, and has a sweetish taste.

Constituents.—The root contains starch, mucilage, sugar, volatile oil, and *apiin*, $C_{24}H_{28}O_{13}$. The latter is best obtained from the fresh herb by boiling with water, expressing while hot, and purifying the green gelatinous precipitate which forms on standing, by dissolving it in hot water. It was discovered by Braconnot (1843), is a white inodorous and tasteless powder, perhaps a glucoside, soluble in boiling water and alcohol, separating on cooling jelly-like; the hot aqueous solution acquires a blood-red color on the addition of ferrous sulphate.

The fruit was examined by C. Rump (1836), and found to contain 1.4 per cent. volatile oil and 22 per cent. fixed oil, besides mucilage and other common principles. *Oil of parsley* is colorless or yellowish, has the specific gravity 1.01 to 1.14, dissolves in 2½ parts of 80 per cent. alcohol, commences to boil near 170° C. (338° F.), and consists of a hydrocarbon $C_{10}H_{16}$, and a stearopten $C_{12}H_{14}O_4$. This *parsley camphor* crystallizes in silky needles or prisms, which fuse at 30° C. (86° F.), and are not sublimable; it is readily soluble in strong alcohol, ether, fixed and volatile oils, and has a faint odor of parsley, and a camphoraceous pungent taste.

Joret and Homolle (1855) separated from parsley fruit *apiol*, by exhausting with alcohol, treating the tincture with animal charcoal, distilling off three-fourths of the alcohol, dissolving in ether, evaporating the ethereal solution, macerating the residue with levigated litharge, and filtering through charcoal. A simpler process was recommended by L. Wolff (1877). The fruit is exhausted with petroleum benzin, the solvent evaporated, and the residue treated with strong alcohol, on the evaporation of which apiol is left. It is a colorless oil, of spec. grav. 1.07, becomes turbid without congealing at —12° C. (10.4° F.), has an acid reaction, the odor of parsley, and a pungent taste, forms a kind of emulsion with alkalies, and is easily soluble in alcohol, ether, chloroform, and in glacial acetic acid.

Physiological Action.—In modern as in ancient times parsley has been used as a carminative, discutient, and diuretic. The root is said to be more actively diuretic than the rest of the plant; the fruit resembles in its action those of fennel, anise, etc., and the peculiar oil, apiol, acts in part after the manner of the essential oils. Half an ounce of this oil given to a rabbit produced laborious breathing, frequent pulse, muscular debility and twitches, insensibility, coldness, and death. Given to man in doses of from seven to fifteen grains it creates a sense of warmth at the epigastrium and of general well being. Thirty and from that to sixty grains produce a state of intoxication, with scintillations before the eyes, deafness and buzzing in the ears, staggering movements, and severe headache.

Medical Uses.—Freshly bruised parsley leaves are a popular remedy for the "weed," or the engorgement of the mammæ at the commencement of lactation, and for threatening abscess of these and other external *glands*. A decoction of parsley root is useful in relieving *strangury* from cantharides and turpentine, and the painful micturition attending attacks of *gravel*. The dried leaves and the juice have been used to cure *gonorrhœa*, and also *periodical fevers* and *neuralgia;* but the seeds are said to be superior to either in the treatment of intermittent fever, when given in the form of a recently prepared and strong decoction. Its repulsive smell and taste render it a very ineligible remedy, and it is now supplanted by apiol, to which identical therapeutic powers are ascribed. The value of this agent as an antiperiodic is no better established than that of the almost innumerable medicines which are reported to cure periodical affections. The case is different in regard to *amenorrhœa*, *scanty menstruation*, and *dysmenorrhœa*, in which its efficacy is well established, whenever these affections appear to be owing to a want of activity and power in the ovarian nisus, in a word, in all those cases for which direct emmenagogues are considered appropriate. It must not be forgotten, however, that the state in question is often subordinate to or associated with a general atony of the system which requires for its cure tonics, hæmatics, and hygienic agents.

Powdered parsley seeds may be given in doses of from ten to fifteen grains. The root should be employed in the recent state and generally in strong infusion. Apiol may be administered two or three times a day in doses of five or six drops inclosed in gelatin capsules. In the uterine disorders above referred to the use of the medicine should be commenced four or five days before the expected period.

PHALARIS.—CANARY SEED.

Fructus (semen) canariense.—*Semence de canarie*, Fr.; *Kanariensamen*, G.

The fruit of Phalaris canariensis, *Lin.* *Nat. Ord.*—Graminaceæ.

Origin.—This annual grass is indigenous to the basin of the Mediterranean, and is cultivated for its fruit, which is much used as food for canaries and other birds. 131,423 bushels of canary seed were imported by the United States during the year 1876–77.

Description.—The fruit is about one-sixth of a inch long, ovate or elliptic, flattened, inclosed by glossy, yellowish-gray paleæ, after the removal of which the fruit is smooth and brownish, and internally white. It is inodorous, and has a slightly bitter taste.

Constituents.—Like other graminaceous fruits, canary seed contains starch and gluten; Dubuc ascertained also the presence in it of notable quantities of calcium chloride and of a brown bitter coloring matter.

Medical Action and Uses.—Canary seed is to be ranked with other amylaceous seeds as nutritious and emollient. It is familiar as a food for birds, and has been used by man for the same purpose, alone or mixed with wheat or rye flour. In medicine poultices have sometimes been made of it.

PHELLANDRIUM.—PHELLANDRIUM.

Fructus phellandrii, P. G.—*Five-leaved water-hemlock*, E.; *Phellandrie*, *Fenouil d'eau*, Fr.; *Wasserfenchel*, G.

The fruit of Œnanthe phellandrium, *Lam.;* s. Phellandrium aquaticum, *Lin.* *Nat. Ord.*—Umbelliferæ, Orthospermæ.

Origin.—This biennial plant grows in swampy places and on river banks in Europe and Northern Asia. It has pale-green pinnately dissected leaves, with ovate lobed or pinnately cleft leaflets, the submersed ones narrow and thread-like. The flowers are white, in compound umbels, with short linear involucral leaves. (See also page 406.)

Description.—The fruit is one-eighth to one-sixth of an inch long, nearly cylindrical, narrowed above, and oblong-ovate in shape. The three dorsal ribs are broad and obtuse, the two lateral ones larger, the four grooves narrow, each with a single oil tube and two additional oil tubes on the face of each mericarp. It is of a brown, and when collected in an unripe state of a blackish-brown color, and has an unpleasant odor, recalling that of caraway, and a bitterish, somewhat acrid taste.

Constituents.—Berthold (1818) obtained 1.5 per cent. of volatile oil, 7.8 fat and wax, 4.9 resin and other unimportant principles. Smaller quantities, .5 to .8 per cent., of volatile oil were obtained by others. Frickhinger (1839) describes the volatile oil as being brownish-yellow, limpid, of spec. grav. .86, of neutral reaction, fulminating with iodine, and possessing the odor and taste of the fruit. Distilled with potassa the alkaline distillate contained ammonia but no other alkaloid; 186 ounces of the recently dried fruit yielded over 12 drachms of ammonium sulphate. The supposed alkaloid obtained by C. Fronefield (1860) was probably identical with Devay and Guillermond's (1852) *phellandrin*, which appears to be merely volatile oil; it is volatile, liquid, neutral, and soluble in alcohol, ether, and fixed oils.

Medical Action and Uses.—Five-leaved water-hemlock has been compared in its action to conium; for it is said that some animals upon eating the fresh herb lose their muscular power, and that this effect is not produced by the dried herb. An essential oil prepared from it injected into a dog's veins in the dose of ten grains, caused dyspnœa, trembling, and anxiety for several hours. The fruit appears to be stimulant, diaphoretic, diuretic, and expectorant, and without direct and exclusive action upon the nervous system. Although recommended sometimes as a remedy for dropsy, whooping-cough, intermittent fever, etc., it is chiefly in chronic *bronchitis* that the virtues of this medicine are displayed. At a time when this affection was considered a form of consumption, phellandrium was reputed to be a remedy for the latter disease; but it is now certain that it could be useful in tubercular phthisis in so far only as it might diminish the bronchial secretion, as it does in simple bronchitis. It shares this virtue with numerous plants whose activity is due to their essential oil; but neither it nor they can be compared in efficiency with the terebinthinate and balsamic preparations. The *dose* of the powdered fruit is from thirty to sixty grains. An infusion, made with half an ounce of the bruised fruit in half a pint of hot water, may be given in doses of one or two tablespoonfuls several times a day.

PHLORIZINUM.—PHLORIZIN.

Phloridzin, Phlorrhizin.

Formula $C_{21}H_{24}O_{10}$. Molecular weight 436.

Preparation.—This principle has been obtained from the bark of the apple-, pear-, cherry-, and plum-tree, more abundantly in that of the root than in that of the stem. It is prepared from the concentrated decoction, by setting it aside and recrystallizing with the aid of animal charcoal. It was discovered by De Koninck and Stass (1835).

Properties.—It crystallizes in fine silky prisms containing $2H_2O$, becomes anhydrous at 100° C. (212° F.), fuses at about 108° C. (226.4° F.), congeals at 130° C. (266° F.), and fuses again near 160° C. (392° F.), being then converted into an isomeric modification, which is less freely soluble and crystallizable than the normal compound. Phlorizin is inodorous, bitter, neutral, colored yellow and red by sulphuric acid, and yields with ammonia, in the presence of moisture, red amorphous *phlorizein*, $C_{21}H_{30}N_2O_{13}$. Phlorizin requires about 1000 parts of cold water for solution, but is freely soluble in hot water and in two parts of cold alcohol; it is nearly insoluble in ether, and dissolves in alkalies, the solutions becoming yellow in contact with air. On being fused with potassa, *phloretic acid*, $C_9H_{10}O_3$, a crystalline homologue of salicylic and anisic acids, is obtained, together with *phloroglucin*, $C_6H_6O_3$; the solution of phloretic acid is colored green by ferric chloride.

Composition.—The empirical formula of phlorizin has been given above. According to Rochleder (1869) it belongs to the salicylic series, while *isophlorizin*, an isomeric principle of apple leaves, is classed with the benzoylic compounds. Phlorizin is a glucoside, and when continuously heated with dilute mineral acids is resolved into glucose and *phloretin*, $C_{15}H_{14}O_5$, which is nearly insoluble in water, has a sweet taste, and by hot alkalies is decomposed into phloretic acid and *phloroglucin*. The latter is a sweet crystallizing compound, which is also produced from quercetin, dragon's blood, gamboge, kino, and other compounds by heating them with hydrate of potassium; Wiesner (1878) regards it as a very delicate test for ligneous tissue, with which one drop of its dilute solution produces a beautiful red color after the addition of a drop of hydrochloric acid.

Medical Action and Uses.—In 1862 De Ricci called attention to this substance as a substitute for quinia, and a number of physicians testified to its efficacy; but soon it became apparent that the new succedaneum was neither more nor less valuable than the numerous bitter vegetable products which act as stomachic tonics and sometimes cure cases of mild *intermittent fever*. Among these medicines it is most comparable to salicin. Phlorizin is now quite disused.

PHOSPHORUS, *U. S.*, *Br.*—PHOSPHORUS.

Phosphore, Fr.; *Phosphor*, G.

Symbol P. Atomicity trivalent and quinquivalent. Atomic weight 31.

Origin and Preparation.—Phosphorus exists mostly as phosphates, in many minerals, and in all plants and animals; the bones of the higher animals are phosphate of calcium. Phosphorus was discovered by Brandt (1669), of Hamburg, among the products of the dry distillation of urine, and about 1769 Gahn and Scheele detected the presence of phosphoric acid in bones, and the latter succeeded in isolating it. Phosphorus is made by treating calcined bones with sulphuric acid, evaporating the liquid, after mixing it with powdered charcoal, to complete dryness, and distilling the residue in a stoneware retort. In case the organic matter of bones is to be utilized in the manufacture of glue, the bones are treated with muriatic acid, and the liquid treated as stated. The retort is connected with a wide bent tube which dips into water, a number of retorts are placed in each furnace, and after the distillation is completed, the melted phosphorus is strained under water, and run into tubes of suitable size, where it congeals. Phosphorus is manufactured in the United States, but much of it is still imported.

Properties.—Phosphorus is seen in commerce in the form of cylindrical sticks, which are nearly colorless or pale yellow, transparent, of a waxy lustre, and about as hard as beeswax, and flexible at ordinary, but brittle at low temperatures. It is very easily inflammable in the air, and must be preserved and cut under water, in which it is insoluble. Its density is usually about 1.77; but after purification with alcoholic potassa was found by Böttger to be 2.089. It melts at 44° C. (111.2° F.), and may be cooled to 40° C. (104° F.) before it congeals again, under certain circumstances even to 4° C. (39.2° F.), as observed by Bellani (1813). Grotthuss (1810) obtained phosphorus in an oily condition, after boiling it with alcoholic solution of potassa; and Kallhofert (1850), by slowly evaporating a solution of phosphorus in carbon bisulphide from under water. Houston and Thompson (1874) made similar observations with phosphorus treated with hot potassa solution, and regard this oil as a modification of ordinary phosphorus. The boiling point of phosphorus is 288° C. (550° F.), according to Dalton; Mitscherlich found it at 260° (500° F.); the density of the vapor is 4.3. Phosphorus is sparingly soluble in alcohol, ether, fixed and volatile oils (see Oleum phosphoratum and Pilula phosphori); it crystallizes after fusion when slowly cooled, and from its solutions in volatile oils and carbon bisulphide. Exposed to the air it emits white vapors, which have an alliaceous odor, and are luminous in the dark (phosphorescence), and when ignited burns with a brilliant white flame, giving off dense white vapors of phosphoric anhydrid. It unites directly also with sulphur, chlorine, iodine, bromine, and with many metals, and precipitates some of the latter from their solutions. When kept in water and exposed to light and air, it is superficially corroded, and becomes white and opaque (Baudrimont, 1865), while phosphorous acid is found in the water; the change does not take place in water which is free from air. Under certain conditions, phosphorus, when melted and suddenly cooled, becomes black, according to Blondlot (1869). This is due to the presence of a black body, which is rather more volatile than ordinary phosphorus. Commercial phosphorus frequently contains a little arsenic, from which it cannot be freed by distillation.

AMORPHOUS or RED PHOSPHORUS.—This was discovered by Schrötter (1848), by heating ordinary or vitreous phosphorus for a long time to near its boiling point (about 240° C. = 464° F.) in an atmosphere in which it cannot burn. It is an amorphous dark red mass or powder, becomes nearly black on being boiled with potassa solution, is insoluble in simple solvents, remains unaltered in dry air, and enters into chemical combinations less readily than the ordinary variety. According to Hittorf (1865), it has the specific gravity 2.19, is infusible, volatilizes slowly above 260° C. (500° F.), and according to Lemoine (1867), is best converted into ordinary or vitreous phosphorus by heating to near 450° C. (842° F.) in an atmosphere of nitrogen. At the temperature stated, Hittorf observed it to be converted into another modification, which forms black laminæ of a metallic lustre, is less volatile even than amorphous phosphorus, but, like the latter, is gradually converted by heat into ordinary vitreous phosphorus.

Compounds of Phosphorus. HYPOPHOSPHOROUS ACID, H_3PO_2 (molecular weight 66), is formed by boiling phosphorus with milk of lime (see p. 318), and under other circumstances. In its purest state it forms a thick uncrystallizable liquid; for medicinal purposes Procter (1858) suggested decomposing 480 grains of calcium hypophosphite dissolved in 6 ounces of water by a solution of 350 grains of crystallized oxalic acid in 3 ounces of water, filtering from the calcium oxalate, and evaporating to 8½ fluidounces, when it contains 10 per cent. of the acid.

PHOSPHOROUS ACID, H_3PO_3 (Molecular weight 82), is formed on the slow oxidation of phosphorus in moist air, and forms a crystalline deliquescent mass. If phosphorus is slowly burned with a very limited supply of dry air, *phosphorous oxide* or anhydrid, P_2O_3, is formed as a voluminous flocculent powder, which liquefies in the air by the absorption of moisture, and is gradually oxidized to phosphoric acid, or, heated in a close vessel, is decomposed into phosphoric acid and phosphoretted hydrogen.

PHOSPHORIC OXIDE, P_2O_5 (Molecular weight 142), and Phosphoric acid have been described on page 62.

Phosphorous acid and phosphites are rarely, if ever, employed in medicine. The phosphates and hypophosphites, which are sometimes used, are described under their appropriate heads. Of other chemical compounds only phosphide of zinc has been employed.

Off. Prep.—Acid. phosphoricum dilutum, *U. S.*, *Br.*; Oleum phosphoratum, Pil. phosphori, *Br.*

Medical History.—The first employment of phosphorus in medicine is ascribed by some to Kinkel in 1721, and by others to Mentz in 1751. After them it was advocated from time to time during the last and the early part of the present century, and the most extravagant statements were published of its life-giving powers; but the numerous, and generally unforeseen, dangers that sometimes followed its administration caused it to be abandoned as a medicine, and to retain its interest for physicians chiefly through its operation as a poison. Within the last few years it has once more risen into notice, in a great measure, we must believe, through the influence of those chemico-physiological doctrines which still prevail, and the predominant part which the nervous system holds in the medical theories of the day, and possibly also to the increased number of nervous diseases chargeable to the augmented wear and tear of modern life.

Physiological Action. *On Animals.*—Applied in substance or solution to the sound skin it does not usually occasion other symptoms than a superficial irritation, but, if the integument be broken, painful ulcers follow which are extremely difficult to heal, and the phenomena of constitutional poisoning are rapidly developed. It is a very striking fact, that when phosphorus in bulk is introduced beneath the skin of animals, it causes neither pain nor inflammation; and although it gives rise to toxical symptoms, the phosphorus itself retains its transparency, and does not visibly diminish in bulk. Administered internally in moderate doses, to various birds and mammals, such as ducks, rabbits, dogs, pigs, etc., it plainly acts as a stimulant of the nervous system, exciting the animals to unusual activity, and in some instances developing an exaggerated sexual excitement. Continuous administration of small doses of phosphorus to dogs produces the following effects: after two or three days the animal becomes dejected, the eyes congested, the urine is passed scantily and with straining, the pulse and the respiration are slower, and the temperature higher. Subsequently the pulse and respiration grow much quicker, and the temperature rises even to five degrees above the normal point. Death occurs without convulsions at the end of a week. On examination of the body the gastric mucous membrane is found ecchymosed, the liver soft and dark, with bloody spots on its surface, its glandular elements are in a state of fatty degeneration, the gall bladder is distended with bile containing urea and albumen; the kidneys are in a state of fatty degeneration (acute Bright's disease), which accounts for the abnormal ingredients of the bile. One-twelfth of a grain of phosphorus being given three times a day to a dog, the animal survived seventeen days. After its death a vast ecchymosis occupied the left side of the thorax, extending to the costal pleura, and even to the pulmonary in a limited space. In the right lung and in the heart were also ecchymosed spots; the pulmonary tissue was dense, dirty in color, and quite oily to the touch, and demonstrably so by microscopic examination. The liver also was slightly ecchymosed, and totally disintegrated by oily infiltration. The urine was oily and albuminous, the kidneys softened and doughy, and broken down by oily infiltration (Percy). The same lesions and symptoms essentially have been found in other animals poisoned with phosphorus. Long-continued non-poisonous doses of phosphorus occasion chronic gastritis and fatty degeneration of the stomach, liver, kidneys, heart, and other muscles, both voluntary and involuntary, and hemorrhages in various parts of the body. It, at the same time, however, appears to increase the deposit of osseous matter in the bones.

On Man.—In the dose of from one-sixtieth to one-tenth of a grain phosphorus quickens the pulse, raises the temperature, promotes perspiration and urination, increases both mental and physical activity, and sometimes excites the sexual organs. But it may, also, soon afterwards derange the digestion, causing flatulent distension, alliaceous eructations, a coated tongue, anorexia, colic, diarrhœa, vomiting, and jaundice. Sometimes these and similar symptoms appear suddenly when the treatment has been steadily continued, or when a larger and poisonous dose of two or three grains, for instance, has been taken at once. But in such cases the toxical phenomena may not appear for thirty-six hours. The first is usually a burning pain in the stomach, and vomiting of matters which are more or less luminous in the dark. The heat extends to the whole abdomen, which may be tender under pressure; the stools are loose, dark, bloody, and sometimes phosphorescent, and are voided with pain. The pulse and temperature are generally raised at first, but subsequently fall below the normal rate. Usually there is general nervous excitement, sometimes headache, giddiness, fainting, sleeplessness, delirium, spasms, convulsions, followed by collapse, coma, coldness of the extremities, strabismus, and dilatation of the pupils. In other instances death is owing to exhaustion, the mind remaining clear. Meanwhile, from the second to the fourth day, there is pain in the liver, with dark jaundice, and blood is passed by stool and in the urine, and may exhale from the gums, or appear in ecchymoses of the skin. The urine is albuminous. After death the interior of the body is everywhere phosphorescent in the dark; the stomach is seldom widely inflamed, but chiefly in the pyloric extremity, where there may also be some ulceration, and the organ is apt to contain a bloody liquid. Sanguineous effusions are also found in other organs. The blood is dark and thick, but, according to most authorities, not usually disintegrated, and it contains an undue proportion of tissue-waste in the form of uric acid, creatine, etc. The liver is of a light yellow color, and it, as well as the heart, capillary vessels, and kidneys, shows more or less distinct signs of fatty degeneration The symptoms of chronic phosphorus poisoning, as they occur, for instance, among lucifer-match makers, are briefly these: bronchial irritation and dyspepsia; a straw-colored or grayish tint of the skin; extreme sensitiveness to cold; formication; stiffness and numbness of the limbs; softening, abscess, and ulceration of the gums; loss, and sometimes decay of the teeth, with caries and necrosis of the jaw-bones. These symptoms are attended with hectic fever, and if the patient continue to work in phosphorus until they are fully developed, he is worn out by them, or dies of consumption of the lungs.

These symptoms are, in their various degrees, produced by phosphorus alone, and not by any of its alkaline compounds; its oxygen compounds occasion totally different effects, and even these are not poisonous. Phosphorus is absorbed mainly without change, and a very minute proportion of it is oxidized in the system. Its administration occasions a very small increase, if any, in the urinary phosphates; and when we remember that of these a man daily excretes not less than fifty-four grains, it is impossible to conceive that the minute quantity in which alone it is possible to administer free phosphorus can have any marked influence upon the proportion of phosphorus compounds in the tissues. Whatever action it possesses seems fairly attributable to a molecular irritation, which, if carried too far, results in tissue transformation and physiological death. This interpretation seems to be justified by the apparently successful treatment of certain paralyses by extremely minute doses of phosphorus. The confident anticipations that the physical and chemical constitution of bodies would enable us to predict their therapeutic effects, have found no support in the medical history of this substance, and, least of all, the notion that it supplies a deficiency of phosphorus in the diseased system.

Medical Uses.—Phosphorus has been employed chiefly in the treatment of diseases of the nervous system. It is useless, if not mischievous, in *epilepsy*. In *paralysis* following cerebral hemorrhage, or embolism, or their frequent consequence, softening, improvement may be attributed to phosphorus in the first case alone. But its value becomes more than doubtful when the tendency to cure after this accident is borne in mind. Possibly its stimulant influence may quicken the operations of repair, but not without the risk of increasing the mischief. The same statement is essentially true of *spinal* paralysis; but as this affection is not, like the other, always associated with a substantial lesion, the cases of paraplegia benefited by phosphorus are numerous enough to deserve a certain consideration. The same statement is applicable to *locomotor ataxia.* The persistent but moderate and interrupted use of phosphorus has unquestionably in a few instances temporarily improved the power of locomotion in this disease, but it has not, any more than other remedies, effected a cure. In regard to this class of diseases it may well be said: "Phosphorus is a rapid stimulant, but it acts by causing waste and not by increasing power, it impoverishes and does not enrich. It momentarily galvanizes, as it were, the torpid functions, but is incapable of renewing a dilapidated constitution, or even a nervous system exhausted by chronic disease" (Gubler). Although in former years phosphorus was alleged to have cured *neuralgia*, it is only of late that it has been asserted to operate "with a rapidity, a certainty, and a permanency unequalled by the action of any other medicine in this or any other disorder" (Thompson). It is said to exhibit its virtues most conspicuously, indeed to be "apparently specific," in neuralgia attended with extreme debility produced by hemorrhage, lactation, etc., when the pain follows on exposure to cold, and especially when it affects the fifth nerve. Doses less than one-twelfth of a grain of phosphorus every four hours are said to be inefficient, and it is added that if relief does not ensue in twenty-four hours, it is useless to persevere in this treatment. It is singular that, if the medicine possesses such remarkable powers, they should not have been recognized and described by other observers. But notwithstanding the extreme frequency and intractability of this disease, phosphorus is not usually employed by physicians who have had the largest experience in its treatment. In certain cases of neuralgia of the heart, or simple *angina pectoris*, the medicine is related to have entirely suspended the attacks. Phosphorus has been used with probable advantage in chronic *psoriasis*, *lepra*, *lupus*, etc., but can seldom be necessary unless after the failure of more usual remedies. It has also been credited with the cure of splenic *leucocythæmia*, but more extended and critical inquiry has proved it to be useless.

There is some reason to believe that this medicine may be serviceable in functional asthenic *amaurosis*, but in no other form of that defect of vision. In *melancholia*, and even in *dementia*, it is alleged to be useful; and still more so in that state of *nervous exhaustion* and depression which follows excessive mental or even physical fatigue. In the latter case there is a rational as well as an empirical ground for supposing that it may occasionally be useful. In regard to the reputed *aphrodisiac* action of phosphorus, authorities differ; for while one of its most moderate expositors (Lemaire) declares that if any power belongs to the drug it is certainly this, the most extravagant of its eulogists (Thompson) concludes that phosphorus is not an aphrodisiac, unless given in a larger dose than it is safe to employ for remedial purposes. In poisonous doses it certainly exerts this power upon man and animals, but only as a transient influence which is soon succeeded by genital insensibility.

In *poisoning* by phosphorus it has been usual to administer lime-water, magnesia, or charcoal, with the intention of producing a chemical combination with the two first-mentioned substances, and a mechanical mixture with the last. It should be borne in mind, however, that phosphorus does not act primarily as a corrosive poison, like several acids, and that its local gastric lesions are quite disproportioned to those which are due to its absorption. It may also be remarked that, under ordinary circumstances, the contents of the stomach do not favor the combustion of phosphorus. Oil of turpentine has been proved by numerous experiments, and by some clinical observations, to be capable of arresting the poisonous phenomena. It should be administered in doses of from fifteen to thirty drops every half hour for several hours; and meanwhile all albuminous and oily substances should be withheld. An agent, the very opposite in its chemical properties to this hydrocarbon, has recently been recommended by Percy, who claims that oxygenated water by the stomach and the inhalation of oxygen gas are the true antidotes to phosphorus, by converting it into hypophosphorous and phosphoric acids which are comparatively innocuous. This conclusion is supported by experiments on animals.

The dose of phosphorus is variously stated as between one-thirtieth and one-fourth of a grain. Those who have most advocated its use recommend that a first dose of one-eighteenth of a grain should be repeated every four hours until six doses are taken. If then no improvement have occurred, the dose should be increased to one-twelfth of a grain, and repeated in the same manner as before. Of the authorities in this matter some recommend that the medicine should be given before and some after meals. Phosphorus was originally administered in ether or alcohol, and more recently dissolved in almond oil, olive oil, cod-liver oil, glycerine, chloroform, etc., or mixed with cocoa butter, wax, soap, spermaceti, and formed into pills coated with gelatine; or, finally, in capsules containing phosphorized oil (1 : 100). Each capsule should contain one milligramme ($\frac{1}{65}$ gr.) of phosphorus. The following formula has been recommended: ℞.—Phosphori, gr. ij; Carbon. bisulphid. q. s.; solve; Saponis, Guaiaci, Resinæ, āā gr. xxxv; Glycerinæ, gtt. xij; Pulv. rad. glycyrrhiz. gr. xij.—M. ft. mass. Divide into pills of the required strength, and coat with gelatin or varnish.

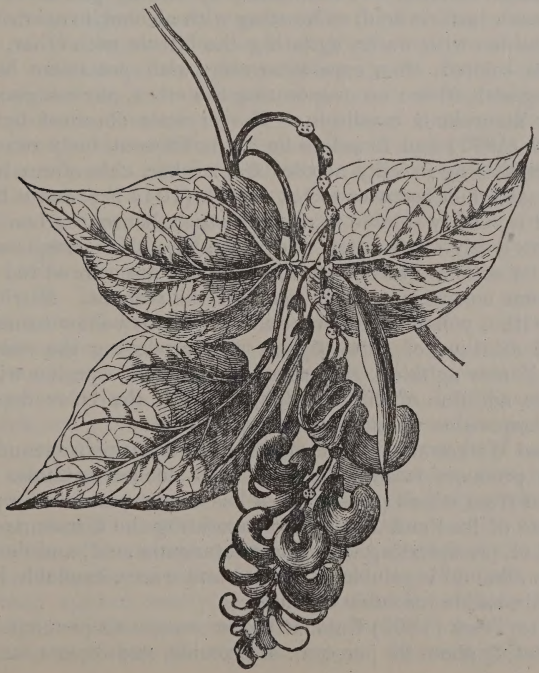
PHYSOSTIGMA, *U.S.*—CALABAR BEAN.

Physostigmatis faba, Br.; *Faba calabarica*, P. G.; *Fève de Calabar*, Fr.; *Kalabarbohne*, G.

The seed of Physostigma venenosum, *Balfour.* Transact. Roy. Soc. Edinb. xxii. tt. 16, 17; Bentley and Trimen, Med. Plants, 80.

Nat. Ord.—Leguminosæ, Papilionaceæ.

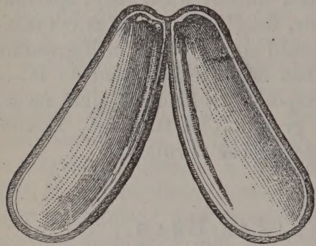
Fig. 129.



Physostigma venenosum, *Bal.* Flowering branch.

Origin.—This plant is a woody climber, growing near the mouth of the Niger and Old Calabar in Western Africa, and attaining a length of forty or fifty feet. It somewhat resembles the scarlet runner or Spanish bean of our gardens. The purple flowers are in pendulous racemes, originating from tubercular knots to the number of two or three. The curved style bears at its apex a triangular fleshy reflexed appendage. The pale-brown reticulately-veined legumes contain two or three seeds. The plant was described by Balfour in 1861, and has been introduced into India and Brazil.

Fig. 130.



Calabar bean, split, showing cotyledons.

Description.—The seeds are one to nearly one and a half inch long, about five-eighths of an inch broad, and half an inch thick, oblong and more or less reniform in shape. A well-marked black furrow, the hilum, with a ridged border, extends along the convex edge from one extremity of the seed to the other, and contains in the centre the thread-like raphe. The seed has a brittle, somewhat polished, granular testa, of a chocolate-brown color, two white cotyledons adhering to the testa, and concave upon the inner surface, thus inclosing a rather large cavity; along the hilum, each cotyledon is marked with a long shallow groove. The short radicle is situated at one end, and its position is externally indicated by the small depressed micropyle. Calabar beans are inodorous, but on the evaporation of the tincture an odor resembling that of cantharides is given off. Their taste is nearly like that of the ordinary bean.

Constituents.—The poisonous principle of Calabar beans is the alkaloid *physostigmia*, which was isolated by Jobst and Hesse (1864), and by the latter (1867) ascertained to have the composition $C_{15}H_{21}N_3O_2$. Vée (1865) proposed to call the alkaloid *eserina*. It is obtained by mixing powdered Calabar beans with one per cent. tartaric acid, exhausting with alcohol, evaporating the solvent, treating the residue with water, agitating the filtrate with ether, as long as the latter becomes colored, then supersaturating with potassium bicarbonate and again agitating with ether; on evaporating the ether, physostigmia is left behind in a colorless, amorphous condition. The crystals obtained by Vée were isolated by Hesse (1877) and found to be an indifferent body resembling cholesterin, and crystallizing in silky needles from ether, chloroform, and petroleum-benzin. Physostigmia becomes soft at 40° C. (104° F.), and is liquid at 45° C. (113° F.); it is readily soluble in alcohol, ether, benzol, carbon bisulphide and chloroform, less freely so in water, and neutralizes acids completely. The pure alkaloid and its salts are tasteless; the solutions are colored red by chlorinated lime and become colorless again by more of the reagent. Nitric acid dissolves the alkaloid with a yellow color, sulphuric acid with yellow turning olive-green. Alkalies color solutions of physostigmia red, producing the *rubreserin* of Duquesnel, and if now agitated with ether, the ethereal solution will become blue or red, on the addition of dilute sulphuric acid, the color depending on the degree of decomposition undergone by the alkaloid.

Harnack and Witkowski (1876) succeeded in isolating a second alkaloid *calabarina* which produces tetanic effects in cold-blooded animals. It is obtained from the liquid from which physostigmia has been separated, by precipitating it with subacetate of lead and ammonia, evaporating the filtrate, treating the residue with alcohol, precipitating with phosphotungstic acid, and decomposing with baryta. This alkaloid is soluble in alcohol and water, insoluble in ether, and its mercuric double-iodide insoluble in water.

According to Teich (1867) Calabar beans contain 48 per cent. of starch, 3.65 nitrogen indicating about 23 per cent. of proteids, and 3 per cent. of ash, chiefly phosphate of potassium. Mucilage and a small quantity of fat are likewise present. The alkaloids appear to exist mainly in the cotyledons; but the testa likewise possesses medicinal activity.

Adulterations of Calabar beans have not been observed by us. The seeds of a *Mucuna* and of the *Oil palm* have been mentioned, but bear no resemblance to the officinal article.

Off. Prep.—Extractum physostigmatis, *U. S.*, *Br.*

Physiological Action. *On Animals.*—After a small but fatal dose, a slight tremor seizes the animal, beginning in the posterior region and advancing forwards; paralysis follows in the same order of parts; the bowels are apt to be evacuated, and the pupils contract. Respiration becomes stertorous during inspiration and expiration, as well as slow and irregular. Slight muscular twitches appear and reflex action is annihilated; but, while the sense of pain is lost, tactile sensibility and the muscular sense are unimpaired. The rate of the heart-beat declines while the power of the systole increases until the approach of death, when it also subsides. Death does not take place by the heart, unless the dose of the poison have been very great; but is brought about by muscular paralysis of the respiratory apparatus, destroying life by an accumulation of blood in the lungs and asphyxia. Immediately after death the pupils dilate; muscular contractility is retained for some time longer, the heart may continue to act for an hour or more, and the intestines may exhibit their peristaltic movements. The large veins of the thorax are distended, as are also those upon the surface of the brain; the vascular system of the spinal cord appears natural. When a large fatal dose is given, the right and left sides of the heart and the arteries and veins, which everywhere remain well filled, present their characteristic differences of color. The peculiar tremor above referred to may be produced in dogs by the hypodermic injection of one-fifth of a grain of eseria. It may be exaggerated into distinct spasmodic movements and even general convulsions. Vomiting is usual; and salivation, also, with a frothy bronchial secretion, frequent urination, and fecal discharges, which become more and more liquid. When the poison is applied directly to a part concerned in the function of motility, it occasions paralysis of the organ. On the brain itself it exerts no action, but upon the spinal cord it first occasions a few twitches in the limbs followed by their paralysis. Applied directly to an insulated nerve-trunk it paralyzes the afferent fibres first and then the efferent. On or in the heart it arrests the action of the organ; and applied to the capillary bloodvessels, it causes their dilatation.

On Man.—In excessive but not fatal doses physostigma causes pallor of the skin, giddiness, weakness and faintness, indistinctness of vision, contraction of the pupils, nausea or vomiting, an accumulation of fluid in the mouth, a feeble but tumultuous action of the heart, and a total inability to perform voluntary muscular acts. The muscles twitch, but there is a complete absence of pain in them or elsewhere. In a few fatal cases of poisoning by this substance the following characteristic effects have been observed: Extreme muscular relaxation and debility, salivation, urgent nausea and vomiting; a slow, feeble, almost insensible pulse, coldness of the extremities, and of the skin, which is covered with a cholera-like sweat. Some colic may be felt at first, but generally no pain is experienced, although a distressing oppression of the chest is complained of. The pupils are not usually contracted. There is much vomiting and purging, the respiration is rattling, and the face livid. Consciousness remains until death, which occurs without a struggle. On dissection the body presents no characteristic lesions, unless it be a fluid condition of the blood, which also distends the heart, a flaccid state of the muscles, and some pale injection of the gastric mucous membrane. Investigations, post-mortem, taken together with the action of physostigma when applied locally, seem to render it probable that the whole chain of toxical phenomena occasioned by this substance is more readily explained by its immediate action upon the muscles or upon the nervous branches supplying them, than by its operation upon the spinal axis. This conclusion is supported by the results of its direct application to the eye. It then produces a marked contraction of the pupil, which may last in a high degree for twelve or fourteen hours, and less conspicuously for several days. But the effect is confined to the one eye, if the application is limited to one; and if it be made also to the corresponding eyelids, they become paralyzed; but no general symptoms are exhibited. It seems probable that the phenomenon of pupillary contraction by this substance is due to its dilating the bloodvessels of the iris, just as dilatation of the pupil by atropia is caused by its power of contracting the same bloodvessels.

Medical Uses.—The power of physostigma is employed to contract the pupil; for example: "In *mydriasis* dependent upon the over-action of belladonna, or as a symptom of amaurosis; in *iritis* and inflammation of the neighboring structures, where the prevention of adhesions may be more successfully secured by an alternation of contraction and dilatation, than by dilatation alone; in injuries of the eyeball with displacement of the iris, etc." Thus *prolapse*, and also *adhesion* of the *iris*, are more or less under the control of the local action of this medicine or of its use alternately with belladonna. The operation of *iridectomy* is facilitated by the tension and increase of surface which the iris, under the use of this medicine, presents. *Night blindness* has been successfully treated by instillations of a solution of eserine, which is supposed to act by augmenting the vascularity of the retina. When the sight is impaired by paralytic dilatation of the iris, this medicine is a useful palliative of the defect. Of all the medicines which have cured *tetanus*, physostigma certainly holds the first place. In 1874 an analysis of published cases showed that out of sixty-three cases of traumatic tetanus treated by this medicine, thirty-three recovered. Since then, this unusual proportion of cures of a disease which was before nearly always fatal, has been considerably increased. When the treatment has failed, as has often happened, the failure has been mainly attributable to an inefficient employment of the remedy. The minimum dose of extract of physostigma which should first be administered is one-third of a grain. It should be repeated every quarter of an hour until its specific operation is developed, and the spasms are completely overcome. This effect should be steadily maintained, and then reproduced as often as the spasms recur. It is usually necessary to increase the dose in order to maintain its original impression. In a tetanoid disease known as *tonic convulsion*, the medicine has also been successfully employed. Its efficacy in *strychnia poisoning* is not so well established, and in *chorea* it more generally fails than succeeds.

The physiological antagonism between physostigma and belladonna has been illustrated by the neutralization of the poisonous effects of the latter by the former medicine. But as fatal *poisoning by belladonna* is exceedingly rare, the practical value of the antidote is very small. That poisoning by physostigma is neutralized by the hypodermic injection of atropia has been abundantly demonstrated by experiments upon man. The antagonism is not so evident in similar experiments upon rabbits.

Physostigma has been found useful internally as a palliative of *gastralgia;* and topically its tincture is distinctly anodyne in *neuralgia* and *muscular rheumatism*, and in cases of painful malignant *tumors*.

As antidotes to the poisonous effects of physostigma, atropia should be used hypodermically, while coffee, and alcoholic and other diffusible stimulants are internally administered. If the patient is unable to swallow, artificial respiration should be maintained, mechanically as well as by means of induced electricity, and the use of atropia persisted in. The hypodermic dose of the latter should not be less than one-thirtieth of a grain.

Administration.—The commencing dose of the powdered bean is about one grain; of the officinal extract about one-tenth of a grain. There is a fluid extract of which one part represents four of the bean. A tincture is prepared by percolation, so as to produce two ounces of tincture from an ounce of the powdered bean (Fraser). The dose is about ten drops. A tincture used in Philadelphia contains in one pint the virtues of two ounces of the bean. Its dose is about twenty drops. For external use, a solution of one part of the alcoholic extract in five parts of glycerin has been employed. For application to the eye, this solution is applied on little disks of gelatine or of paper that have been soaked in it. Eserine may be applied to the eye in its original state or as a hydrochlorate, in a solution containing one part to a thousand. Internally, it may be given in the dose of from one sixty-fifth to one-twelfth of a grain.

PHYTOLACCÆ BACCA, *U. S.*—POKEBERRY.

Raisin d'Amérique, Fr.; *Amerikanische Kermesbeere*, G.

The fruit of Phytolacca decandra, *Lin.*

PHYTOLACCÆ RADIX, *U. S.*—POKEROOT.

Racine de phytolaque, Fr.; *Kermesbeerenwurzel*, G.

The root of Phytolacca decandra, *Lin.* *Nat. Ord.*—Phytolaccaceæ.

Origin.—Poke is a perennial herb, indigenous to North America, and naturalized in the West Indies and Southern Europe. It grows in waste places, and has a smooth stem four to eight feet high, alternate petiolate, ovate-oblong acute leaves, and white decandrous flowers in elongated racemes, which are usually opposite the leaves. The young shoots collected in early spring are sometimes eaten as a substitute for asparagus. It commences to flower in June, and ripens its fruits in August, when the root and berries should be collected.

Description.—1. THE ROOT. In the fresh state the root is large, conical, branched, and fleshy. In commerce, it is seen in transverse or longitudinal slices, from one to four inches in diameter, longitudinally wrinkled, yellowish brown-gray externally, hard, and breaking with a fibrous fracture. It is of a dingy white color internally, and exhibits upon transverse section a number of circles composed of wood-tissue radially divided by numerous medullary rays, and concentrically approximate, being separated from one another by shrunken parenchyma, which in the fresh state is fleshy and of about the width of the wood-circles. The root is inodorous; its taste is at first sweetish, afterwards somewhat acrid.

2. THE FRUIT is a flattened globular compound berry, about one-third inch in diameter, and composed of ten carpels which are concentrically arranged around a short axis, are laterally confluent, and contain each one lenticular black and shining seed, with the embryo curved around a mealy albumen. The fruit is of a dark purple color, has a thin pericarp, and contains a purplish-red juice which is inodorous and has a sweet and slightly acrid taste. When the berries are dried on their common peduncles, they have a slight resemblance to raisins.

Constituents.—The root was analyzed by E. Donnelly (1843), who found starch, tannin, resin, and other common constituents of plants, but did not succeed in isolating the active principle. Reichel's analysis (1836) of the root of Phytolacca (Pircunia, *Beteso*) drastica, *Pöppig*, yielded similar results; among the salts was found 6.6 per cent of calcium malate. The fruit has not been analyzed since Braconnot's experiments in 1804; its coloring matter is bleached by sunlight and turned yellow by alkalies. According to Landerer (1836) the juice is employed in Turkey for coloring sweetmeats.

Physiological Action.—Although long known to possess certain acrid and narcotic properties, poke has never been generally employed as a medicine. Its juice, or a strong decoction of the root, applied to the skin when abraded or tender, causes a smarting or burning pain; and it is reported that a person engaged in powdering the root suffered from coryza, headache, purging, and prostration. Vomiting and purging are said to have followed eating the flesh of pigeons that had fed upon the berries; but it is well known that pigeons and other birds which feed on these berries are eaten without harm. The young shoots are eaten boiled, like asparagus and cabbage sprouts. The powdered root is emetic and purgative in the dose of one or two drachms, and two teaspoonfuls of the juice of the root have produced a similar effect. It is remarkable that the evidences of gastro-intestinal irritation do not arise until an hour or two after the medicine has been taken. In an overdose, besides vomiting and purging and intense thirst, with epigastric distress, it affects the nervous system, causing great prostration, coldness of the skin, and even a cyanotic discoloration, feebleness of the pulse, drowsiness, vertigo, dimness of vision, coma, and even convulsions. In the case of a child six years old, they assumed the tetanic form. This patient recovered; but the death of an adult female from this substance is recorded. None of these effects are produced even by thirty grain doses of the powdered root.

Medical Uses.—The most probable evidence in favor of the medicinal powers of this plant relate to its use in *rheumatism*, and in *diseases of the skin.* In the former, and especially in *syphilitic* rheumatism, it has been employed as a tincture either of the root or of the berries, and as a decoction of the former; and is reputed to have displayed anodyne and sudorific powers. The decoction, the tincture, the juice of the leaves, etc., have been employed extensively and with reputed advantage, both internally and locally, in the treatment of sanious *ulcers*, *scabies*, *tinea capitis*, *sycosis*, and *favus*, and of the *mange* in dogs. An ointment made with the roots or leaves (℥ij to lb. j lard) has been used for the same purposes. All of these preparations have been much employed in the treatment of *hæmorrhoids*, and the infusion and decoction both internally and by injection. The decoction has been administered with alleged benefit in *scrofula*, as well as used locally in treating the ulcers peculiar to that disease.

In the action and in the medicinal uses of phytolacca it is difficult to avoid observing a certain analogy between it and dulcamara, on the one hand, and white hellebore, on the other. The *dose* of the powdered root as an emetic is from ten to thirty grains. Of a saturated tincture, about a fluidrachm may be given two or three times a day. An ointment may be made by mixing with an ounce of lard the extract produced by evaporating an ounce of the tincture.

PICHURIM.—Pichurim Beans.

Fèves pichurim, *Noix de sassafras*, Fr.; *Pichurimbohnen*, *Sassafrasnüsse*, G.

The cotyledons of Nectandra (Ocotea, *Mart.*) puchury major, and N. puchury minor, *Nees.*

Nat. Ord.—Lauraceæ.

Origin.—Both species are Brazilian trees with ovate smooth leaves and elliptical drupaceous one-seeded fruits, which are surrounded at the base by the hardened involucre. The embryo only is used, and is dried by artificial heat.

Description.—The so-called pichurim beans consist of the cotyledons, which are rarely united. They are oblong or roundish ovate, convex and blackish-brown on one side, nearly flat or concave and lighter colored on the other side, and near one end with a depressed scar left by the detached radicle. The large pichurim beans are from one and a half to nearly two inches long; the small rarely exceed three-fourths of an inch, and are often covered on the convex side with the pale-brown finely-wrinkled integuments. Both have internally a light-brown color with yellowish oil cells, and have an aromatic odor and taste, resembling that of nutmeg with an admixture of sassafras.

Constituents.—Kobes (1800) obtained from the large variety 2.1, and Bonastre (1821) from the small variety 3 per cent. of pale-yellow volatile oil; the latter also 10 per cent. of a butyraceous and 22 per cent. of a solid fat. Sthamer (1845) extracted the soft fat by cold alcohol, and the solid kind by boiling with alcohol and expressing; the latter is laurin. Alex. Müller (1853) separated the volatile oil by fractional distillation into a colorless pungent oil, boiling at 150° C. (302° F.); a colorless oil of an orange-like odor, boiling near 170° C. (338° F.); a yellowish-green portion, having the odor of pichurim, and boiling near 240° C. (464° F.); and a considerable quantity of a dark-blue oil, boiling at about 260° C. (500° F.), and containing a little lauric acid. All the fractions contain oxygen. Pichurim contains also starch, gum, and other common vegetable principles.

Medical Action and Uses.—Introduced a century ago into Europe by the Portuguese, pichurim beans were for a long time regarded as possessing a great medicinal value, and even very recently were included in the officinal lists of the German, Spanish, and Portuguese Pharmacopœias. They appear to depend for their virtues upon a concrete volatile oil, and have been chiefly used as stimulants and tonics in mild subacute and chronic *diarrhœa* and *dysentery*, and in habitual debility of the intestinal canal tending to produce flatulence and diarrhœa. Pichurim bark, which has an aromatic smell resembling that of nutmegs, and an astringent taste, is used in Panama in the treatment of *typhoid states* of the system, in atonic *dyspepsia*, *chronic vomiting*, *intermittent fever*, and *menstrual disorders*. The beans are given in powder in doses of from ten to twenty grains, or else in an infusion; the bark is used in the same manner, and in doses twice as great as these.

PILOCARPUS.—JABORANDI.

Pernambuco jaborandi.

The leaflets of Pilocarpus pennatifolius, *Lemaire*, s. P. pinnatus, *Mart.* (s. P. Selloanus, *Engler?*). Bentley and Trimen, Med. Plants, 48.

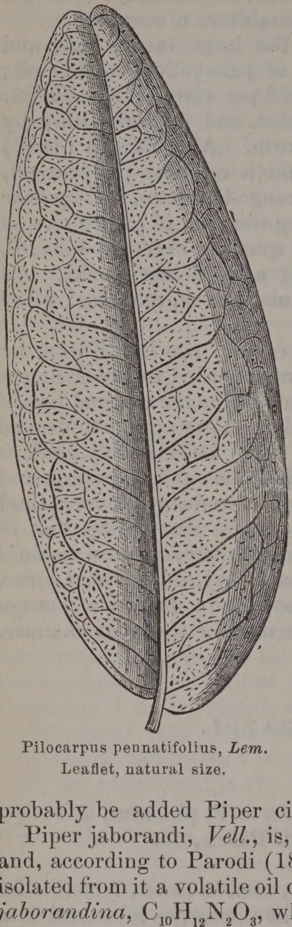
Nat. Ord.—Rutaceæ, Xanthoxyleæ.

Origin.—Jaborandi is a kind of generic name, used in South America for several plants possessing diaphoretic properties. The pilocarpus jaborandi is a shrub growing in Brazil in the neighborhood of Pernambuco, perhaps also in the southern provinces of that empire. *Pil. selloanus*, from Southern Brazil, may probably be merely a hairy variety of *Pil. pennatifolius*, but is regarded as distinct by Baillon. E. M. Holmes (1875) determined the origin of jaborandi.

Description.—The leaves are imparipinnate, and are composed of four to ten short-stalked leaflets with an unequal base, and a terminal one which has a longer stalk and is more tapering and nearly equal at base. The leaflets are about four inches long, oval or ovate-oblong, entire and slightly revolute at the margin, rather rounded below and obtuse and usually emarginate above. They are of a coriaceous texture, green and shining above, and on the under side paler and smooth or somewhat hairy and with a prominent midrib. The entire blade is marked with numerous pellucid glands. The leaves are nearly inodorous, but when bruised, exhale a slight aromatic odor; the taste is herbaceous, afterwards aromatic, warm, and somewhat bitter.

Constituents.—Byasson (1875) obtained from jaborandi leaves a volatile oil and an alkaloid, which is soluble in alcohol, ether, chloroform, ammonia, and dilute acids, and has since been called *pilocarpina.* It is obtained from the aqueous solution of the alcoholic extract by adding an alkali, agitating with

Fig. 131.



Pilocarpus pennatifolius, *Lem.* Leaflet, natural size.

chloroform, and evaporating the latter solution. The alkaloid is uncrystallizable, but A. W. Gerrard (1875) has crystallized from alcohol a number of its salts, of which the sulphate and acetate are very deliquescent; the latter is also soluble in ether, chloroform, and benzol, in which the nitrate and phosphate are insoluble, while the chlorhydrate and, bromhydrate dissolve besides in water and alcohol, also in chloroform. Kingzett (1876) gives to the alkaloid the formula $C_{23}H_{34}N_4O_4$, and states that on distillation with caustic potassa it yields trimethylamina, and that jaborandi contains only one alkaloid, while both Gerrard and Hardy (1875) believed they had evidence of the presence of a second alkaloid.

The volatile oil of jaborandi was examined by Hardy (1876), who obtained 0.56 per cent. from the leaves, and found it to consist of *pilocarpene*, which is a hydrocarbon, $O_{10}H_{16}$, sp. grav. 85, and boiling at 178° C. (352.4° F.); of another hydrocarbon boiling at 250° C. (492° F.); and a third one boiling at a higher temperature, and forming a solid transparent mass.

Other Jaborandis.—Peckolt (1875) enumerated the following Brazilian drugs, which are known in some of the provinces as jaborandi, and belong either to the natural order of Piperaceæ, or to that of Rutaceæ (Xanthoxylaceæ).

1. Serronia (Piper, *Vell.*, Ottonia, *Kth.*) jaborandi, *Guill.;* 2. Piper reticulatum, *Lin.;* 3. P. nodulosum, *Link.;* 4. Artanthe mollicoma, *Miquel;* 5. Aubletia (Monniera, *Lin.*) trifolia, *Rich.*, and Xanthoxylum elegans, *Engl.* To these must probably be added Piper citrifolium, *Lam.*, and, perhaps, other species.

Piper jaborandi, *Vell.*, is, according to Peckolt, the true jaborandi of Brazil, and, according to Parodi (1875), the true *yaguarundi* of Paraguay. The latter isolated from it a volatile oil of an acrid and biting taste, and a crystalline alkaloid, *jaborandina*, $C_{10}H_{12}N_2O_3$, which is slightly soluble in ether, and has but a weak affinity for acids.

Pharmaceutical Uses.—Jaborandi leaves are with difficulty reduced to a moderately fine powder, and, in preparing a *fluid extract of jaborandi*, Dr. F. V. Greene (1877) found it necessary to compress the moistened powder by a layer of washed sand; the drug is then exhausted with 50 per cent. alcohol, and for every 16 troyounces, 14 fluidounces of tincture are reserved, the subsequent weaker portion being evaporated to 2 fluidounces.

Physiological Action. *On Animals.*—Jaborandi and its preparations given to Guinea pigs and dogs do not occasion sweating, but in the latter animals there are profuse salivation and diarrhœa, and, when they are sacrificed, extreme congestion of the gastro-intestinal mucous membrane is found, and sometimes hemorrhage. Injected into the veins it causes primarily an increased, followed by a diminished blood-pressure and a fuller volume of the pulse-wave.

On Man.—When a leaf of this plant is chewed it causes an acrid sensation in the fauces, and the powder by prolonged contact with the skin irritates it. In doses of from thirty to ninety grains infused in boiling water, the water and the grounds being swallowed together, it produces within ten or fifteen minutes a diffused glow, followed by profuse perspiration generally, and usually by salivation so copious that it may amount to one or two pints during as many hours. It sometimes also increases the bronchial secretion, or causes diarrhœa, or produces swelling of the submaxillary glands. During the sweating the temperature is apt to fall about 1° F., the pulse grows fuller and tenser, and its rate is at the same time increased, sometimes by as much as forty or fifty beats a minute. The heart strikes forcibly against the chest, and the carotids visibly pulsate. The face becomes flushed at first, but grows pale when the perspiration is most profuse. During these operations some drowsiness is apt to occur which seems to be owing to exhaustion rather than to any narcotic virtue in the drug, and in some cases the sight is clouded, so that only very near objects can be distinctly seen. In rare instances sweating fails to occur, and salivation is much less usual than sweating. The fall of temperature noticed above seems to be ordinarily due to the diaphoresis, but it sometimes is observed independently of the latter symptom. Vomiting is an ordinary effect due in part to the irritation of the medicine when given by the stomach, but in part also to the large amount of saliva swallowed. Hiccup is not unusual. It is noteworthy that the usual promoters of diaphoresis are quite unnecessary when this medicine has been given. It is the only direct and essential diaphoretic of the materia medica. During the sweating and salivation produced by jaborandi the quantity of urine excreted is diminished, and is voided with pain. Nearly all observers agree that it contains less than the normal proportion of urea, but some have found it to be increased. Urea is, however, largely eliminated with the saliva and the sweat. Sphygmographic observations denote a dilatation and diminished tension of the whole vascular system during the action of jaborandi; and in experiments upon frogs the heart becomes gradually distended, and finally ceases to beat in diastole. The imperfect vision sometimes produced by the internal use of this drug has already been alluded to. It is attributed to a defect of accommodation. When the extract of jaborandi, or pilocarpin, dissolved in glycerin is introduced into the eye, it in most cases contracts the pupil, but when taken internally it produces this effect much less uniformly, if at all. Instead of diminishing the secretion of milk, as might reasonably be expected from its causing such profuse discharges elsewhere, it appears to be a true galactagogue. It is remarkable that children are but little affected by doses which would produce the full operation of the medicine upon adults.

Jaborandi resembles atropia in quickening the pulse and flushing the face, and in acting more powerfully upon adults than upon children; but it is antagonistic to atropia in its action upon the salivary, sudoral, and mammary secretions, upon the pupils also, and the minute arteries. Moreover, the tendency of belladonna to excite delirium contrasts with that of jaborandi to cause prostration and drowsiness, and the sweats and salivation produced by the latter are checked by the hypodermic injection of atropia. The dryness of the mouth and skin which this alkaloid or belladonna occasions is relieved by the administration of jaborandi or pilocarpin. The mammary secretion is diminished by the one and increased by the other. In this connection it may be mentioned that in experiments upon frogs the dilatation of the heart produced by the one agent has been overcome by the operation of the other. Nevertheless, it has happened in cases of poisoning by belladonna or its alkaloid, that no mitigation of the symptoms has followed the administration of jaborandi or pilocarpin.

Pilocarpin or its muriate when injected hypodermically in the dose of about one-fifth of a grain gives rise to effects which in their nature are almost identical with those of jaborandi taken internally, but they are more promptly produced, as well as more certainly, and are more lasting. Sweating, especially, which sometimes fails to occur under the operation of jaborandi, is invariably excited by pilocarpin, which is also, when thus administered, less apt to cause vomiting, probably because it does not irritate the stomach.

Medical Uses.—The utility of jaborandi in medicine is confined to its power of lessening the amount of liquid in the system. Hence it is often of service in removing effusions due to cardiac or renal obstruction, and even to inflammation. The last effect has been illustrated in some cases of chronic *pleurisy*, probably however with serous rather than purulent effusion. In *dropsy* caused by obstructive disease of the heart and kidneys it is a temporary palliative which may appropriately be used from time to time during a treatment by digitalis, etc. Indeed, it simply serves as a substitute for the ancient practice of purging by the bowels, and may be used alternately with it. Its action in lessening the contractile power of the heart and arteries, and retaining them in diastole, should be borne in mind, since it tends to favor the accumulation of blood in them, and to obstruct instead of relieving circulation and respiration. In this way, doubtless, the medicine used in certain cases of pulmonary *emphysema* has embarrassed respiration, and threatened to produce asphyxia. But when dropsy of whatever form (hydrothorax, ascites, anasarca) due to Bright's disease is associated, not with obstructive lesions of the heart, but with hypertrophy of the left ventricle, the relief obtained from jaborandi is immediate and striking. A caution has been given to beware of the possible uræmic symptoms that may follow the diminished urination; but as urea is eliminated by the saliva and sweat, the advice does not appear to be important. In scarlatinous dropsy, also, the vigor of the heart being unimpaired, great advantage may be derived from the sudation produced by this medicine, for it tends to lessen the mechanical dangers of the effusion, while other medicines may be used to remove the tubular obstruction of the kidneys. In a word, its utility in all forms of dropsy is precisely like that which has long been derived from hot air and steam-baths, and other powerful diaphoretics, but is greater, inasmuch as it causes profuse salivation as well as sweating. It must be borne in mind, also, that some clinical observers have found it injurious by causing distressing nausea and vomiting, and so exhausting the strength that its repeated use was not tolerated.

Jaborandi has been employed to diminish the discharge of urine in *diabetes insipidus*, but it only changes the outlet of the liquid without reducing the loss. Upon "scientific principles" jaborandi should be a specific for acute articular *rheumatism*, but clinically it is so far from curing that it does not modify the symptoms or the course of the disease. In syphilitic rheumatism its sudorific action is said to have removed the nocturnal pains; and it has been efficacious in muscular rheumatism and *sciatica*. In scaly *skin diseases* it is useless. In *mumps* it is reported to have been curative, both of the parotid swelling and of the metastatic engorgement of the testicles. In a case of unilateral *sweating* the hypodermic injection of pilocarpin is reported to have cured the affection after having at first increased it. In *asthma* with bronchitis (humid asthma), it sometimes affords surprising relief. A case of persistent *hiccup* from disease of the brain, and which had resisted various other remedies, yielded at once to the hypodermic injection of half a grain of pilocarpin.

Jaborandi may be administered in an infusion made with ninety grains of the medicine and four fluidounces of water, and taken in three or four equal portions at intervals of ten minutes. To avoid nausea it may be given by enema. A concentrated tincture containing the virtues of thirty grains in a fluidrachm of the preparation, and a fluid extract made with 50 per cent. alcohol, a fluidrachm of which represents sixty grains of jaborandi, have both been employed. Pilocarpin or its nitrate may be prescribed by the mouth in doses of from half a grain to three-quarters of a grain; and hypodermically a quarter of a grain may be given.

PILULÆ.—PILLS.

Pilules, Fr.; *Pillen*, G.

Pills are medicaments which have been formed into spherical, or sometimes slightly elongated or more or less lenticular bodies, intended to be swallowed without being previously masticated. Their weight ranges from less than one grain to about five grains; if a pill exceeds this weight, it is called a *bolus*. Boluses are occasionally made weighing twenty or thirty grains each, and are often of a softer consistence than pills. Very small pills, coated with sugar, have been called *granules*.

Excipients.—All drugs and chemicals may be worked into pills, but few only are adapted for this purpose without the addition of some other liquid or solid material, called the excipient, to impart to them the necessary plasticity. Soap, gum resins, some resins, and several extracts do not require any addition, except a few drops of water or alcohol, with which they may be triturated into plastic masses, and then serve as excellent excipients for many non-adhesive drugs. That the majority of extracts are unfit for the preparation of pills without the addition of an absorbent powder, is explained at page 559. Absorbent powders, like powdered marshmallow, liquorice root, bread crumb, etc., are likewise required for liquids, such as *fixed* and *volatile oils*, *oleoresins*, *balsams*, etc., but such mixtures cannot be formed into a pill mass by the addition of mucilaginous liquids. The substances named are best combined with a solid fat, like expressed oil of nutmeg, or with wax in sufficient quantity to form a plastic mass; however it is preferable in such cases to use also some absorbent powder, and for volatile oils the wax is better replaced by a resin, like mastic. The proportion in which such excipients are to be used, may be stated as being, for every five parts of the medicine, ten parts of the two excipients, of which not less than two parts should be wax, resin, or solid fat. Very limpid oils require a somewhat larger proportion of the excipients, and the absorbent powder need not necessarily be inert.

Ethers, *chloroform*, and similar liquids are not adapted for use in pill form owing to their great volatility; and tinctures, unless added only in very small quantities, in which case they are triturated with the absorbent powder, are best reduced by evaporation to the consistence of a soft extract.

It is also advisable to avoid prescribing very *deliquescent compounds* in the form of pills, unless they are immediately covered with a substance impervious to moisture; or the pill mass may be formed with a mixture of one part of wax and three parts of *Canada balsam*, as proposed by Dannecy (1877).

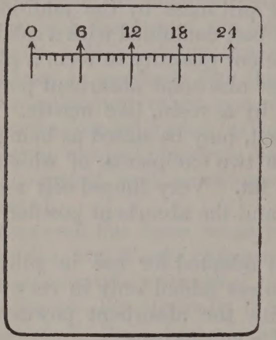
Many vegetable powders contain an amount of gum or similar principle sufficient to form, by trituration with a little water, honey, syrup, or glycerin, an adhesive mass suitable for making pills. Saline and mineral substances, as a rule, require a firmer excipient.

It is obvious, from the foregoing, that there cannot be an excipient which would be alike serviceable for all medicinal substances, or even for all drugs capable of being reduced to powder. The choice of the excipient is very frequently left to the pharmacist, and involves a knowledge not only of the constituents of the drugs, but also of the reactions which may take place between the different ingredients in the presence of moisture. *Mucilage of acacia* or of *tragacanth* serves a good purpose if the pills are to be used in a short time, but if kept on hand they become hard and dissolve very slowly. This may be prevented by replacing about one-half or more of the water with *glycerin*. The *glycerite of starch* (see p. 674), and various combinations of it with gum arabic, tragacanth, and sugar have been used for the same purpose. Some very soluble salts, like boro-tartrate of potassium, have been recommended as excipients, but are scarcely required. Most of the officinal *confections*, and more particularly that of roses, of hip and even of senna, will render powders adhesive, and if *extracts* are not inadmissible, they will be found to yield good pill masses with a comparatively large amount of powder; a rather soft extract is capable of serving as an excipient for its own weight of vegetable powder, and three or four times its weight of resins and insoluble salts, and with the addition of a little syrup, or honey, twice the weights indicated may be incorporated.

As a rule, it will be found desirable for the physician to order some adhesive material, like extracts, together with the other ingredients of pills; but the former should not be in excessive quantities, so as not to require the addition of inert absorbent powder. When no excipient is directed, the pharmacist should select one which is simple in composition, does not increase the bulk of the mass, and is not liable to become very hard. When resinous extracts and similar materials are ordered, an excipient is not often required, but the powders may be triturated together in a warm mortar, and the plastic mass rolled out into pills while still warm. The compound cathartic pills furnish an example of this kind.

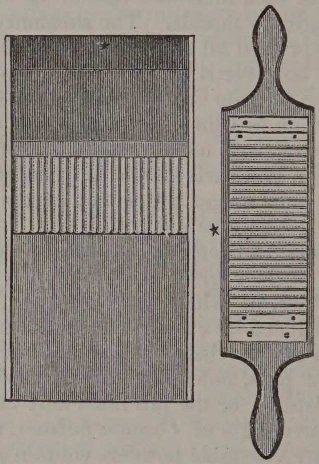
Preparation.—After the mass has been uniformly mixed and properly prepared in the mortar, or for a small number of pills upon a glazed slab, it is rolled out either by means of a spatula, or a flat piece of hard wood, or when the mass is tough or voluminous, the flat back of the cutter of a pill machine is used. A cylinder of uniform thickness and the desired length having been obtained, it is cut into the requisite number of pieces upon a graduated tile or by means of a pill machine. Several sizes of the latter are usually kept in the shops for preparing pills of different sizes, and serve not only for dividing, but likewise for shaping the pills by placing the cylindrical roll upon the cutting surface, and moving the cutter forward and backward with a gradually increased pressure. Those pieces which have not become spherical or which have been cut by hand, are rolled between the fingers until they are nearly globular, after which they are placed upon a smooth surface, and completely rounded by means of a slight pressure of the fingers, or by rotating them under the blade of a pallet knife or under a flat piece of hard wood, similar to the pill roller.

Fig. 132.



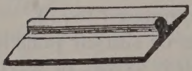
Pill tile graduated.

Fig. 133.



Pill machine.

Fig. 134.

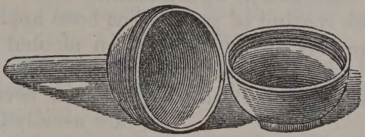


Pill roller.

Pill-dusting.—The pill mass, being plastic and adhesive, is apt to adhere to the slab and the fingers while being rolled out and shaped into pills. This is prevented by the use of a fine powder, which should be strictly inert, unless otherwise directed by the physician. Among the most suitable powders are liquorice root, marshmallow root, and lycopodium. The fineness and uniformity of the latter, its slight adhesive qualities, and its tastelessness render it particularly desirable for this purpose. Powdered starch is usually too slippery, but when mixed with finely powdered sugar and gum arabic is sometimes preferable on account of its white color. Magnesia and magnesium carbonate should be used with due care, on account of the possible effect upon the ingredients of the pills. Powdered talc (soapstone), with or without sugar and gum arabic, is likewise serviceable, and has the advantage of imparting a very thin opaque and tasteless coating to the pills without impairing their solubility in the stomach. When asafetida or other substances of a nauseous odor are given in the form of pill, the odor may either be entirely covered or considerably modified by the use of powdered cinnamon, aromatic powder, ginger, orris root, or a similar powder.

Pill-coating.—If the pill mass had not been too soft, the amount of powder adhering to the surface of the finished pill is quite small, though generally sufficient if quickly swallowed to cover the taste of bitter and nauseous ingredients. More perfect coverings may be obtained in various ways, an ordinary rather deep pill-box being used, or preferably an apparatus made of hard wood, consisting of two hollow hemispheres to one of which a short handle is attached. For *silvering* or *gilding*, the pills are made firm, if possible rolled out and shaped without using any powder, and after a perfectly smooth surface has been obtained, slightly dampened and introduced into the apparatus together with the requisite quantity of gold or silver leaf; after a rapid rotary motion for a few seconds the pills will be found uniformly coated with the thin metal. Glycerin should not be used as an excipient or only in very small quantity, as it lessens the brightness of this kind of coating.

Fig. 135.



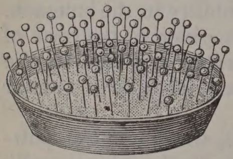
Apparatus for coating pills.

The same apparatus may likewise be employed for *sugar-coating* pills extemporaneously. To accomplish this, the pills receive first a thin coating of a thick mucilage, or preferably of syrup of acacia, by rotating them upon a moistened slab, after which they are introduced into the apparatus with not too large a quantity of finely powdered sugar. The smoothness of the surface of the sugar depends altogether upon the mutual attrition of the pills, and consequently upon the absence of too large an excess of sugar, and upon the rapidity of motion during the operation. A coating of *French chalk* may be applied in the same manner. Pills are now extensively coated with sugar on the large scale, hemispherical copper pans being used to which a somewhat eccentric rotary motion is given; these pans may be moderately heated either by steam or otherwise. To obtain a uniform and compact coating, the powdered sugar is added gradually as required.

The practice of sugar-coating pills is approved by the Pharmacopœia in reference to pills which are expected to be slow in their operation, but is stated to be of doubtful propriety in regard to those intended to act quickly, as the coating retards the solution of the pill matter in the liquids of the stomach, and the same remark holds good, with at least equal force, for nearly every other kind of coating.

Pills are occasionally coated with *tolu* or *collodion*. The operation is in both cases alike, the tolu balsam, which should for this purpose be hard at the ordinary temperature, being dissolved in ether; the pills are rapidly rotated with the ethereal liquid gradually added, a flat dish being used, and afterwards exposed upon a tile and occasionally stirred until the coating is dry.

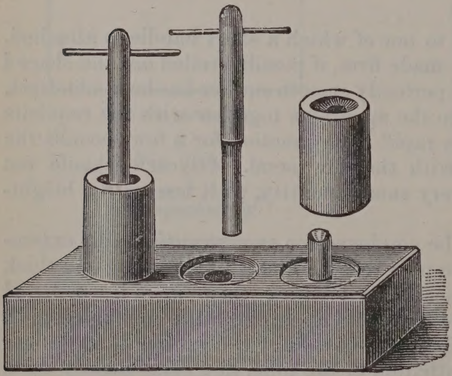
Fig. 136.



Tray with gelatin-coated pills.

For coating pills with gelatin, a different manipulation from those described is required. A solution of pure gelatin in one-half or one-third its weight of water is made, and the solution kept at a temperature just high enough to keep it liquid. The pill, fastened upon the end of a pin, is dipped into the liquid, quickly withdrawn, and after some rotary motions to promote the uniform diffusion of the gelatin solution and its superficial hardening, the pins are fixed in a tray where the coating is allowed to become sufficiently firm, when a second and sometimes a third coat is applied in the same manner. If many pills are to be thus coated, a number of pins may be fastened to a flat cork or piece of wood, and an equal number of pills dipped together. The coating of gelatin may be applied to pills while still plastic, but they should be sufficiently firm not to lose their shape while temporarily exposed to a somewhat elevated temperature. Most bitter principles being soluble in aqueous liquids, the taste of the pill mass will to some extent be communicated to the first layer of gelatin. After a sufficiently thick coating of gelatin has been applied, the pills are withdrawn after heating the pins in the flame of an alcohol or gas lamp, whereby the adjacent gelatin is melted and the orifice closed.

Fig. 137.



Apparatus for making compressed pills.

Compressed Pills.—These pills, which have been recently introduced, are usually lenticular in shape, and are made without any excipient simply by subjecting the powdered material to pressure. Prof. Remington (1876) constructed an apparatus which is made of cast-steel, the mould being on a rod which fits in a movable cylinder into which the weighed material is introduced; the compression is effected by striking the rod with a wooden mallet a quick blow. Powders which are readily soluble in water without being deliquescent appear to be best adapted for this kind of pills.

Preservation. — Uncoated pills are best preserved in lycopodium or other powder, and in a vessel which does not prevent the change of air. Moist pills kept in well-closed vessels are apt to become mouldy.

It should be mentioned that the British Pharmacopœia directs only *pill masses*, leaving the final division to be specially ordered by the physician. The U. S. Pharmacopœia, on the other hand, directs *pills* of a certain weight, and only two pill masses, namely, Pilula ferri carbonatis and Pil. saponis composita.

PILULÆ ALOES, *U. S.*—PILLS OF ALOES.

Pilula aloes Socotrinæ, Br.—*Pilules d'aloès*, Fr.; *Aloepillen*, G.

Preparation.—Take of Socotrine Aloes in fine powder, Soap in fine powder, each forty-eight grains. Beat them together with water so as to form a pilular mass, to be divided into twenty-four pills. *U. S.*

Take of Socotrine Aloes in powder two ounces; Hard Soap in powder one ounce; Volatile Oil of Nutmeg one fluidrachm; Confection of Roses one ounce. Beat all together until thoroughly mixed. *Br.*

Pilula aloes Barbadensis, Br., is made in precisely the same manner except that Barbadoes aloes is substituted for Socotrine aloes and oil of caraway for oil of nutmeg, both in the same proportion as in the preceding formula.

The Socotrine aloes in the first formula should be *purified* aloes.

Medical Action and Uses.—The soap in this pill serves to divide the aloes and render it more soluble, whereby, it is thought, the tendency of the medicine to irritate the rectum is diminished. In the British pill the presence of oil of caraway or oil of nutmeg is intended to lessen the tendency of the medicine to gripe. These pills are very convenient as laxatives in habitual *constipation*, and may be taken at bedtime or after dinner. A single pill repeated daily forms the ordinary dose. They may be used as purgatives in the *dose* of five or more pills, but are less suited for this purpose than other aloetic preparations.

The *Pilula aloes Barbadensis*, Br., is nearly identical as a purgative with that of the United States Pharmacopœia, but the oil of caraway it contains gives it the advantage. *Dose*, from five to ten grains.

The only difference between *Pilula aloes Socotrinæ*, Br., and that made with Barbadoes aloes, besides the source of the aloes itself, is that the former contains oil of nutmeg, and the latter oil of caraway. It would seem more convenient, as well as reasonable, that the one or the other oil should be added, as they may be according to the United States Pharmacopœia, according to the nature of the case. The *dose* of the Socotrine aloes pill is from five to ten grains.

PILULÆ ALOES ET ASSAFŒTIDÆ, *U. S.*, *Br.*—PILLS OF ALOES AND ASAFETIDA.

Pilules d'aloès et asefétide, Fr.; *Aloe und Asafœtida-Pillen*, G.

Preparation.—Take of Socotrine Aloes in fine powder, Asafetida, Soap in fine powder, each thirty-two grains. Beat them together with water so as to form a pilular mass, to be divided into twenty-four pills. *U. S.*

Take of Socotrine Aloes in powder, Asafetida, Hard Soap in powder, Confection of Roses, each one ounce. Beat all together until thoroughly mixed. *Br.*

Medical Action and Uses.—These pills may take the place of simple aloetic pills in cases of constipation attended with flatulence, and especially in nervous or hysterical persons. *Dose*, from two to five pills.

PILULÆ ALOES ET FERRI, *Br.*—PILLS OF ALOES AND IRON.

Pilulæ aloeticæ ferratæ s. Pilulæ Italicæ nigræ, P. G.—*Pilules d'aloès et de fer*, Fr.; *Aloe und Eisenpillen*, *Italienische Pillen*, G.

Preparation.—Take of Sulphate of Iron one ounce and a half; Barbadoes Aloes in powder two ounces; Compound Powder of Cinnamon three ounces;

Confection of Roses four ounces. Reduce the sulphate of iron to powder, rub it with the aloes and compound powder of cinnamon, and, adding the confection, make the whole into a uniform mass. *Br.*

The pills of the German Pharmacopœia are prepared from equal parts of exsiccated sulphate of iron and powdered Socotrine aloes, and with spirit formed into a mass, which is divided into pills each weighing 0.10 gram.

Medical Action and Uses.—This is an old and efficient combination used in the treatment of *amenorrhœa* associated with anæmia and constipation. Like other analogous compounds, it should be used habitually in moderate doses, and in larger ones at the menstrual epochs. *Dose*, from five to ten grains.

PILULÆ ALOES ET MASTICHES, *U. S.*—PILLS OF ALOES AND MASTIC.

Lady Webster's dinner pills, E.; *Pilules d'aloès et de mastic*, Fr.; *Aloe-und Mastix-Pillen*, G.

Preparation.—Take of Socotrine Aloes in fine powder forty-eight grains; Mastic in fine powder, Red Rose in fine powder, each twelve grains. Beat them together with water so as to form a pilular mass, to be divided into twenty-four pills. *U. S.*

Medical Action and Uses.—The association of mastic with aloes in a purgative pill can hardly have any other effect than to retard the solution of the latter, and thereby cause it to act upon the large rather than upon the small intestine. These pills are used to hasten defecation, and are generally taken with or immediately before or after the principal meal. Hence they have been called *Pil. ante cibum*, *Pilules des gourmands*, etc. Under the latter title, however, pills are used containing extract of cinchona, and absinth, as well as aloes. Each pill should contain about two grains of aloes.

PILULÆ ALOES ET MYRRHÆ, *U. S.*, *Br.*—PILLS OF ALOES AND MYRRH.

Rufus's pills, E.; *Pilules d'aloès et myrrhe*, *Pilules de Rufus*, Fr.; *Rufus'sche Pillen*, G.

Preparation.—Take of Purified Aloes in fine powder forty-eight grains; Myrrh in fine powder twenty-four grains; Aromatic powder twelve grains; Syrup a sufficient quantity. Beat the whole together so as to form a pilular mass, to be divided into twenty-four pills. *U. S.*

Take of Socotrine Aloes two ounces; Myrrh one ounce; Saffron dried one-half ounce; Confection of Roses two and one-half ounces. Triturate the aloes, myrrh, and saffron together, and sift; then add the confection of roses, and beat them together into a uniform mass. *Br.*

Medical Action and Uses.—The proportion of myrrh in this compound is too small in quantity to exert much influence; but, owing to its supposed action upon the uterine system, it is believed to increase the virtue of the aloes in the treatment of *amenorrhœa*, *uterine catarrh*, etc. The still smaller proportion of saffron can scarcely add much to its virtues. As a purgative, from three to six pills may be given, or from ten to twenty grains of the mass in a bolus. As a laxative, taken at bedtime for a week or more, one or two pills will generally suffice, and will be found the most efficient mode of administration in the uterine disorders referred to.

PILULÆ ANTIMONII COMPOSITÆ, *U. S.*—COMPOUND PILLS OF ANTIMONY.

Pilula hydrargyri subchloridi composita, Br.; *Pil. calomelanos composita.—Compound pills of subchloride of mercury, Plummer's pills*, E.; *Pilules altérantes composées, P. antidartreuses, P. de Plummer*, Fr.; *Plummer'sche Pillen*, G.

Preparation.—Take of Sulphurated Antimony, Mild Chloride of Mercury, each twelve grains; Guaiac in fine powder, Molasses, each twenty-four grains. Rub the sulphurated antimony first with the mild chloride of mercury, and then with the guaiac and molasses, so as to form a pilular mass, to be divided into twenty-four pills. *U. S.*

Take of Subchloride of Mercury, Sulphurated Antimony, of each one ounce; Guaiacum Resin in powder two ounces; Castor Oil one fluidounce, or a sufficiency. Triturate the subchloride of mercury with the antimony, then add the guaiacum resin and castor oil, and beat the whole into a uniform mass. *Br.*

Medical Action and Uses.—Plummer's pills, or compound calomel pills as they might properly be called, probably owe their virtues to the mercury they contain, since various other mercurial preparations are equally efficacious in the diseases for the cure of which these pills are in greatest repute, viz., *chronic rheumatism* and *diseases of the skin*, so far as they are due to a syphilitic taint, and since the proportion of guaiac they contain can have no efficiency. The *dose* is one or two pills twice a day.

PILULÆ ASSAFŒTIDÆ, *U. S.*—PILLS OF ASAFETIDA.

Pilule d'asefétide, Fr.; *Asafœtida-Pillen*, G.

Preparation.—Take of Asafetida seventy-two grains; Soap in fine powder twenty-four grains. Beat them together with water so as to form a pilular mass, to be divided into twenty-four pills. *U. S.*

Medical Action and Uses.—These pills, especially when sugar-coated, are a convenient form for the administration of asafetida, of which each one contains three grains. *Dose*, from one to three pills.

PILULA ASSAFŒTIDÆ COMPOSITA, *Br.* See PILULÆ GALBANI COMPOSITÆ.

PILULA CAMBOGIÆ COMPOSITA, *Br.*—COMPOUND PILL OF GAMBOGE.

Preparation.—Take of Gamboge in powder, Barbadoes Aloes in powder, Compound Powder of Cinnamon, each one ounce; Hard Soap in powder two ounces; Syrup a sufficiency. Mix the powders together, add the syrup, and beat the whole into a uniform mass.

Medical Action and Uses.—As an efficient purgative in constipation and in congested states of the portal circulation, this pill may be recommended. *Dose*, from five to ten grains.

PILULÆ CATHARTICÆ COMPOSITÆ, *U. S.*—COMPOUND CATHARTIC PILLS.

Antibilious pills, E.; *Pilules cathartiques composées*, Fr.; *Abführpillen*, G.

Preparation.—Take of Compound Extract of Colocynth thirty-two grains; Extract of Jalap in fine powder, Mild Chloride of Mercury, each twenty-four grains; Gamboge in fine powder six grains. Mix the powders together; then with water form a pilular mass, to be divided into twenty-four pills. *U. S.*

In making this pill mass it is advisable to use a warm mortar, and add very little water; while still warm, it may be formed into pills which will better retain their shape than if made with more water at the ordinary temperature.

Medical Action and Uses.—Whether or not the calomel in these pills act upon the liver as was once fully believed, there can be no question, that, in all cases requiring thorough purgation, in which the gastric digestion is disordered, the liver tumid and tender, the skin and the conjunctiva muddy, and the urine dark and sedimentary, these symptoms are promptly relieved by a full purgative dose of them. Hence, they are much used in malarial localities at seasons when periodical diseases prevail, and in other places for the relief of similar symptoms produced by the habit of eating excessively of animal food and using alcohol beyond the needs of the economy. There is much reason for believing that the compound cathartic pill operates as a purgative upon the entire intestinal tract.

The *dose* of this preparation as a laxative is about three grains, or one pill; as an active cathartic about three pills. It is not adapted for habitual use, on account of its tendency to produce salivation when often repeated.

PILULA COLOCYNTHIDIS COMPOSITA, *Br.*—COMPOUND PILL OF COLOCYNTH.

Pilules de coloquinte composées, P. cochées mineures, Fr.; *Coloquinten-Pillen,* G.

Preparation.—Take of Colocynth Pulp in powder one ounce; Barbadoes Aloes in powder, Scammony in powder, each two ounces; Sulphate of Potash in powder one-quarter ounce; Oil of Cloves two fluidrachms; Distilled Water a sufficiency. Mix the powders, add the oil of cloves, and beat into a mass with the aid of the water. *Br.*

The formula of the French Codex directs Colocynth, Barbadoes Aloes, and Scammony, of each ten grams; Honey thirty grams; Oil of Cloves 0.05 gram, to be divided into two hundred pills, which are to be coated with silver.

Medical Action and Uses.—This pill is appropriate in the same cases as the compound pill of gamboge. *Dose,* from five to ten grains.

PILULA COLOCYNTHIDIS ET HYOSCYAMI, *Br.*—PILL OF COLOCYNTH AND HYOSCYAMUS.

Preparation.—Take of Compound Pill of Colocynth two ounces; Extract of Hyoscyamus one ounce. Beat them into a uniform mass. *Br.*

Medical Action and Uses.—The operation of the compound extract of colocynth in this pill is mitigated by its association with extract of hyoscyamus; but an officinal formula is hardly necessary for such a combination. It is better to add the narcotic extract to whatever purgative pill has a tendency to gripe, in a magistral prescription. *Dose,* from five to ten grains.

PILULA CONII COMPOSITA, *Br.*—COMPOUND PILL OF HEMLOCK.

Preparation.—Take of Extract of Hemlock two and a half ounces; Ipecacuanha one-half ounce; Treacle a sufficiency. Mix the extract of hemlock and ipecacuanha, and add sufficient treacle to form a pill mass.

Medical Action and Uses.—This combination is intended to act as a sedative and expectorant, but the extract of conium contained in it can exert but little influence in either way. A pill of Dover's powder is much more efficient. *Dose*, from five to ten grains.

PILULÆ COPAIBÆ, *U. S.*—PILLS OF COPAIBA.

Pilules de copahu, Fr.; *Copaiva-Pillen*, G.

Preparation.—Take of Copaiba two troyounces; Magnesia recently prepared sixty grains. Mix them together, and set the mixture aside until it concretes into a pilular mass, to be divided into two hundred pills. Should the mixture not concrete in eight or ten hours, a deficiency of water in the copaiba may be inferred; and this difficulty may be obviated, in subsequent operations, by shaking the copaiba with one-twentieth of its weight of water, and allowing it to stand for some days, until all the uncombined water has subsided, and then decanting and keeping it in closed bottles for use. *U. S.*

The pills of the French Codex are nearly identical, each containing 0.25 gram of copaiba. The variety of copaiba best adapted for these pills is Maracaibo copaiba (p. 454), since it contains a larger proportion of resin; this enters into combination with the magnesia, forming a resin soap, which gradually becomes dry and hard. If thin Para copaiba is to be used for making these pills, it is advisable to evaporate sufficient of the volatile oil until the residue, after cooling, forms a viscid liquid, when it may be mixed with the magnesia. The Pharmacopœia directs recently prepared magnesia, which is anhydrous, and does not easily combine with the copaivic acid until after it has become hydrated. In making the mixture, it is therefore better to supply at once any deficiency in water of hydration. The combination will also be hastened by the application to the mixture of a moderate heat for about ten minutes.

In Europe pills of copaiba and powdered cubebs are sometimes used, and made into a mass by means of wax. The quantities necessary are one part of each of the ingredients named, or three parts of copaiba, five of cubebs, and one of wax. This mass retains its plasticity for a long time.

Medical Uses.—Since the introduction of capsules of copaiba these pills have become superfluous, and should be discarded from the Pharmacopœia.

PILULA FERRI CARBONATIS, *U. S.*, *Br.*—PILL OF CARBONATE OF IRON.

Pilulæ ferri carbonici, P. G.; *Pilulæ ferratæ Valleti.*—*Vallet's pill mass*, E.; *Pilules de carbonate ferreux*, *Pilules ferrugineuses*, Fr.; *Valletsche Pillen*, G.

Preparation.—Take of Sulphate of Iron eight troyounces; Carbonate of Sodium nine troyounces; Clarified Honey three troyounces; Sugar in coarse powder two troyounces; Boiling Water two pints; Syrup a sufficient quantity. Dissolve the salts separately, each in a pint of the water, and having added two fluidounces of syrup to the ferruginous solution, filter both solutions. Mix the two solutions, when cold, in a bottle just large enough to hold them, close it accurately with a stopper, and set it by that the carbonate of iron may subside. Pour off the supernatant liquid, and, having mixed water recently boiled, with syrup in the proportion of a pint to the fluidounce, wash the precipitate with the mixture until the washings no longer have a saline taste. Drain the precipitate on a flannel cloth, and express as much of the water as possible. Lastly, mix the precipitate immediately with the clarified honey and sugar, and, by means of a water-bath, evaporate the mixture, stirring constantly, until it is brought to the weight of eight troyounces. *U. S.*

Take of Saccharated Carbonate of Iron one ounce; Confection of Roses quarter of an ounce. Beat them into a uniform mass. *Br.*

The formula of the French Codex is similar to that of the United States Pharmacopœia, except that milk sugar is used in place of sugar; six parts of the mass are mixed with one part each of powdered marshmallow and liquorice root, and divided into pills, each weighing 0.25 gram, which are to be silvered. The pills of the German Pharmacopœia contain 0.05 grain of ferrous carbonate, and are rolled in powdered cinnamon.

On mixing solutions of ferrous sulphate and sodium carbonate, ferrous carbonate and sodium sulphate are formed by mutual decomposition (see p. 612). In contact with air the white iron precipitate rapidly oxidizes. The change is prevented by washing the precipitate in bottles by decantation with water recently boiled, and excluding the air; an additional protection is afforded by dissolving some sugar in the water. The pill mass, when recently made, is of a greenish-gray color, but on exposure becomes superficially greenish-black. If properly made, it contains nearly 42 per cent. of ferrous carbonate.

Medical Action and Uses.—The pill of carbonate of iron is one of the most efficient forms in which iron can be exhibited for obtaining its constitutional effects, through its digestion and assimilation. It is therefore especially indicated in pure *anæmia*, in anæmic *chlorosis*, and in all those affections in which there is a deficiency of red corpuscles in the blood, particularly when the digestive function is not greatly impaired. In the latter cases the vegetable salts of iron are preferable. The *dose* of this preparation is from three to five grains, after each meal.

PILULÆ FERRI COMPOSITÆ, *U. S.*—COMPOUND PILLS OF IRON.

Pilules de Griffith, P. de fer et de myrrhe composée, Fr.; *Griffith'sche Pillen*, G.

Preparation.—Take of Myrrh in fine powder thirty-six grains; Carbonate of Sodium, Sulphate of Iron, each eighteen grains; Syrup a sufficient quantity. Rub the myrrh, first with the carbonate of sodium, and afterwards with the sulphate of iron, until they are thoroughly mixed; then beat them with syrup so as to form a pilular mass, to be divided into twenty-four pills. *U. S.*

By the reaction between the iron and sodium salts, ferrous carbonate is formed, which, though an unstable compound when in contact with the air, is prevented to a considerable extent from becoming oxidized, except on the surface of the pills.

Pills of similar composition, but without myrrh, are used in Europe under the name of *Blaud's ferruginous pills.* Made according to the French Codex, 20 pills contain 3 grams each of exsiccated ferrous sulphate and carbonate of potassium. The ingredients may be triturated with 0.5 gram of powdered tragacanth, and, with a little honey, beaten into a good pill mass.

Medical Action and Uses.—These pills, each of which contains less than a grain of oxide of iron and a grain and a half of myrrh, are supposed to be peculiarly adapted to the treatment of *amenorrhœa* and of other conditions requiring the use of a reconstituent and stimulant medicine. They are intended to represent, in a more convenient form, the compound iron mixture; but clinical observation does not show their equality with that efficient medicine. From two to six pills may be given at a *dose*, two or three times a day.

PILULÆ FERRI IODIDI, *U. S.*, *Br.*—PILLS OF IODIDE OF IRON.

Pilules d'iodure de fer, *P. de Blancard*, Fr.; *Eisenjodür-Pillen*, G.

Preparation.—Take of Iodine three hundred grains; Iron in the form of wire and cut in pieces one hundred and twenty grains; Sugar in fine powder, Liquorice Root in fine powder, each one hundred and ninety-two grains; Liquorice in fine powder, Gum Arabic in fine powder, each forty-eight grains; Reduced Iron ninety-six grains; Water a fluidounce and a half. Mix the iodine with ten fluidrachms of the water in a glass flask, and gradually add the iron, agitate until the solution has become of a light pea-green color; filter into a porcelain capsule containing the reduced iron, and add the remainder of the water in order to wash the filter. Evaporate the solution until a pellicle forms, and add the remaining powders previously mixed together; continue the evaporation, by means of a water-bath, with constant stirring, until reduced to a pilular consistence, and divide into three hundred and eighty-four pills.

Dissolve sixty grains of Balsam of Tolu in a fluidrachm of Ether, shake the pills with the solution until they are uniformly coated, and put them on a plate to dry, occasionally stirring them until the drying is completed. Lastly, keep the pills in a well-stopped bottle. *U. S.*

Take of Fine Iron Wire forty grains; Iodine eighty grains; Refined Sugar in powder seventy grains; Liquorice Root in powder one hundred and forty grains; Distilled Water fifty minims. Agitate the iron with the iodine and the water in a strong stoppered ounce phial until the froth becomes white. Pour the fluid upon the sugar in a mortar, triturate briskly, and gradually add the liquorice. *Br.*

Each pill of the French Codex represents 0.04 of iodine and (nearly) 0.05 gram of ferrous iodide; is rolled in powdered iron, and afterwards coated with tolu. The pills of the United States Pharmacopœia represent nearly one grain of ferrous iodide; the formula of the latter authority would be much improved if the sugar was added to the solution of ferrous iodide before evaporation (see page 622). The powdered iron incorporated in the mass prevents the decomposition of the ferrous iodide.

Medical Action and Uses.—Each pill contains about a grain of iodide of iron and one-fifth of a grain of reduced iron, and may be used for the purposes to which iodide of iron in other forms is applied. These pills are reported to be useful in *anæmia* and the *scrofulous* or *tuberculous* diathesis; but the opinion is founded rather on hypothetical notions than upon a clinical basis. In point of fact glandular scrofula and pulmonary tuberculosis are neither identical nor closely allied, and while iodine and iron are both useful in the former, they are usually injurious in the latter, except when iron is demanded by the anæmic state of the system; but neither of them touches the root of the disease.

PILULÆ GALBANI COMPOSITÆ, *U. S.*—COMPOUND PILLS OF GALBANUM.

Pilula assafœtidæ composita, Br.—*Compound pill of asafetida*, E.; *Pilules de galbanum composées*, Fr.; *Galbanum-Pillen*, G.

Preparation.—Take of Galbanum, Myrrh, each thirty-six grains; Asafetida twelve grains; Syrup a sufficient quantity. Beat them together so as to form a pilular mass, to be divided into twenty-four pills. *U. S.*

Take of Asafetida, Galbanum, Myrrh, of each two ounces; Treacle by weight one ounce. Heat all together by means of a water bath, and stir the mass until it assumes a uniform consistence. *Br.*

A similar pill was formerly officinal in France as *Pilules antihystériques.*

Medical Action and Uses.—The ingredients of this compound render it more or less stimulant to the mucous membrane, and especially appropriate in chronic *pulmonary catarrh* and *uterine leucorrhœa.* It is also used in functional nervous disorders, especially of a hysterical nature. *Dose* from five to twenty grains, or from two to four pills.

PILULÆ HYDRARGYRI, *U. S.*—PILLS OF MERCURY.

Pilula hydrargyri, Br.; *Pilulæ cæruleæ; Massa cærulea.—Blue pills, blue mass,* E.; *Pilule de mercure, P. bleues,* Fr.; *Mercurial-Pillen,* G.

Preparation.—Take of Mercury three hundred and eighty-four grains; Confection of Rose five hundred and seventy-six grains; Liquorice Root in fine powder one hundred and ninety-two grains. Rub the mercury with the confection until the globules cease to be visible; then add the liquorice root, and beat the whole into a pilular mass, to be divided into three hundred and eighty-four pills. *U. S.*

Take of Mercury two ounces; Confection of Roses three ounces; Liquorice Root in fine powder one ounce. Rub the mercury with the confection of roses until metallic globules are no longer visible; then add the liquorice, and mix the whole well together. *Br.*

The pills of the French Codex represent 0.05 gram (¾ grain) of mercury each.

The Pharmacopœias recognize blue mass of such a strength that it represents one-third of its weight of mercury. The extinction of the mercury is very much facilitated, if, instead of following the manipulation of the Pharmacopœia, the finely powdered liquorice root is triturated with the mercury and 72 grains of honey; 96 grains of rose-water are gradually added, and the trituration is continued until globules of mercury are no longer visible even on pressing a small portion of the mass upon paper; 360 grains of sugar and 48 grains of finely powdered rose leaves are added, and the whole rubbed together until a uniform mass is obtained. Should the mixture become too dry, a little distilled water may be added, and, after the incorporation has been completed, allowed to evaporate again spontaneously. Proceeding in the manner indicated, no difficulty will be experienced in preparing, in a short time, a supply sufficient to last for several months, and strictly identical with the requirements of the Pharmacopœia.

Blue mass or blue pill is not unfrequently ordered in powders, but is unsuited for the purpose unless mixed with other absorbent powders. It may, however, be readily obtained in the state of a permanent powder having the same relative composition as the pill mass, by substituting in the above directions, for the honey and rose water, an equal weight of milk sugar, using a drop of oil of roses to impart the requisite flavor, and keeping the mixture moist by the addition of alcohol; after a uniform mass has been obtained, it is spread out to allow the alcohol to evaporate spontaneously, after which it may be reduced to a permanent powder.

When properly prepared, blue mass contains metallic mercury in the state of very fine division. It is not impossible that when kept on hand for a long time, a change, due to the partial oxidation of mercury, may gradually take place. Such a change, however, could only be very superficial, since the metal is well protected by the other ingredients of the pill mass.

Medical Action and Uses.—Pills of mercury, or blue pills, differ from all other preparations of the metal in being less irritating to the stomach and bowels, and therefore less apt than they to act as cathartics; but, for this reason probably, they are also more likely to form combinations in the primæ viæ, which are readily absorbed, and produce the constitutional effects of the medicine. These effects are, therefore, very commonly sought to be induced by the medicine in question, given in doses of three grains or less, repeated two or three times a day until the characteristic soreness of the gums is observed. If it tends to operate as a laxative it is usually associated with a quarter of a grain of opium, or less, in each pill, or the mercurial is repeated at intervals of an hour or two in doses of a third or a quarter of a grain. When it is desired to excite by means of this mercurial the gastro-intestinal secretions, and those of the *liver* and *pancreas*, a dose of from three to six grains is administered at night, and is followed the next morning by a saline or senna draught, or other analogous cathartic. Whether the mercury does or does not specifically promote the secretions of the glands referred to is a question still undetermined, and which is discussed elsewhere (see Hydrargyrum).

PILULA IPECACUANHÆ CUM SCILLA, *Br.*—PILL OF IPECACUANHA AND SQUILL.

Preparation.—Take of Compound Powder of Ipecacuanha three ounces; Squill in powder, Ammoniacum in powder, each one ounce; Treacle a sufficiency. Mix the powders, and beat into a mass with the treacle. *Br.*

Medical Action and Uses.—The presumed effect of this pill is to mitigate *bronchitis* in its chronic and especially its senile forms, by a combined sedative and stimulant action. There can be no question of its utility in many cases for which the balsams and terebinthinates are too stimulating. *Dose*, from five to ten grains.

PILULÆ OPII, *U. S.*—PILLS OF OPIUM.

Pilules d'opium, Fr.; *Opiumpillen*, G.

Preparation.—Take of opium in fine powder twenty-four grains; Soap in fine powder six grains. Beat them together with water so as to form a pilular mass, to be divided into twenty-four pills. *U. S.*

Medical Action and Uses.—Very often opium in substance is more suitable than any of its liquid preparations or than the salts of morphia. This is especially the case when it is desirable to limit the action of the medicine, as far as possible, to the *stomach* and *bowels*, in painful affections of those viscera, and in cases of *vomiting* and *purging*, such as occur in *cholera morbus*, *ulcer of the stomach*, *gastralgia*, *typhoid fever*, etc. In most of these diseases the efficiency of the medicine is increased by its slow solution, and hence, in them, an old opium pill is greatly preferable to a freshly made one. One pill may be given for a *dose*, and repeated if necessary.

PILULA PHOSPHORI, *Br. Add.*—PHOSPHORUS PILL.

Pilules phosphorées, Fr.; *Phosphorpillen*, G.

Preparation.—Take of Phosphorus two grains; Balsam of Tolu one hundred and twenty grains; Yellow Wax sixty grains. Put the phosphorus and balsam of tolu into a Wedgewood mortar about half full of hot water, and when the phosphorus has melted and the balsam has become sufficiently soft, rub them together beneath the surface of the water until no particles of phosphorus are visible, the temperature of the water being maintained at or near to 140° F.; add now the wax, and as it softens mix it thoroughly with the other ingredients. Allow the mass to cool without being exposed to the air, and keep it in a bottle immersed in cold water. It may be softened with a few drops of rectified spirit when made into pills. *Br.*

Tolu as a vehicle for phosphorus in pills was proposed by A. C. Abraham (1874), who observed that it will retain 4 per cent. of the latter if combined with it in the melted condition. A. W. Gerrard (1873) had previously made a similar observation with regard to rosin, and this preparation became known at the time as *phosphoretted resin;* it is prepared by melting the resin in a wide-mouth vial, adding the requisite quantity of phosphorus, and when it has melted, agitating the stoppered vial until the phosphorus is dissolved. Like resin, it may be powdered, and like the officinal pill mass it should be kept under water to prevent oxidation. W. H. Walling (1875) found cacao butter very serviceable; three hundred grains of it are melted in a vial, twenty-five grains of phosphorus are added, the vial is corked and well agitated until solution has been effected, and afterwards with two hundred grains of powdered soap until a uniform mixture is obtained. E. Lilly (1876) suggested fusing six parts of phosphorus under two hundred and sixty parts of syrup, agitating well to effect its fine division, and incorporating with three hundred and forty parts of flour. W. B. Addington (1875) proposed to dissolve the phosphorus in sufficient bisulphide of carbon, and to incorporate the solution in a mortar with a suitable extract, continuing the trituration until the solvent has evaporated. The extract may be replaced by soap, resin, or other suitable material. This process is convenient for the extemporaneous preparation of phosphorus pills.

Medical Action and Uses.—This is one of the forms in which phosphorus may be prescribed internally. *Dose,* from three to six grains.

PILULA PLUMBI CUM OPIO, *Br.*—PILL OF LEAD AND OPIUM.

Preparation.—Take of Acetate of Lead in fine powder thirty-six grains; Opium in powder six grains; Confection of Roses six grains. Beat them into a uniform mass. *Br.*

Medical Action and Uses.—Two and a half grains of acetate of lead and one-eighth of a grain of opium are contained in every three grains of this mass. The association of the two medicines is of great value in chronic *diarrhœa, dysentery,* and *bronchitis,* but as the proportion in which they ought to be employed should vary in almost every case, a fixed formula for their union appears superfluous. *Dose,* from three to five grains.

PILULÆ QUINIÆ SULPHATIS, *U. S.*—PILLS OF SULPHATE OF QUINIA.

Pilula quiniæ, Br.—*Pill of quinia,* E.; *Pilules de quinine,* Fr.; *Chininpillen,* G.

Preparation.—Take of Sulphate of Quinia twenty-four grains; Clarified Honey sufficiently inspissated fourteen grains. Add the honey to the sulphate of quinia, and beat them together so as to form a pilular mass, to be divided into twenty-four pills. *U. S.*

Take of Sulphate of Quinia sixty grains; Confection of Hips twenty grains. Mix them to a uniform mass. *Br.*

Quinia pills are readily made extemporaneously by either formula, but will be colored. Since they are usually desired white, the mass is often made with simple syrup or glycerin, using at the same time a minute quantity of powdered acacia or tragacanth; or glycerite of starch is employed as an excipient. Sulphate of quinia may also be made into pills by the aid of aromatic sulphuric acid, of which 12 to 15 drops are required for 20 grains of the salt, as proposed by Parrish (1853). The mixture is at first quite soft, but soon becomes plastic, and may then be rapidly rolled out and divided; the previous addition of one or two drops of syrup will keep it soft for a short time. Other dilute acids, except acetic acid, may be substituted for the sulphuric acid, or, if solid, like citric and tartaric acids, may be incorporated with about five or ten times their weight of the salt in the dry state, and formed into a mass by the addition of a liquid.

Medical Action and Uses.—Pills of sulphate of quinia are not, generally, as efficient as liquid preparations of the salt, particularly if they have become hardened by age. The use of the disulphate obviates this objection partially. These pills are better adapted for securing the tonic than the antiperiodic or febrifuge operation of quinia. They should be taken either immediately before or after a meal, especially when the stomach is irritable. The ordinary *dose* is one pill, containing one grain of the sulphate.

PILULÆ RHEI, *U. S.*—PILLS OF RHUBARB.

Pilules de rhubarbe, Fr.; *Rhabarberpillen*, G.

Preparation.—Take of Rhubarb in fine powder seventy-two grains; Soap in fine powder twenty-four grains. Beat them together with water so as to form a pilular mass, to be divided into twenty-four pills. *U. S.*

Soap is an excellent excipient for rhubarb and many other powders.

Medical Action and Uses.—One of these pills, containing three grains of rhubarb, acts as a mild laxative, especially when taken after a meal, or at bedtime, unless the constipation be very decided. They are generally prescribed to relieve slowness of defecation rather than actual constipation. *Dose*, from one to three pills.

PILULÆ RHEI COMPOSITÆ, *U. S.*, *Br.*—COMPOUND PILLS OF RHUBARB.

Compound rhubarb pill, E.; *Pilules de rhubarbe composées*, Fr.; *Rhabarber und Aloepillen*, G.

Preparation.—Take of Rhubarb in fine powder forty-eight grains; Socotrine Aloes in fine powder thirty-six grains; Myrrh in fine powder twenty-four grains; Oil of Peppermint three minims. Beat them together with water so as to form a pilular mass, to be divided into twenty-four pills. *U. S.*

Take of Rhubarb Root in powder three ounces; Socotrine Aloes in powder two and one-quarter ounces; Myrrh in powder, Hard Soap in powder, each one and a half ounce; Oil of Peppermint one and a half fluidrachm; Treacle by weight four ounces. Mix the powders with the oil, then add the treacle, and beat the whole into a uniform mass. *Br.*

Medical Action and Uses.—Compound pills of rhubarb are among the best medicines for the relief of habitual *costiveness* depending upon atony of the large intestine and flatulent dyspepsia. *Flatulence*, whether gastric or intestinal, is a serious hindrance to the proper movements of the muscular walls of the digestive canal, and tends to hinder the progress of the alimentary or fecal mass, and to increase its fermentation, with the production of gas or of the acid and irritating products of decomposition. Such results are more or less prevented by the stimulating operation of medicines of which these pills are an example. *Dose*, from one to four pills.

PILULA SAPONIS COMPOSITA, *U. S.*, *Br.*—COMPOUND PILL OF SOAP.

Pilula opii, Br. 1864.

Preparation.—Take of Opium in fine powder sixty grains; Soap in fine powder half a troyounce. Beat them together with water so as to form a pilular mass. *U. S.*

Take of Opium in powder one-half ounce; Hard Soap in powder two ounces; Distilled Water a sufficiency. Mix the opium and soap, and beat into a mass with the water. *Br.*

Medical Action and Uses.—This preparation contains one grain of opium in five of the mass. Its merit is supposed to consist in its ready solubility in the gastric juices, and in its being a convenient vehicle for prescribing opium under another name. *Dose*, from three to five grains.

PILULA SCAMMONII COMPOSITA, *Br. Add.*—COMPOUND SCAMMONY PILL.

Pilules de scammonée composées, Fr.; *Scammoniumpillen*, G.

Preparation.—Take of Resin of Scammony, Resin of Jalap, Curd Soap in powder, each one ounce; Strong Tincture of Ginger one fluidounce; Rectified Spirit two fluidounces. Add the spirit and tincture to the soap and resins, and dissolve with the aid of a gentle heat; then evaporate the spirit by the heat of a water-bath until the mass has acquired a suitable consistence for forming pills. *Br.*

The process adopted furnishes a very good pill mass, in which the resins are uniformly divided through the agency of the soap, which also keeps them in suspension when the mass is macerated with water. A similar preparation, which does not contain scammony, has been in use for a long time in continental Europe (see Resina jalapæ).

Medical Action and Uses.—In this preparation the compound powder of scammony assumes a pilular form. It may be prescribed when drastic purgation is required in *dropsy*, *congestion of the brain* or *liver*, etc. *Dose*, from five to fifteen grains.

PILULÆ SCILLÆ COMPOSITÆ, *U. S.*, *Br.*—COMPOUND PILLS OF SQUILL.

Pilula scillæ composita.—Compound squill pill, E.; *Pilules de scille composées*, Fr.; *Meerzwiebelpillen*, G.

Preparation.—Take of Squill in fine powder twelve grains; Ginger in fine powder, Ammoniac in fine powder, each twenty-four grains; Soap in fine powder thirty-six grains; Syrup a sufficient quantity. Mix the powders; then beat them with syrup so as to form a pilular mass, to be divided into twenty-four pills. *U. S.*

Take of Squill in powder one and one-quarter ounce; Ginger in powder, Ammoniac in powder, Hard Soap in powder, each one ounce; Treacle by weight two ounces, or a sufficiency. Mix the powders, add the treacle, and beat into a uniform mass. *Br.*

Medical Action and Uses.—The stimulant action of these pills upon the bronchial mucous membrane makes them appropriate in the treatment of *chronic bronchitis* when it is attended with excessive secretion. The ginger in the compound probably renders it less hurtful to the stomach than it would be without that ingredient. *Dose*, two pills two or three times a day.

PIMENTA, *U.S.*, *Br.*—PIMENTO.

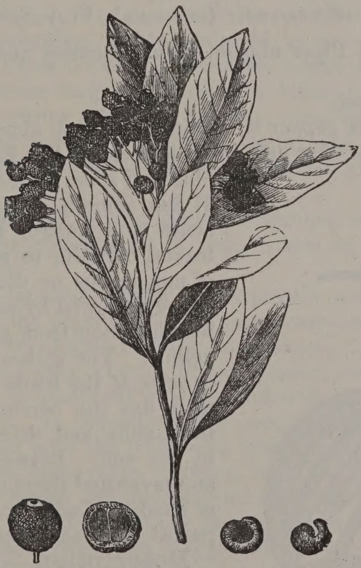
Semen amomi, *Piper jamaicense.*—*Allspice*, E.; *Piment de la Jamaique*, *Toute-épice*, Fr.; *Nelkenpfeffer*, *Englisches Gewürz*, *Neugewürz*, G.

The unripe berries of Eugenia pimenta, *D. C.*, s. Myrtus pimenta, *Lin.*, s. Pimenta officinalis, *Lindl.*, s. P. vulgaris, *Wight and Arn.* Bentley and Trimen, Med. Plants, 111.

Nat. Ord.—Myrtaceæ.

Origin.—The allspice tree is indigenous to the West Indies, Central America, and the northern part of South America, and has been introduced into other tropical countries. It is slender, about 30 feet high, has opposite, entire, oblong or oval oblong, obtuse, and pellucid punctate leaves, and small white racemose flowers, the terminal ones being sessile, and the lateral ones peduncled. The fruit is collected before it is ripe, but after it has attained its full size. From one to one and a fourth million pounds of allspice are annually imported into the United States.

Fig. 138.



Pimenta officinalis, *Lindl.*

Description.—Allspice is nearly globular, ¼ inch or less in diameter, and crowned above with the short four-parted calyx limb, or marked by its remnants which surround a shallow depression containing a short style. The pericarp is of a reddish-brown or brown-gray color, and a granular appearance externally, lighter internally, woody, but thin and fragile, and contains numerous oil cells. The berry has two cells, each with a single brown, plano-convex, roundish-reniform seed, inclosing the spirally curved, dark purplish-brown embryo. Allspice has an agreeable pungently aromatic odor and taste with a flavor resembling that of cloves.

Constituents.—The most important constituent is the volatile oil (see Oleum pimentæ, p. 988), of which the fruit yields 3 to 4 per cent. Bonastre (1826) examined the fruit deprived of the seeds, and the latter separately, and obtained from them 10 and 5 per cent. respectively of volatile oil; they also contain resin, tannin, fixed oil, sugar, mucilage, etc.

Off. Prep.—Aqua pimentæ, Syrupus rhamni, *Br.*

Medical Action and Uses.—Pimento is an aromatic stimulant, and, like other agents of its class containing an essential oil, is used as a condiment to stimulate the digestive organs when they are suffering from exhaustion, and particularly from the debility caused by the prolonged heat of summer in tropical regions. In medical practice it is chiefly employed to relieve *flatulence*, to augment the effect of vegetable tonics, and to correct the tendency of purgatives to produce griping, or to cover the nauseous taste of certain medicines. It may be given in infusion; but the oil is more generally used.

PIPER, *U. S.*—BLACK PEPPER.

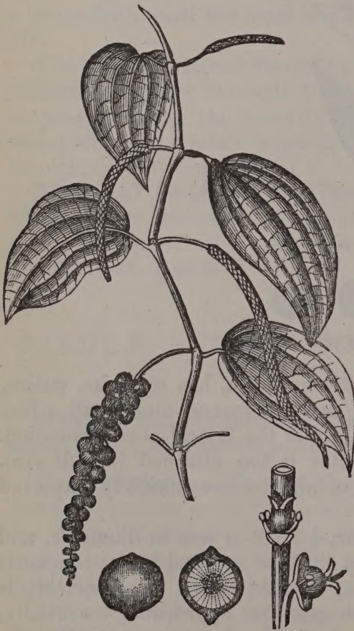
Piper nigrum, Br.—*Poivre noir* (*commun*), Fr.; *Schwarzer Pfeffer*, G.

The unripe berries of Piper nigrum, *Lin.* Bentley and Trimen, Med. Plants, 245.

Nat. Ord.—Piperaceæ.

Origin.—The black pepper is a climbing shrub about 20 feet high, indigenous to India, and at present cultivated in most of the East Indian and Philippine and some of the West Indian Islands. It has smooth, alternate, petiolate, ovate, acute and entire, five- or seven-nerved leaves, opposite to which elongated spikes of monœcious or diœcious flowers are produced, followed by sessile, berry-like fruits, which change from green to red and finally yellow. The spikes are gathered as soon as some of the fruits begin to turn red; the next day the berries are rubbed off with the hands, and dried either near a fire or in the sun. Between seven and one-half and seven and three-quarters million pounds of black and white pepper are annually imported into the United States.

Fig. 139.



Piper nigrum, *Lin.*

Description.—Black pepper is globular, about $\frac{1}{6}$ inch in diameter, reticulately wrinkled on the surface from the dried and contracted thin sarcocarp, blackish-brown or grayish-black externally, lighter colored internally, and incloses a single globular seed, which is whitish, mealy, and contains an undeveloped embryo in a central cavity. Pepper has a peculiar aromatic odor and a hot and pungent taste.

Constituents.—Black pepper was examined by Oersted (1819), who announced the discovery of piperina; and about the same time by Pelletier and Poutet, who recognized the presence of volatile oil, acrid resin, starch, gum, etc. Willert (1817) ascribed the acrid taste to the soft resin, which conclusion was corroborated by Pelletier. Lecanu obtained 1.17 per cent. of volatile oil from black, and 1.04 per cent. from white pepper. *Oil of pepper* is colorless, lighter than water, commences to boil at 167.5° C. (333.5° F.), and was found by Dumas (1835) to be isomeric with oil of turpentine. It has the odor of pepper, but is destitute of its pungent taste, and yields with dry hydrochloric acid gas a liquid compound.

Piperina, $C_{17}H_{19}NO_3$, is obtained from the alcoholic extract of pepper, by treating it with potassa solution, which dissolves the resin, washing the residue with water, and purifying it by repeated crystallization from alcohol. On neutralizing the potassa solution with an acid, the pungent resin is obtained. Piperina forms colorless, four-sided, flat prisms, which are inodorous and nearly tasteless, but in alcoholic solution have a sharp peppery taste. It fuses by heat like wax, has a neutral reaction to test-paper, is nearly insoluble in water, and dissolves in volatile oils, in 60 parts of cold ether (Merck), in 30 parts of cold alcohol (Wittstein), and freely in acetic acid; the last two solutions are precipitated on the addition of water. Sulphuric acid colors it blood-red, and with nitric acid it becomes yellow, orange, and red. It is a weak base, but when boiled with alcoholic solution of potassa was found by Babo and Keller (1856) to be resolved into *piperic acid*, $C_{12}H_{10}O_4$, and *piperidina*, $C_5H_{11}N$. Piperic acid is in hair-like yellowish needles, which fuse at 150° C. (302° F.), and at a higher temperature volatilize partly unaltered, at the same time giving off a coumarin-like odor. Piperidina is a colorless liquid of an ammoniacal and pepper-like odor, and when largely diluted of a bitter taste. It boils at 106° C. (222.8° F.), has a strong alkaline reaction, dissolves freely in water and alcohol, and yields with acids crystallizable salts; the piperate of piperidina crystallizes in silky scales, which, on being heated, give off a part of the alkaloid.

The *pungent resin* is dark green, soluble in alcohol, ether, and alkalies, and in connection with other constituents of pepper, also in water. Pepper yields about 5 per cent. of ash.

Adulterations.—Ground pepper is frequently adulterated with various farinaceous substances, the press-cake of flaxseed, capsicum, and other materials. The adulterations may be detected by the microscope.

Other Peppers.—PIPER ALBUM, *White pepper*, consists of the ripe fruit of black pepper, which is immersed in water and with the hands deprived of the pericarp and sarcocarp. It consists of the seed, which has a reddish-brown testa, and this is covered with the white soft inner tissue of the fruit, in which about ten light lines are observable, running from the base towards the apex. White pepper is rather larger and less pungent than black pepper, but contains the same constituents. A factitious white pepper is said to have been sometimes put into the market, made from black pepper by rubbing off the outer layers; it is easily recognized by its smaller size and larger central cavity.

PIPER LONGUM, *Long pepper*, consists of the spikes of Piper (Chavica, *Miq.*) officinarum, *C. D. C.*, which is indigenous to Java. The nearly allied Piper longum, *Lin.*, s. Chavica Roxburghii, *Miq.*, is likewise a shrub, but is found in India, Ceylon, and the Philippines. The spikes of the full-grown but still immature fruits are collected; they are 1 to 1½ inch long, nearly cylindrical, covered with the closely-packed coalesced fruits, and agree with black pepper in odor, taste, and composition.

That the fruit of Cubeba Clusii, *Miq.*, contains piperina, has been mentioned on page 473.

Off. Prep.—Confectio piperis, *Br.;* Oleores. piperis, *U. S.*, *Br.;* Pulv. opii comp., *Br.*

Medical Action and Uses.—Pepper is a powerful local and general stimulant, a quality which it owes to its concrete and volatile oils, and it also probably exerts a special and more sustained influence upon the nervous system through its peculiar principle, piperin. Applied to the skin, powdered pepper occasions severe pain and redness; in the mouth and throat, in large quantities, it excites intense burning; and in the stomach a sense of diffusive warmth with some acceleration of the pulse. In very large doses, it excites a burning heat throughout the abdomen, thirst and vomiting, sometimes fever, and occasionally convulsions. In some cases, heat and tingling are felt in the palms of the hands and in the soles of the feet, followed by a sense of coolness in these parts. It augments the urine, and irritates the bladder and urethra; and it may produce a transient eruption of urticaria upon the skin.

Black pepper is, of all condiments, except salt, the most extensively used, to facilitate the digestion of soups and watery vegetables. Anciently, it was one of the most approved remedies for *intermittent fever*, and in modern times a large number of examples attest its efficacy, both in the form of the crude drug and as piperin. There can be no doubt that in many cases it has effected complete cures; but it is more generally employed in connection with quinia when the latter has failed, and often with marked advantage. Whether its efficiency is due to its own antiperiodic properties, or to its rendering the system more susceptible to the action of quinia, is undecided. Pepper is sometimes used in poultices to promote the resolution of enlarged *lymphatic glands;* in gargles to stimulate the *throat* and *gums* in flaccid conditions of these parts; and in plasters for the relief of *muscular rheumatism*, and to assuage *headache*, *colic*, and other local pains. In powder it has been used to destroy *head-lice.* Anciently, it was employed as a topical application to *hæmorrhoids*, and in recent times the confection of pepper has been used internally for a like purpose. In some cases of *fistula in ano*, of *gleet*, and of *leucorrhœa*, it has been found very serviceable.

Powdered pepper may be given as a stomachic stimulant in *doses* of from five to twenty grains, or as a condiment mixed with food. As an antiperiodic, eight or ten pepper-corns may be taken two or three times a day. The *dose* of piperin is from one to ten grains.

PIX BURGUNDICA, *U. S.*, *Br.*—Burgundy Pitch.

Poix de Bourgogne, *Poix blanche*, Fr.; *Burgunder Harz* (*Pech*), G.

The prepared resinous exudation from the spruce fir, Abies excelsa, *D. C.*, s. Pinus abies, *Lin.* Woodv., Med. Bot., pl. 208.

Nat. Ord.—Coniferæ.

Origin.—The *spruce fir*, or *Norway spruce fir*, is a stately tree attaining a height of 150 to 180 feet, and growing in Northern Asia and Northern Europe, and in the latter continent southward in mountainous regions to the Pyrenees and Alps; it is frequently cultivated in the United States. It has spreading, nearly horizontal branches, pendulous branchlets, scattered, somewhat four-angled leaves, about ¾ inch long, and pendulous light brown nearly cylindrical cones, which are from 6 to 8 inches in length.

Collection.—The oleoresinous exudation of the spruce fir, which flows from incisions, is collected in Finland, Southwestern Germany, Austria, and Switzerland, and is melted in water and strained. That collected in some districts of the Bernese Jura is known in commerce as *poix blanche.* (*Pharmacographia.*) During the year 1877–1878, 68,851 pounds of Burgundy pitch entered the United States.

Description.—Burgundy pitch is thus described by the British Pharmacopœia: "Hard and brittle, yet gradually taking the form of the vessel in which it is kept; opaque, varying in color, but generally dull reddish-brown; of a peculiar, somewhat empyreumatic perfumed odor and aromatic taste, without bitterness; free from vesicles; gives off no water when heated." The following additional characters of true Burgundy pitch were ascertained by Hanbury (1867): "Fracture shining, conchoidal, translucent; some samples contain much water and are opaque and of a dull gray color, and require straining to free them from impurities; not wholly soluble in alcohol of .838, but leaves a small amount of white flocculent matter; placed in contact with double its weight of glacial acetic acid in a vial, it is dissolved with the exception of a small amount of flocculent matter."

Constituents.—Burgundy pitch contains *volatile oil*, which is most likely isomeric with oil of turpentine, and *resin*, which probably consists mainly of Maly's *abietic acid.* (See Terebinthina.)

Adulterations and Substitutions.—The German Pharmacopœia recognizes the product of *various* species of Abies, which are not enumerated, under the designations *Resina pini*, *Resina pini burgundica*, and *Pix alba*, and gives the following description: "It is a yellow or yellowish-brown, opaque, or diaphanous, fragile resin, having a glossy fracture, becoming soft when held in the hand, of a terebinthinate odor, and almost completely soluble in alcohol."

The substance commonly sold in England is made by melting together colophony with palm oil or some other fat, water being stirred in to render the mixture opaque. (*Pharmacographia.*) Hanbury has described artificial Burgundy pitch as varying in color between tawny yellow, orange-yellow, and orange-brown. The fracture is wax-like, or shining, or conchoidal, always opaque, but becoming gradually transparent on the surface by the loss of water; the odor is weak, terebinthinous, and hardly aromatic; it is less soluble in alcohol of .838, and with glacial acetic acid forms a turbid mixture, which soon separates into two layers—a thick oily liquid above and a bright solution below.

Off. Prep.—Emplast. antimonii, *U. S.;* Empl. ferri, *U. S.*, *Br.;* Empl. galbani comp., Empl. opii, *U. S.;* Empl. picis, *Br.;* Empl. picis burgundicæ, Empl. picis c. cantharide, *U. S.*

Medical Action and Uses.—Applied to the skin as a plaster it produces itching, redness, and a papular eruption, and upon a delicate integument may occasion a vesicular and even a pustular eruption with superficial ulcers. This eruption has been attributed to the retention by the impermeable plaster of the cutaneous secretions, but the better opinion is that the effect depends upon the inherent properties of the resin.

In the form of a plaster Burgundy pitch is in general use to protect, sustain, or stimulate the part to which it is applied. In most cases these several objects are attained together. Thus in the popular use of it as a remedy for *lumbago*, particularly, but of other forms also of *muscular rheumatism*, it supports the part mechanically, protects it from external impressions, and stimulates it to the production of perspiration, or even to the formation of an eruption, as already mentioned. In the latter way it acts revulsively upon the deeper seated parts, and is habitually used to relieve internal congestions and diminish secretions, as in *chronic bronchitis* and chronic *pulmonary tuberculosis.* In chronic and in subacute *pleurisy* its counter-irritant action is resorted to for promoting absorption of the effusion. In these several affections it, also, if applied in a plaster of proper dimensions, gives to the chest a greatly needed mechanical support during the act of coughing. Some obstinate cases of *sciatica* have been cured by enveloping the buttock and thigh in a Burgundy pitch plaster, and leaving it permanently in place. In like manner this plaster has been used to relieve chronic *diarrhœa* following dysentery, etc., but this cannot conveniently be done when the abdomen is prominent or flaccid.

Before applying a plaster of this sort to a hairy skin, the hair should be shaved off; and in removing the plaster from such a part it should first be softened by passing lightly over its free surface a bottle of hot water or a warm flat-iron. The portion of pitch which still adheres may be partially removed by pressing upon it a linen or muslin rag, to which the adhesive material will cling rather than to the skin itself, and the remainder may be washed off with alcohol.

PIX CANADENSIS, *U.S.*—CANADA PITCH.

Hemlock pitch.

The prepared resinous exudation from Abies canadensis, *Mich.*, s. Pinus canadensis, *Lin.*

Nat. Ord.—Coniferæ.

Origin.—The *hemlock-spruce* is a common forest tree of Canada and the Northern United States, but is more rare further south, where it grows principally in the Alleghanies. It attains a height of sixty or eighty feet, has horizontal branches, the young ones drooping; has flat, obtuse, somewhat denticulate, and on the lower surface glaucous leaves, and elliptic-ovate cones about an inch in length. The bark is very astringent, and by treatment with water furnishes an extract which is largely employed in tanning, under the name of *extract of hemlock bark.* By distilling the branches with water, a volatile oil is obtained, which is sold as *oil of spruce* or *oil of hemlock;* eight pounds of the boughs yield about one ounce of oil. (Stearns, 1858.)

Collection.—According to Stearns, there are two methods of collecting Canada pitch; one of which consists in cutting cup-like incisions into the living tree, and removing the soft oleoresin as it exudes; the other and most common one is to remove the wood and bark around the knobs or knots of the felled trees, which are rich in resin; these being placed in water in a large kettle, the resin is boiled out, and rising upon the top is skimmed off, and further purified by remelting and straining.

Description.—Canada pitch is found in the market in opaque reddish-brown masses, which gradually become translucent on the surface. It is brittle at the ordinary temperature, but usually takes the form of the vessel in which it is kept; it is of a somewhat lighter color internally, breaks with a shallow conchoidal fracture, is softened by the heat of the hand, and has a weak, somewhat terebinthinate odor.

Constituents.—It is composed of one or more resins and of a minute quantity of volatile oil, which have not yet been examined.

Adulteration.—Stearns states that Canada pitch is often adulterated by the collectors with common rosin to the extent of 70 per cent. Such an addition must render it harder and less fusible, but no test is known by which to determine the sophistication.

Off. Prep.—Emplast. picis canadensis, *U.S.*

Medical Action and Uses.—Canada pitch is almost identical with Burgundy pitch in its action and uses; but owing to its greater softness, is less convenient for making plasters. Its volatile oil, known as oil of spruce and oil of hemlock, is said to have been employed to produce abortion. There is no reason for attributing to it a specific action on the uterine system.

PIX LIQUIDA, *U.S.*, *Br.*—TAR.

Resina empyreumatica liquida.—Goudron, Goudron végétal, Fr.; *Theer*, G.

The impure turpentine from the wood of Pinus palustris, *Mill.*, and of other species of Pinus, procured by burning.

Origin.—The principal species used for the production of tar are Pinus palustris, *Mill.;* P. tæda, *Lin.;* P. rigida, *Mill.;* which grow in North America;

and P. sylvestris, *Lin.*, and Larix sibirica, *Ledebour*, indigenous to Northern Europe. Sufficient tar is produced in the United States to supply the domestic market, and leave a portion for exportation.

Preparation.—Pine wood which is unfit for use as timber is usually employed. It is cut into billets of suitable size, which are arranged into large conical stacks, or, as is sometimes the case in Europe, are closely packed in clay furnaces of a similar shape. The stacks or piles are covered with a layer of earth and ignited above, and the draft is regulated so as to sustain a slow combustion without flame. The tarry products, as they are formed, gradually descend and collect in a cavity or ditch at the base of the pile, from which they are transferred into barrels. The process is one of destructive distillation, in which, however, the pyroligneous acid and volatile oil of the wood are lost. By the use of properly constructed stills, which have been recently introduced, these products may likewise be saved (see page 17).

Description.—Tar is a thick, viscid, semi-fluid mass, heavier than water, of a deep blackish-brown color, transparent in thin layers if free from water, and has an unpleasant empyreumatic odor, and a sharp and bitter taste. On standing it usually separates a granular crystalline matter consisting of pyrocatechin, and often assumes the consistence of thick honey. It has an acid reaction, which, together with a light-brown color and sharp bitterish taste, is imparted to water agitated with it. On the application of heat, water and acetic acid distil over, together with a yellow volatile oil, which is known as *oil of tar*, is lighter than water, and, on exposure to air, rapidly turns dark brown. Tar is soluble in alcohol, ether, chloroform, fixed and volatile oils, and in caustic alkalies.

Constituents.—Tar is of a very complex composition, which varies with the kind of wood, the amount of resins present therein, and the care with which it has been prepared. It contains *acetic acid*, *aceton* (page 6), *methylic alcohol* (page 127), *mesit* $C_6H_{12}O_2$, *toluol* C_7H_8, *xylol* C_8H_{10}, *cumol* C_9H_{12}, *methol* C_9H_{12}, likewise creasote (page 465), carbolic acid (page 30), *paraffin* (page 1034), naphthalin (page 932), pyrene $C_{16}H_{10}$, chrysene $C_{18}H_{12}$, retene $C_{18}H_{18}$, and others. Of the compounds mentioned, the first series up to methol pass over with the light tar oil, which also contains Reichenbach's *eupion*, a very light oily product of low boiling point. The *heavy tar oil* contains the other compounds named, and in addition *cedriret*, *kapnomor*, *picamar*, and *pittakal*, which names were introduced by Reichenbach to designate various substances not yet obtained in a pure state. After distilling from tar the light and most of the heavy oil, a substance is left behind, which is still recognized in the German Pharmacopœia as

PIX NAVALIS, s. *Pix nigra* s. *solida*, s. *Resina pini empyreumatica;* Pitch, Black pitch, *E.;* Poix noire, *Fr.;* Schwarzes Pech, Schiffspech, G. It is a black resinous, brittle mass, which becomes soft when held in the hand, and has the odor of tar.

Pyrocatechin, $C_6H_6O_2$, is one of the products formed on the dry distillation of catechin, of the tannins, which produce green precipitates with iron salts, and from other compounds. It crystallizes in short prisms, is readily sublimable, and dissolves easily in water, alcohol, and ether. Its solution is colored dark green by ferric chloride, the color changing to violet on the addition of a little ammonia, bicarbonate of sodium, or tartaric acid. It reduces nitrate of silver at ordinary temperatures, and yields with lead acetate a white precipitate.

Off. Prep.—Glyceritum picis liqu., Infus. picis liqu., *U. S.;* Unguent. picis liquidæ, *U. S.*, *Br.*

Physiological Action.—Tar is hostile to insects, and is used successfully for destroying the acarus scabiei. Applied to the skin where it is delicate, it is apt to cause a sense of heat and irritation, and occasionally even vesication, with an erythematous redness. Internally, and in small doses, it acts as a general stimulant, although when freely given it tends to impair the appetite. In larger doses it occasions oppression, nausea, vomiting, colic, and diarrhœa, with frequency of the pulse. In excessive quantities, besides these effects it may give rise to headache, a sense of intoxication and general depression, with irritation of the kidneys, and the secretion of high-colored urine smelling strongly of tar, and giving a deposit on the addition of nitric acid. This deposit is distinguishable from albumen by its solubility in alcohol or ether. Cases are reported of fatal poisoning by tar. Tar-water in small doses is said to quicken the pulse and augment the secretion of the skin and kidneys. The vapor of tar, when inhaled, increases the normal bronchial secretion, but diminishes that which depends upon an atonic condition of the bronchia. Applied to the skin pure or in an ointment, and especially in the treatment of skin diseases, it is very apt to occasion nausea and vomiting, or diarrhœa; the discharges from the stomach and bowels have the characteristic odor of tar, and the urine the peculiar color and smell caused by tar taken internally.

Medical Uses.—Anciently tar was used as a dressing for wounds and sores, and various cutaneous eruptions in man and beast, and was administered internally as a remedy for chronic pulmonary complaints. These are the affections in which, even now, it is principally used. Tar-water is prepared by stirring one part of tar with ten parts of pure water, and allowing them to stand for several days, and then decanting the impregnated water. It has been used with the greatest advantage in *chronic bronchitis*, and in many cases of pulmonary *phthisis*, lessening the expectoration, diminishing the oppression and pain in the chest, and soothing the cough, without increasing the thirst or impairing the digestion. But when hectic symptoms are prominent it is seldom tolerated. This is true even of the treatment of these diseases by the inhalation of tar vapors, which, in the more torpid cases, is sometimes remarkably beneficial. The best mode of using tar vapors is the following: In a cup placed in a small water-bath over a common night-lamp, mix some tar with about a twenty-fourth part of its weight of carbonate of potassium, in order to neutralize the pyroligneous acid which may be present, and which would irritate the lungs. The vapors should be extricated very slowly at first, so as moderately to charge with them the air of the chamber which the patient chiefly inhabits, and afterwards they may be generated more freely. Quite as beneficial, and more convenient and agreeable, is the inhalation of tar-water, and even of wine of tar, from a steam-atomizer.

Of other internal uses of tar may be mentioned that of tar pills for the relief of *constipation;* the use of tar-water by the mouth, and by injection, in chronic *vesical catarrh*, in *gleet*, *leucorrhœa*, *etc.*

The ancient use of tar in the treatment of *scabies* is sometimes still resorted to; but it is less certain than other methods of curing permanently, and it involves the ruin of the patient's body and bed linen. In *scaly eruptions* its efficacy is much more unequivocal, but the same objection to it exists as in the case of the disease just mentioned. Moreover, lepra and psoriasis generally get well under the use of arsenic alone. If this falls short of its purpose, tar ointment may be employed in addition. For its efficient use it is necessary that the scales upon the skin should first be removed by a warm bath; after which the tar, or its ointment, should in small quantity be rubbed into the patches of the eruption with a brush, and the patient rolled in a blanket and allowed to remain quiet for five or six hours, when the excess of the application can be removed with cloths, and the ordinary clothing resumed. In some cases of inveterate *eczema* when the skin has become dry, rough, and thick, tar ointment, or oil of tar, is a most efficient remedy, provided that its strength be duly proportioned to the sensibility of the skin. It is also useful in *herpes circinatus*, and in *prurigo.*

Tar has long been employed by the vulgar as a dressing for *excoriations*, *boils*, *scorbutic sores*, and *unhealthy ulcers* generally. Of late it has been extensively used in the form of oakum as a dressing for such lesions, especially in hospitals. It seems especially adapted for use in burns which suppurate copiously. It corrects the fetor of such sores. The oakum is applied after being moistened with water, and is covered with an impermeable tissue. Tar and tar-water have been applied to *mercurial ulcers* of the mouth and throat, and the former is an excellent application to *fissured nipples* and *hemorrhoids.* Finally, the fumes of tar are commonly used to deodorize and purify vessels, rooms, etc., tainted with foul smells, or supposed to be infected with morbid poisons.

Tar may be given mixed with milk or beer, or else in pills. From thirty grains to half an ounce may be taken daily. The glycerite of tar is a convenient form of the medicine. Tar-water may be taken to the extent of a pint or two daily.

PLUMBI ACETAS, *U. S.*, *Br.*—ACETATE OF LEAD.

Plumbum aceticum, P. G.; *Acetas plumbicus, Saccharum saturni.—Sugar of lead*, E.; *Acétate de plomb*, *Sel (Sucre) de saturne*, Fr.; *Essigsaures Bleioxyd*, *Bleizucker*, G.

Formula $Pb2C_2H_3O_2.3H_2O$. Molecular weight 379.

Preparation.—Take of Oxide of Lead in fine powder twenty-four ounces; Acetic Acid two pints, or a sufficiency; Distilled Water one pint. Mix the acetic acid and the water, add the oxide of lead, and dissolve with the aid of a gentle heat. Filter, evaporate till a pellicle forms, and set aside to crystallize, first adding a little acetic acid should the fluid not have a distinctly acid reaction. Drain and dry the crystals on filtering paper without heat. *Br.*

The process described is frequently followed on the large scale. Often, however, metallic lead is dissolved in acetic acid, which requires to be done in the presence of air, since the metal is unable to displace the hydrogen of the acid. Plates of lead are placed endwise in open vessels containing acetic acid, one-half of their length projecting above the liquid, and as fast as the metal, under these conditions, is oxidized by the oxygen of the air, it is dissolved; so that the formation of the salt in both cases is the result of the action between plumbic oxide and acetic acid, water being formed at the same time; $PbO + 2C_2H_4O_2$ yields $Pb2C_2H_3O_2 + H_2O$. To obtain handsome and well-defined crystals the solution must have a very distinct acid reaction; if it is permitted to become neutral or faintly acid, a portion of the salt forms small granular crystals agglomerated into soft cauliflower-like masses, containing perhaps a basic lead compound.

For uses in the arts, large quantities of impure acetate of lead are prepared from wood-vinegar, and vary in color from various shades of brown to pale red and white.

Properties.—Pure acetate of lead crystallizes in colorless prisms, which have an acetous odor and a sweet astringent taste. It is slightly efflorescent in the air, and on continued exposure is superficially converted into carbonate of lead. It fuses at 75.5° C. (168° F.), and congeals on cooling slowly to a radiating crystalline mass. It contains 14.2 per cent. of water of crystallization, which it loses at about 110° C. (230° F.), over sulphuric acid and by the action of absolute alcohol, crystallizing from this liquid in an anhydrous condition. It dissolves at the ordinary temperature in about two parts, at 40° C. (104° F.) in one part, and at the boiling point in a half part of water. The solution has a slight acid reaction, and if concentrated and mixed with strong alcohol gradually separates a portion of the salt in crystals. It dissolves also, though less freely, in alcohol, and is precipitated from this solution as a crystalline powder on the addition of ether. The aqueous solution acquires a red color on the addition of a little dilute solution of ferric chloride, and is precipitated by the various reagents for lead salt. (See Plumbum.)

Tests.—Acetate of lead should yield a clear solution with distilled water. A slight turbidity resulting from the presence of a little carbonate must disappear on the addition of a small quantity of acetic acid. Perfect solubility indicates the absence of sulphate and notable quantities of chloride. The aqueous solution, completely precipitated by sulphuretted hydrogen, should yield a filtrate, which is not precipitated by ammonia and sulphydrate of ammonium (zinc, etc.), or oxalic acid (calcium, barium), and it does not leave any fixed residue on being evaporated to dryness. Small quantities of copper would be indicated by the blue color of the filtrate, obtained after precipitating the solution of the salt with an excess of ammonia. Thirty-eight grains of acetate of lead dissolved in water, require for complete precipitation two hundred grain-measures of the volumetric solution of oxalic acid. *Br.*

Off. Prep.—Liq. plumbi subacetatis, *U. S.*, *Br.*; Pilula plumbi c. opio, *Br.*; Suppositoria plumbi, *U. S.*; Suppos. plumbi et opii (plumbi comp.), *U. S.*, *Br.*; Unguent. plumbi acet., *Br.*

Physiological Action. *On Animals.*—In large but not immediately poisonous doses acetate of lead occasions signs of pain, with vomiting and purging, and sooner or later death; after which the gastric mucous membrane is injected with venous blood, and covered with thick mucus. If the dose has not been sufficient to prove fatal within a few days, paralysis occurs, of the hinder and then of the fore limbs, with embarrassed and spasmodic breathing, signs of extreme distress, and death by exhaustion. Injected into the veins it destroys life with signs of pulmonary congestion and feeble action of the heart, the right cavities of which, with the lungs, are, after death, found distended with blood. After such poisoning lead may be found in the portal blood, the liver, the spleen, the urine, etc., but most of all in the bones according to some observers, in the spleen according to others. Esculent plants nourished by water from lead factories become poisonous; and animals that breathe the air of such places are apt to be affected with convulsions or paralysis.

On Man.—Locally applied a solution of acetate of lead blanches and corrugates the skin; hence it is said to be astringent. It is shown to be a cardiac sedative by its power of reducing the pulse-rate. An overdose, besides causing a sense of constriction and sweetness in the mouth, soon excites pain in the abdomen, with vomiting, and diarrhœa, which is sometimes bloody; the limbs tremble, and are affected with slight spasms or even convulsions. Sometimes there is a giddiness like that of intoxication. There may be fever, hurried respiration, and scanty urine. Recovery from acute lead poisoning is the rule, however severe the primary symptoms may be. Doses of from two to eight drachms of the acetate have been taken without injury; but sometimes also a protracted derangement of the digestion is induced, which ultimately proves fatal.

The long-continued use of medicinal doses of this salt produces a metallic taste in the mouth, tenderness and swelling of the gums, and often a bluish line where they are attached to the incisor teeth, slowness and feebleness of the pulse, colic, a sense of constriction of the trunk, and some numbness of the hands and feet. To these symptoms may be added fetid breath, looseness of the teeth, blackened feces, neuralgic pains in the legs first and then in the arms. It may be remarked, however, that these effects must be very rare indeed, since hardly any of the physicians who prescribe the medicine habitually have witnessed them. The most common evidence of chronic lead poisoning is a peculiar paralysis of the extensor muscles (not of the supinators), of the hands first, and subsequently of the legs. It has been produced by hair dyes and face powders, by lotions, ointments, plasters, etc., containing lead; in compositors by handling type; by the use of snuff, wine, beer, water, and even air impregnated with lead particles; by the use of food put up in leaden wrappers or cooked in leaden utensils, and by chewing tobacco kept in leaden wrappers. Among those who work in lead or who drink liquors impregnated with it, the most usual effect is the so-called painter's colic, which appears to be a neuralgia with spasmodic contraction of the small intestines.

Besides the paralysis of the extensor muscles, which is apt to result in their atrophy and a corresponding rigid contraction of the opposing flexors, other nervous symptoms arise from the same poison, and delirium, convulsion, or coma gives characteristic features to the attack. The delirium varies from mere wandering of the mind to maniacal violence; the convulsive attacks are generally epileptiform; and coma may either follow convulsion or occur independently of it. After death the only apparent lesion may be hypertrophy of the brain.

In many cases of chronic lead poisoning albuminuria has been observed, and lead detected in the bile and urine; in pregnancy the death of the fœtus and abortion are very apt to occur. Where paralysis has long continued the muscles and the nerves that supply them are atrophied, and sulphuret of lead has been extracted from the spinal cord after death.

Although such effects are occasionally traceable to the influence of the acetate of lead, they are in the great majority of instances due to the toxical influence of other compounds of the metal; and when the vehicle is drinking water, its effects are owing to the presence of oxide and carbonate of lead diffused in water which does not contain enough sulphuric acid, and possibly of some other substances, to precipitate them. Hence the purer the water conveyed through leaden pipes or contained in leaden cisterns, the greater is the risk of its contamination. It has been suggested that those who, while they use water impregnated with lead, partake of salt freely, are more liable than others to be poisoned, since the chloride of sodium favors the production of a soluble and therefore readily absorbed salt of lead.

When a poisonous dose of acetate of lead has been taken, sulphate of magnesium in a large quantity of water, with the addition of ipecacuanha, should be given to neutralize the poison and favor its rejection by vomiting. Afterwards the solution of sulphate of magnesium should be continued, as an antidote to whatever portion of the lead salt may have reached the intestine, and to cause its expulsion by purgation. If pain exists, it should be palliated by opiates, especially by the hypodermic injection of morphia. The ordinary treatment of lead colic consists in the methodical use of opiates and evacuants; the former hypodermically, the latter in the form of a solution of sulphate of magnesium or of sodium with tartar emetic, while large purgative enemata are repeatedly administered, and large and warm emollient cataplasms are applied to the abdomen. Instead of saline cathartics croton oil may be used. The action of purgatives may be aided, or even superseded, by that of induced electricity, which has the advantage of relieving the pain at the same time. Alum, as elsewhere stated, is a most valuable remedy in this affection, and by some is held to be superior to purgatives.

In the more chronic forms of lead-poisoning, the chief dependence must be placed upon iodide of potassium, which carries off the lead with the urine, and upon sulphurous baths, which remove it as it is eliminated from the skin, while means are taken to stimulate the paralyzed muscles by means of friction, massage, and, above all, by induced electricity. As a stimulant to the spinal centres of muscular motion, strychnia is of extreme utility. The cerebral affections produced by lead are but little under the control of any medicine except opium, which is of great value in subduing delirium in the maniacal form.

Medical Uses. *Internally.*—Among internal *styptics* which act after absorption into the blood, none is so general in its application, or certain in its effects, as acetate of lead. It is said to be more efficient in active than in passive hemorrhages; but the rule, if it be one, is not absolute. It has repeatedly and unequivocally displayed its virtues in *hæmoptysis*, not so unequivocally in *uterine hemorrhage* connected with menstruation and with parturition, and still less conspicuously, though decidedly, in hemorrhage from the *stomach*, *bowels*, and *kidneys*, in all of which cases ergot, the chlorides of iron, creasote and its congeners excel it.

The sedative action of acetate of lead upon the heart, and its power of promoting coagulation of the blood, are thought to be illustrated by cures of sacculated *aneurism* alleged to have taken place under its use; and although the evidence may not be conclusive, it is strong enough to inspire a certain degree of confidence in this plan of treatment. The same may be said of *hypertrophy of the heart*. But in the latter case the utility of the medicine is less demonstrable.

In chronic *dysentery* and *diarrhœa* acetate of lead is one of the most valuable medicines of its class, when given by the mouth and also by the rectum; and the same is true of its use in the decline of the acute form of the first-named disease. While the febrile symptoms continue, it should seldom be employed. It is best administered in doses of one or two grains, three or four times a day, associated with a grain, or less, of opium, or two or three grains of Dover's powder. In some cases of *tympanites* due to indigestion, and of the same condition during *typhoid fever*, it has afforded relief.

The astringency it manifests in the diseases already named, has been further shown in pulmonary affections with excessive secretion. It has long been in common use for diminishing the sputa in *tubercular phthisis* and *chronic bronchitis*, as well as for checking the *sweats* in both diseases. In *whooping cough* with profuse bronchial secretion it has also been used. It has been recommended as the safest and best remedial agent in *pneumonia*, and particularly as being superior to digitalis, tartar emetic, and veratrum, which may very well be, since these medicines are worse than useless in the disease.

In various nervous diseases, including *epilepsy*, *neuralgia*, *hysteria*, *chorea*, and *hysteria*, it has been alleged to be curative; but this statement is without substantial foundation, except in regard to epilepsy, but that disease has seldom been treated by acetate of lead.

Externally.—Acetate of lead has been less frequently employed than the subacetate as an astringent of external parts, yet it may be applied with advantage in lotions to *contusions*, *excoriations*, *sprains*, *fractures*, etc. It is more conveniently employed in collyria for *conjunctivitis*, both acute and chronic, and as an injection into the urethra in *gonorrhœa*, and into the vagina in *leucorrhœa*. In chronic granular *conjunctivitis* finely powdered acetate of lead has been applied to the mucous surface of the eyelids.

Administration.—As a styptic the dose of acetate of lead should be not less than two grains every hour, and generally associated with opium. As much as five grains every hour have been used successfully, and without damage, in certain cases of hemorrhage. In diarrhœal and dysenteric affections one grain, with half a grain of opium, three or four times a day, is the average dose; and for colliquative sweats two grains several hours before the usual time of appearance of the symptom.

PLUMBI CARBONAS, *U. S.*, *Br.*—CARBONATE OF LEAD.

Cerussa, P. G.; *Plumbum carbonicum*, *Carbonas plumbicus.*—*Carbonate de plomb*, *Blanc de plomb*, *Céruse*, Fr.; *Bleiweiss*, G.

Formula $2PbCO_3.PbH_2O_2$. Molecular weight 707.

Preparation.—On passing carbonic acid gas through a solution of acetate of lead, or on adding an alkaline carbonate to a solution of a neutral lead salt, a precipitate of $PbCO_3$ is obtained, which, as a pigment, has less *body* than the basic salt. The latter is obtained in two ways. One method, known as the *Dutch process*, is as follows: Cast sheets of lead are suspended in earthen pots containing a small quantity of vinegar or pyroligneous acid; a number of these pots are arranged in rows, alternating with layers of dung or spent tan, until a shed is filled, which is entirely covered with the same material. A warm and moist atmosphere, charged with carbonic acid, is thus produced in the shed, favorable for the oxidation of the metal, and its conversion by the acetic vapors into basic acetate of lead, which is decomposed by the carbonic acid, yielding white lead and neutral acetate. The latter again unites with a fresh portion of oxide, forming basic acetate of lead, which is again acted upon by the carbonic acid; and the process continues until, in the course of a few weeks, the lead is completely covered with a thick crust of white lead, which is detached, ground with water, and washed to remove acetate of lead, and dried. Various modifications of this process have been recommended, and are in use.

The other method is known as *Thénard's process*, according to which a solution of subacetate is prepared in the usual way, and carbonic acid gas passed through it, the filtrate from the precipitate being again used in the preparation of the lead solution. This process has been modified by Benson, so that levigated litharge is mixed with one or two per cent. of sugar of lead and sufficient water to form a thin paste, which, with frequent stirring, is exposed to the action of carbonic acid, until this ceases to be absorbed; it is washed with water.

Properties.—Commercial carbonate of lead is in pulverulent masses, or forms a soft, heavy, white powder, which becomes black by sulphuretted hydrogen; is insoluble in water and alcohol, but dissolves with effervescence in diluted acetic or nitric acid without leaving any residue. The solutions yield, with sulphuric acid a white, and with potassium iodide a yellow precipitate. The white precipitates occasioned in the solution by soda and potassa are soluble in an excess of the precipitant. Heated to 155° C. (311° F.), carbonate of lead parts with its water; near 180° C. (356° F.) it begins to lose carbonic acid, and when heated before the blowpipe upon charcoal it turns yellow, and yields metallic globules of lead.

Tests.—Carbonate of lead may be adulterated with the sulphates of lead, barium, or calcium, which would be left behind as a white precipitate upon treatment with dilute nitric acid. Other adulterations may be detected by treating the solution with sulphuretted hydrogen, ammonia, sulphydrate of ammonia, and oxalic acid, as described under acetate of lead (p. 1087).

Composition.—White lead is an oxycarbonate, and sometimes has the formula given above, in which case it will leave a residue of 86.2 per cent. upon being heated to redness. But the composition may vary from the presence of other oxycarbonates, and the residue left on ignition has been found as low as 83.7, and as high as 86.7 per cent.

Pharmaceutical Uses.—White lead is used in preparing Liq. gutta-perchæ, *U. S.*, *Br.*, and is an ingredient of some plasters (see p. 527), and of Ung. plumbi carbonatis. *U. S.*, *Br.*

Medical Action and Uses.—This preparation is only used externally in the form of a powder, to protect irritated surfaces, as in *erythema*, *erysipelas*, *intertrigo*, etc., and to produce constriction of the congested skin. It should never be applied where the cuticle is broken, as it is one of the most poisonous of the salts of lead. It enters into an officinal ointment, and it is sometimes used in the form of white paint, mixed with linseed oil, as an application to superficial *burns* and *scalds*.

PLUMBI IODIDUM, *U. S.*, *Br.*—IODIDE OF LEAD.

Plumbum jodatum, P. G.; *Ioduretum plumbicum.*—*Iodure de plomb*, Fr.; *Jodblei*, G.

Formula PbI_2. Molecular weight 461.

Preparation.—Take of Nitrate of Lead, Iodide of Potassium, each four troyounces; Distilled Water a sufficient quantity. With the aid of heat dissolve the nitrate of lead in a pint and a half, and the iodide of potassium in half a pint of distilled water, and mix the solutions. Allow the precipitate formed to subside, and, having poured off the supernatant liquid, wash it with Distilled Water and dry it with a gentle heat. *U. S.*

This is nearly a verbal copy of the directions of the British Pharmacopœia. The reaction between the two salts results in the production of nitrate of potassium, which remains in solution, and iodide of lead, which precipitates; $Pb2NO_3 + 2KI$ yields $2KNO_3 + PbI_2$. The quantities ordered by the Pharmacopœias are almost exactly in equivalent proportions, and the yield is 5½ ounces. Boudet (1847) ascertained that acetate of lead cannot be advantageously used in the preparation of the iodide, inasmuch as double iodide of lead and potassium is invariably produced under the influence of the newly formed potassium acetate. The nitrate does not exert any similar influence; hence nearly the whole theoretical quantity of lead iodide is obtained by the officinal process.

Properties.—Iodide of lead, if precipitated in the cold, is a bright yellow powder, and, if obtained from boiling solutions, crystallizes in thin, shining, golden-yellow scales. It has the spec. grav. 6.1, is inodorous, of a slight metallic taste, and, when heated, turns brick-red, blackish-brown, fuses to a red-brown liquid, and volatilizes, partly undecomposed, at a strong red heat. It is permanent in a dry atmosphere, but when exposed to the light while moist, is slowly decomposed, binoxide and carbonate of lead being formed, besides free iodine. Denot (1834) ascertained that it requires 1235 parts of cold, and 187 parts of boiling water for solution. According to Lassaigne (1831), the colorless aqueous solution, saturated at 20° C. (68° F.), contains .0017 per cent. of iodide of lead. It dissolves in solutions of ammonium chloride, and of soluble iodides and acetates, and is at least partly converted into double iodides.

Its *purity* is ascertained from the properties described. The presence of a double compound with potassium iodide is indicated by the lighter color of the product, and is proven by dissolving a sample in warm solution of ammonium chloride, precipitating the lead with either sulphuric or hydrosulphuric acid, evaporating the filtrate to dryness, and igniting, when no fixed residue should be left.

Off. Prep.—Emplast. plumbi iodidi, *Br.*; Unguent. plumbi iodidi, *U. S.*, *Br.*

Medical Action and Uses.—Iodide of lead is generally used as an external application in the form of an ointment, which is officinal. It has, however, been given internally, with alleged advantage, to diminish malarial enlargement of the *spleen*, in the dose of one-fifth of a grain twice a day in pilular form, and gradually increased.

PLUMBI NITRAS, *U. S.*, *Br.*—NITRATE OF LEAD.

Plumbum nitricum, *Nitras* (*Azotas*) *plumbicus.*—*Azotate* (*Nitrate*) *de plomb*, Fr.; *Salpetersaures Bleioxyd*, *Bleisalpeter*, G.

Formula $Pb2NO_3$. Molecular weight 331.

Preparation.—Metallic lead dissolves slowly in warm dilute nitric acid, but litharge or carbonate of lead is readily taken up by the acid, the latter with effervescence of carbonic acid gas. A solution of nitrate of lead is also obtained in the preparation of binoxide of lead from the red oxide by digesting it with dilute nitric acid.

Properties.—Nitrate of lead crystallizes on slow evaporation in colorless transparent octohedrons. When obtained by the cooling of hot solutions, the crystals are white. It has the specific gravity 4.4, is not altered by exposure, and when heated fuses and gives off oxygen and nitrous vapors, leaving finally oxide of lead. Kremers (1854) ascertained that one part of the salt requires at 10° C. (50° F.) 2.07, at 25° C. (77° F.) 1.65, at 45° C. (113° F.) 1.25, and at the boiling temperature 0.72, parts of water for solution. It is likewise soluble in alcohol, possesses a sweetish astringent taste, and deflagrates slightly on being triturated with sulphur or thrown upon red-hot charcoal. Its solution has the reactions of lead salts, discharges the color of sulphate of indigo, and, when completely precipitated by sulphuric or hydrosulphuric acid, the filtrate on evaporation leaves no fixed residue. It contains 62.5 per cent. of lead, and is free from water of crystallization.

Pharmaceutical Uses.—In the preparation of plumbi iodidum.

Other Lead Salts.—PLUMBI CHLORIDUM, *Chloride of lead*, is obtained by precipitating a solution of lead salt with hydrochloric acid or chloride of sodium. It is a white crystalline powder, which fuses when heated, and congeals to a horn-like mass (*Plumbum corneum*). It is soluble in 105 parts of water, sparingly soluble in dilute hydrochloric acid, and more freely so in the same acid when concentrated. It dissolves also in alkaline acetates and hyposulphites.

PLUMBI TANNAS, *Tannate of lead*, is prepared by dropping a solution of tannin into a solution of acetate of lead, washing and drying the precipitate. It is at first nearly white, but turns gradually brown.

PLUMBUM TANNICUM PULTIFORME, *P. G.*, s. *Cataplasma ad decubitum*, is made from a filtered decoction of 8 parts of oak-bark in 40 parts of water by adding to it 4 parts or a sufficient quantity of solution of subacetate of lead, collecting the precipitate, and while moist mixing it with one part of alcohol. It is prepared extemporaneously.

Medical Action and Uses.—A solution of nitrate of lead (gr. x to ℥j) may be employed as a discutient for bruises and local inflammations, but it is much more useful as a deodorizing agent, to correct the fetor arising from *gangrenous sores* and *offensive discharges* from the nostrils, ears, vagina, and rectum. It is a very efficient remedy for non-constitutional *ozæna*, and a palliative of the syphilitic form. It is best applied by means of the nasal douche, in a solution containing from two to five grains to the ounce of water. As a cicatrizing astringent it is very useful in the treatment of *sore nipples*, when dissolved in glycerine or brandy, in the proportion of ten grains to the ounce. It should be applied after suckling, and the child should not be allowed to take the breast again until the nipple has been thoroughly washed. If the ulcer or fissure is deep, a stronger solution than the above may be required. Powdered nitrate of lead appears to be an efficient application to the sanious fungous ulcers resulting from *onychia*. After the first dressing, it is said, the pain ceases, the swelling decreases, suppuration is lessened, and the fetid odor is destroyed.

PLUMBI OXIDUM, *U. S.*, *Br.*—OXIDE OF LEAD.

Lithargyrum, *Plumbum oxydatum*, P. G.—*Litharge*, E.; *Protoxide de plomb*, Fr.; *Bleioxyd*, *Bleiglätte*, G.

Formula PbO. Molecular weight 223.

Preparation.—Oxide of lead is prepared by combining metallic lead with oxygen derived from the air. If heated to near a white heat, lead begins to volatilize, and in contact with the air burns with a bright white flame to oxide, which was formerly known as *flowers of lead.* When merely heated to fusion, the metal oxidizes, forming a yellow powder known as *massicot;* but at a higher temperature the oxide melts and congeals in scales, known as *litharge*, or *semi-vitrified oxide of lead.* In this state it is obtained in several processes, such as that known as *cupellation*, in which the lead is oxidized, and the litharge, as it forms, removed by a blast, leaving any silver behind which may have been contained in the lead. An identical product is obtained by passing a current of air over molten lead heated to dull redness and constantly renewing the surface.

Properties.—Litharge is a more or less crystalline powder, which is composed of small scales varying in color between yellowish and pale brick-red. When of a distinct yellow tint and glossy surface it has been called *argyritis, yellow* or *silver litharge;* while the red-tinted kind is sometimes known as *chrysitis, red* or *gold litharge.* Its density varies between 9.3 and 9.5. When heated, it acquires a red-brown color, and at a higher heat fuses, congealing on cooling in scales. In the presence of even a small proportion of silica it congeals to a glass-like mass. It is almost completely soluble in dilute nitric acid and in hot acetic acid, leaving but little metallic lead or binoxide of lead, which are usually present in small proportions; but very little effervescence should be produced during its dissolution, showing the absence of more than mere traces of carbonate of lead.

Tests.—The solution of oxide of lead in nitric acid, when precipitated by sulphuric acid, yields a filtrate, which, on being supersaturated by ammonia, does not acquire a blue color (absence of copper), and does not yield a brown precipitate, or but a slight one, consisting of ferric hydrate; nor is a white precipitate produced on the further addition of sulphydrate of ammonium (zinc), or of oxalate of ammonium (calcium).

Composition.—Pure oxide of lead consists of 92.82 lead and 7.18 oxygen.

Pharmaceutical Uses.—Oxide of lead is used in the preparation of most lead salts, and of plasters, and in preparing digitalin.

Other Oxides of Lead.—PLUMBI OXIDUM RUBRUM, Minium, *P. G.;* Red lead, *E.;* Oxyde rouge de plomb, *Fr.;* Mennige, *G.* On heating massicot to near 450° C. (840° F.), it gradually combines with more oxygen, and is converted into red lead; the conversion of the denser litharge into red lead is attended with greater difficulties. It is a bright orange-red, granular, crystalline powder, which, on being heated, becomes deeper red, purplish, and finally black, and has a density varying between 8.7 and 9.1. It is partly soluble in dilute nitric acid, leaving binoxide of lead, and at a red heat is converted into litharge, oxygen being given off. When pure, it contains 90.66 per cent. of lead, and 9.34 of oxygen, its formula being $Pb_3O_4=2PbO.PbO_2$.

PLUMBI BINOXIDUM; Peroxide (Binoxide) of lead, Puce oxide of lead, *E.;* Peroxyde (Oxyde puce) de plomb, *Fr.;* Bleihyperoxyd, *G.* This is left behind as an insoluble powder on treating red lead with diluted nitric acid, and is also produced from solutions of lead salts by mixing them with an excess of solution of chlorinated lime or chlorinated soda. It is a dark-brown powder, which, on exposure to the light, gives off oxygen, leaving red lead, and by heat is converted into oxygen and litharge. When triturated with one-eighth of its weight of sugar, or with its own weight of oxalic acid, it is reduced to oxide or converted into carbonate. Its mixture with sulphur may be ignited by friction, a behavior which renders it useful in the manufacture of matches. Since it readily parts with one-half of its oxygen, it is a valuable reagent for strychnia and some other organic bodies, yielding colored oxidation products. Its formula is PbO_2, and it contains 86.61 lead and 13.39 oxygen.

Medical Action and Uses.—Oxide of lead is seldom used alone. It enters into the composition of lead plaster, and hence into most of those which owe their adhesiveness to that compound. A mixture of oxide of lead with sweet oil has been applied to superficial *burns;* and ordinary white paint, containing litharge, linseed oil, and oil of turpentine, is a popular and excellent remedy for the same affection.

PLUMBUM.—LEAD.

Plomb, Fr.; *Blei*, G.

Symbol Pb. Atomicity bivalent or quadrivalent. Atomic weight 207.

Origin and Preparation.—Lead is found in the United States and many other countries, occasionally as oxide, more frequently as carbonate (*white lead ore*), or in combination with other acids. The most abundant lead ore is *galena*, a sulphide of lead, PbS, which is frequently associated with the sulphides of zinc, iron, copper, and silver. The metal is obtained from the galena by roasting it, whereby a portion is oxidized to sulphate of lead, while another portion parts with its sulphur, which escapes as sulphurous acid, the metal being converted into oxide. The newly formed compounds react with the unaltered galena, forming lead which fuses, and sulphurous acid which escapes. A considerable quantity of lead remains in the slag, which is used in a subsequent operation. The extraction of silver is effected by cupellation (see page 1094), and the oxide of lead is then reduced to the metallic state by heating it with charcoal.

Properties.—Lead has a bluish-gray color and a bright metallic lustre. It is a soft metal, and when cooled slowly leaves a mark on being drawn over paper. Its specific gravity is 11.4; it is very malleable and ductile, but less tenacious than most other common metals; fuses at 325° C. (617° F.), and volatilizes at a white heat. On congealing, it contracts considerably, and under some circumstances it may be obtained crystallized in regular octohedrons. When exposed to a moist atmosphere, it is superficially oxidized, and becomes covered with a grayish layer. In contact with water and air, or in the presence of a minute quantity of ammonia or of nitric acid, the metal is corroded, and small quantities of it are held in solution. Sulphates prevent the lead from being dissolved; or, if dissolved, precipitate an insoluble sulphate.

The most important *oxides* of lead have been described above (page 1094). In addition to the three mentioned, the existence of a suboxide, Pb_2O, has been assumed, but is doubted by many chemists. The *sesquioxide of lead*, $Pb_2O_3 = PbO.PbO_2$, has been obtained as a yellow precipitate by adding chlorinated soda to an alkaline solution of lead, and more recently (1878) by H. Debray as a greenish-brown powder, by heating peroxide of lead to 350° C. (662° F.).

There are two series of *lead salts*, in one of which lead is contained in the acidulous radical, while in the other it constitutes the base. The former are called *plumbates*, and are obtained by heating together peroxide of lead with alkaline hydrates; the alkaline plumbates are colorless, decomposed by much water, and yield plumbates of the metals by acting upon metallic salts. The *plumbic salts* are white or colorless, unless colored by the acid; mostly insoluble in water, and then usually soluble in dilute nitric acid. The salts, which are soluble in water, have a sweet and metallic taste and an acid reaction to litmus, and their solutions yield white precipitates with carbonates, sulphates, phosphates, and chlorides, the last of which is slightly soluble in water, but less soluble in muriatic acid; while the precipitated sulphate of lead is insoluble in water and dilute sulphuric and hydrochloric acids. Alkalies produce white precipitates of plumbic hydrate, which is insoluble in ammonia, but soluble in potassa and soda. Ferrocyanide of potassium yields a white precipitate. The precipitates by potassium chromate and potassium iodide are characterized by a bright yellow color; the latter crystallizes from hot solutions in golden-colored scales. Sulphuretted hydrogen precipitates black sulphide of lead, which is insoluble in dilute acids, and sulphydrate of ammonium. Iron and zinc separate from the solutions of lead salts the lead in the metallic state; and by heating the salts with carbonate of sodium upon charcoal before the blowpipe, metallic globules of lead and a reddish-yellow incrustation of lead oxide are obtained.

Off. Prep.—The following chemical compounds are officinal: Plumbi acetas, Plumbi carbonas, Plumbi iodidum, Plumbi nitras, Plumbi oxidum; and as solutions in water: Liquor plumbi subacet. and Liq. plumbi subacetat. dilutus, *U. S.*, *Br.*

The following pharmaceutical preparations contain compounds of lead: Ceratum plumbi subacet., Cerat. saponis, *U. S.;* Emplastrum arnicæ, Empl. assafœtidæ, *U. S.;* Empl. belladonnæ, *U. S.*, *Br.;* Empl. calefaciens, Empl. cerati saponis, *Br.;* Empl. ferri, Empl. galbani comp. (galbani), Empl. hydrargyri, Empl. opii, Empl. plumbi, Empl. resinæ, Empl. saponis, *U. S.*, *Br.;* Suppositoria plumbi, *U. S.;* Suppos. plumbi et opii (plumbi comp.), *U. S.*, *Br.;* Unguentum plumbi acetatis, *Br.;* Ung. plumbi carbon., Ung. plumbi iodidi, *U. S.*, *Br.;* Ung. plumbi subacet. comp., *Br.*

PODOPHYLLUM, *U. S.*—MAY-APPLE.

Podophylli radix, Br.—*Podophyllum root*, *Mandrake root*, E.; *Rhizome de podophyllum*, Fr.; *Fussblattwurzel*, G.

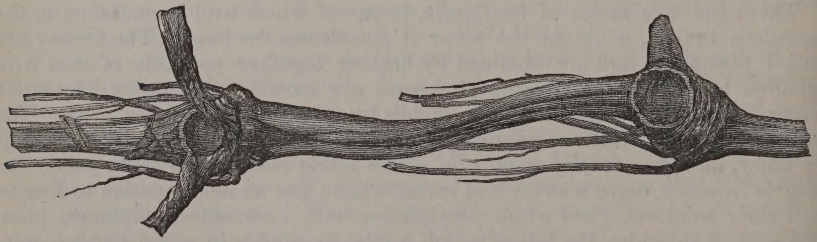
The rhizome of Podophyllum peltatum, *Lin.* Bentley and Trimen, Med. Plants, 17.

Nat. Ord.—Berberidaceæ.

Origin.—Mandrake is an herbaceous perennial, growing in rich woodlands in Canada and the United States. The pale-green stem is about ten or twelve inches high, and bears at its summit two peltate, deeply five- or seven-lobed leaves, which are four to six inches in diameter, and a single white flower, with six or nine petals and twice the number of hypogynous stamens. The flowerless stems frequently bear only a single leaf. The fruit is a yellowish, oval, fleshy berry, and contains twelve or more seeds, which are inclosed in a pulpy arillus. The rhizome is collected in autumn.

Description.—The rhizome is horizontal, several feet long; but as found in commerce is always in fragments varying from one to six or eight inches in length. It consists of joints or annual shoots, one to three inches long, one-eighth to one-quarter inch thick, and marked with distant leaf-scars. The end of each joint is enlarged to the diameter of about half an inch, is depressed globular in shape, and occasionally branching, has approximate leaf-scars, on the upper side a circular depressed stem-scar containing one or two rows of wood-bundles, and on the lower side is beset with from eight to twelve nearly simple rootlets. Rhizome and rootlets are of a yellowish- or reddish-brown color exter-

Fig. 140.



Podophyllum peltatum rhizome, *Lin.*

nally, smooth, or with longitudinal wrinkles, very brittle, and therefore the radicles often detached; nearly inodorous, and of a sweetish, somewhat bitter and acrid taste. The rhizome is white and mealy inside, and has a rather thick bark and a thin circle of yellowish wood-bundles inclosing a compact central pith. The rootlets have a thick white bark and a thin yellowish central cord.

Constituents.—The analysis of podophyllum by J. R. Lewis (1847) showed the presence of starch and other common vegetable principles, and of two resins, one soluble, the other insoluble in ether. According to H. A. Tilden (1859) the former resin predominates largely in the rhizome collected in October; but if collected in April it contains the two resins in nearly the same proportion. The bitter principle was obtained in an impure condition by Hodgson (1831). F. F. Mayer (1863) announced the presence of berberina and another (white) alkaloid, and of saponin. After the precipitation of the resin from the strong alcoholic tincture by means of water, we have on several occasions obtained a yellow precipitate on the addition of hydrochloric acid, which could be recrystallized from alcohol, and was regarded as muriate of berberina. Recent investigations by F. B. Power (1877–1878), however, indicate the total absence from the rhizome of any alkaloid. It remains to be investigated whether the contradictory results are to be attributed to accidental admixtures, or whether at some period of its growth the rhizome contains an alkaloid. Power doubts also the existence of Mayer's saponin, and regards the frothing of the infusion as due to the acid resin. The yellow coloring matter appears to be the same acid resin, probably in combination. (See Resina podophylli.)

Off. Prep.—Extract. podophylli, *U. S.;* Resina podophylli, *U. S.*, *Br.*

Physiological Action. *On Animals.*—Administered by the stomach to dogs and other animals, podophyllin produces retching, salivation, and vomiting, followed by purging, with colic and tenesmus. Hypodermically its operation is the same, except that it is said not to occasion vomiting. Injected into the cavity of the peritoneum, it appears not to have caused any inflammation of that membrane, nor any special symptoms, until after a number of hours, when dry retching occurred, and purging of glairy mucus mixed with blood. The animal seemed to suffer great pain, its pulse grew rapid and feeble, and death took place by exhaustion. No evidence was given of any special influence of the medicine on the liver. Experiments performed with the direct intention of inquiring into the cholagogue action of the drug, have led to diametrically opposite conclusions: on the one hand, that podophyllin diminishes the total amount of the biliary secretion or of its constituents, according to the dose administered; and, on the other hand, that it increases greatly the amount of biliary secretion, preserving the normal proportion of the special biliary matter.

On Man.—Workmen employed in pulverizing podophyllum find it excessively irritating to the eyes, nose, mouth, respiratory passages, and even to the skin. The resin applied to an ulcer produces its characteristic purgative effects with nausea. Internally, in small doses it is a very slow and gentle laxative, producing formed or semi-solid stools; but in large doses it is a drastic and persistent purge. Its bitter and nauseous taste, when taken in powder or in solution, causes salivation; but under any form, and however introduced into the system, it has the same effect if it occasions nausea, which it does by irritating the stomach. It excites the secretion of bile, if at all, in the same way as it does that of the saliva, by the reflex influence of the irritation produced by it in the stomach and duodenum. It has no such specific cholagogue action as has been attributed to it by ignorant practitioners of medicine.

Medical Uses.—It has, among its analogies with jalap, the excellent quality of causing a slow but full evacuation of the bowels, without greatly tending to render them torpid, provided it be given in suitable doses. This quality makes it useful in habitual *constipation.* For this purpose one-sixth of a grain of podophyllin with one-fifth of a grain of extract of belladonna, one grain of extract of hyoscyamus, and a grain of soap may be made into a pill to be taken at bed-time. Like other active cathartics, podophyllin in removing constipation removes also one of the causes which tend to prolong constipation, the condition which is generally spoken of as *torpor of the liver*, and which is attended with hepatic fulness and perhaps some yellowness of the skin, and which is, in fact, generally due to the infarction of the excretory ducts of the liver with inspissated bile. It nearly always arises from sluggish habits of living, imprudence in diet, and neglect of the function of defecation. In the constipation produced by *lead*, the following formula may be employed: ℞.—Podophyllin, gr. ss; Ext. nucis vom. gr. j; Ext. belladonnæ, gr. ss; for a pill to be taken two or three times a day.

The average *dose* of powdered podophyllum is from ten to twenty grains; the dose of the extract is about the same. The strength of podophyllin is uncertain, and its dose varies from one-sixth of a grain to one grain. It seldom begins to act in less than twelve hours. It has been given in varnished capsules, which are supposed not to dissolve before reaching the duodenum, and thus the nausea and gastric irritation are alleged to be mitigated.

POLYGALA RUBELLA, *U. S.*—BITTER POLYGALA.

Polygale, *Laitier*, Fr.; *Kreuzblume*, *Milchwurz*, G.

The root and herb of Polygala rubella, *Willd.;* s. P. polygama, *Walt.*

Nat. Ord.—Polygalaceæ.

Description.—The bitter polygala or *bitter milkwort* is a biennial herb, growing in dry fields and pastures from Canada southward to the Gulf of Mexico. It has a fusiform root and numerous glabrous nearly simple stems, which are six to eight inches high, and bear a terminal narrow raceme of about fifteen to twenty-five purple, finally pendulous flowers. The leaves are alternate, linear-oblong, or oblanceolate, narrowed below, obtuse, and somewhat mucronate. The flowers are showy and conspicuously crested; racemes of inconspicuous flowers are produced on procumbent stems, and usually fertilized in the bud. The plant is without odor, and has a bitter taste.

Allied Species. POL. SANGUINEA, *Lin.*—It grows in similar localities as the preceding, has the stem fastigiately branched above and leafy to the top; narrow linear or lance-linear leaves, and terminal globular heads of dark red and inconspicuously crested flowers. Several others, like Pol. fastigiata, *Nutt.*, and Pol. Nuttallii, *Tor. and Gr.*, are closely related to it.

POL. AMARA, *Lin.*—It grows in mountainous woods and meadows of Europe, is about six inches high, has rosulate obovate or spatulate radical leaves, smaller linear or oblong linear stem leaves, and lax racemes of blue flowers.

POL. VULGARIS, *Lin.*—A common European perennial, with ascending stems, five to nine inches long, lanceolate or spatulate radical leaves, longer linear-lanceolate stem leaves, and short or lax and elongated racemes of blue or purplish flowers.

Constituents.—Reinsch (1839) obtained from Polygala amara small quantities of solid volatile oil, tannin, and wax, considerable pectin, and a crystalline compound, *polygalamarin*, which has a very bitter taste, and foams considerably when agitated with water.

Medical Action and Uses.—It is said to be closely analogous in medicinal virtues to *Polygala amara*, of Europe; but the most recent European works on the Materia Medica reject the latter altogether. It is, however, a mild bitter tonic, which may be convenient in domestic medicine, but scarcely deserves an officinal rank.

POTASSA, *U. S.*—POTASSA.

Potassa caustica, Br.; *Kali causticum fusum*, P. G.; *Potassæ* (*Potassii*) *hydras*, *Kali hydricum fusum*, *Oxydum potassicum*, *Lapis causticus chirurgorum*.—*Caustic potash*, *Potassium hydrate*, E.; *Potasse caustique*, Fr.; *Aetzkali*, G.

Formula KHO. Molecular weight 56.

Preparation.—Take of Solution of Potassa eight pints. Evaporate the solution rapidly in an iron vessel over the fire, until ebullition ceases and the potassa melts. Pour this into suitable moulds, and, when cold, keep it in a well-stopped bottle. *U. S.*

Take of Solution of Potash two pints. Boil down rapidly in a silver or clean iron vessel, until there remains a fluid of oily consistence, a drop of which when removed on a warm glass rod solidifies on cooling. Pour this into proper moulds, and when it has solidified, and while it is still warm, put it into stoppered bottles. *Br.*

Of the above directions, those of the British Pharmacopœia are the most practical. The process by which the solution is made is described and explained on p. 844. By evaporating this solution, the water is driven off and the remaining potassium hydrate is fused, and in the melted condition poured into cylindrical moulds. Vessels made of glass, porcelain, copper, and of most other materials are corroded by the concentrated solution and the fused hydrate; the operation must therefore be performed in a vessel of silver or of well-cleaned iron.

Properties.—Caustic potassa is in dry white cylindrical pieces, which break readily with a crystalline fracture. On exposure to the air, it absorbs water rapidly, becomes liquid, and combines with carbonic acid; it is also soluble in alcohol, and slightly so in ether. When heated it fuses to a colorless oily liquid, and in a strong red heat it slowly volatilizes, forming white acrid vapors. The aqueous solution has the properties and chemical behavior of liquor potassæ (see page 845).

Tests.—Most of the salts likely to be present in caustic potassa are insoluble in alcohol, and are therefore precipitated if the potassa is dissolved in two parts of water, and the solution mixed with four parts of alcohol; only a scanty crystalline precipitate or dense watery liquid should be separated. A minute quantity of chloride is usually present, and indicated by the curdy white precipitate produced with nitrate of silver in the solution acidulated with nitric acid. The presence of nitrate is shown by acidulating the solution with sulphuric acid, adding a minute quantity of indigo solution, and heating, when the blue color will be destroyed. For other tests of purity, see page 845.

An impure potassa of a deep gray or greenish color is sometimes met with. It is unfit for medicinal purposes, and may be purified by treating it with alcohol, which dissolves the alkali, and evaporating this solution to dryness.

Composition.—The formula of potassa is given above. When entirely pure, it contains 16.07 per cent. H_2O and 83.93 per cent. K_2O, but, as met with in commerce, there is usually an excess of water amounting to 6 or 8 per cent.

POTASSIUM *s. Kalium* is the metal, of which the officinal potassa is the hydrate. It was first isolated by Humphry Davy (1807), and is obtained with some difficulty by heating hydrate or sulphide of potassium with metallic iron, in which case ferric oxide or sulphide is formed; or an intimate mixture of potassium carbonate and charcoal is heated to strong redness, when carbonic oxide is produced besides the metal.

It is silver-gray, of a strong metallic lustre, harder than sodium but softer than lead, fuses at 58° C. (136.4° F.), is brittle at the freezing point of water, and at a red heat volatilizes, forming green vapors. Its density is 0.865, its atomic weight 39, and its atomicity univalent. It has a great affinity for oxygen, and, when thrown upon water, decomposes this liquid, melts, and burns with a purple flame. It must be preserved under petroleum naphtha, which is free from oxygen. There are three oxides of potassium known, the *monoxide*, K_2O, *dioxide*, K_2O_2, and *tetroxide*, K_2O_4, of which only the former is of importance on account of the uses in medicine and the arts to which its combinations with water and acids are put.

SALTS OF POTASSIUM.—Potassa is a very strong base, and completely neutralizes the strongest acids. The salts are colorless, unless the acid has a distinct color, and are neutral to test-paper, except those with weak acids, which have a distinct alkaline reaction. They are mostly readily soluble in water, and in such solutions, if not too dilute, are precipitated in a gelatinous condition by hydrofluosilicic acid, and in a crystalline form by perchlorate of ammonium, tartaric acid, acid tartrate of sodium, platinic chloride, and picrate of sodium. The last two precipitates are yellow, the others white. When heated before the blowpipe, the potassium salts impart a purplish tinge to the flame, which is masked by the presence of a small quantity of sodium salt. The yellow color of the latter is absorbed by looking at it through blue glass, and the potassium flame becomes then visible.

Pharmaceutical Uses.—Potassa is used in the preparation of Æther, Liquor potassæ, Potassa cum calce, Potass. iodidum, *U. S.*, and Potass. permanganas, *Br.*

The following potassium compounds are officinal: Potassa, *U. S.*, *Br.;* Potassa c. calce, *U. S.;* Antimon. et potass. tartras (Antimon. tartaratum), Ferri et potass. tartras (Ferrum tartaratum), Potass. acetas, Potass. bicarbonas, Potass. bichromas, Potass. bitartras (tartras) acida, Potass. bromidum, Potass. carbonas, Potass. chloras, Potass. citras, *U. S.*, *Br.;* Potass. cyanidum, *U. S.;* Potass. et sodii tartras (Soda tartarata), Potass. ferrocyanidum (prussias flava), *U. S.*, *Br.;* Potass. hypophosphis, *U. S.;* Potass. iodidum, Potass. nitras, Potass. permanganas, Potass. sulphas, *U. S.*, *Br.;* Potass. sulphis, *U. S.;* Potass. sulphuretum (sulphurata), Potass. tartras, *U. S.*, *Br.;* Sapo mollis, *Br.*

The following pharmaceutical preparations contain potassium compounds: Confect. sulphuris, Decoct. aloes comp., *Br.;* Emplast. antimonii, *U. S.;* Enema aloes, Linim. iodi, Linim. potass. iodidi c. sapone, Linim. terebinthinæ, *Br.;* Liquor iodinii comp. (iodi), Liqu. potassæ, Liqu. potass. arsenitis (arsenicalis), *U. S.*, *Br.;* Liqu. potass. citratis, *U. S.;* Liqu. potass. effervescens, *Br.;* Liqu. potass. permanganatis, Mistura ferri comp., *U. S.*, *Br.;* Mist. glycyrrh. comp., Mist. potass. citrat., *U. S.;* Pilula colocynth. comp., Pil. colocynth. et hyoscyami, *Br.;* Pulv. effervescentes aperientes, *U. S.;* Pulv. ipecacuanhæ comp., Pulv. jalapæ comp., *U. S.*, *Br.;* Syrup. scillæ comp., *U. S.;* Trochisci potass. chlorat., Unguent. antimonii (antim. tartarati), Ung. iodinii (iodi), *U. S.*, *Br.;* Ung. iodinii comp., *U. S.;* Ung. potass. iodidi, *U. S.*, *Br.;* Ung. potass. sulphuratæ, *Br.;* Vinum antimonii (antimoniale), *U. S.*, *Br.*

Physiological Action. *On Animals.*—Injected into the veins of dogs, five grains of caustic potassa dissolved in water produced difficult breathing, exhaustion, paralysis, and speedy death. Larger doses administered to horses by the veins were not fatal, but, besides causing signs of distress, produced increased urination. Given to dogs by the stomach, potassa excites violent and fatal gastro-enteritis.

On Man.—Potassa is one of the strongest caustics. It destroys animal tissue by abstracting water, neutralizing free acids, decomposing nitrogenous compounds, and forming solutions of fibrin, albumen, and gelatin. Between the fingers it has a soapy feel. In contact with the soft tissues it causes severe burning pain, and produces a moist, ashen, and then black, leathery slough, which leaves a granulating ulcer behind it.

The symptoms of poisoning by a solution of potassa are these: An acrid, urinous, and caustic taste in the mouth. burning in the throat, nausea, vomiting of alkaline matters which are usually bloody; intense pain in the fauces, œsophagus, stomach, and bowels; diarrhœa, convulsions, delirium, a cold, clammy skin, and, if the dose has been large and not instantly rejected, speedy death. Sometimes death takes place from inflammation of the larynx; sometimes after several weeks from the gastro-intestinal lesions (which consist of more or less destruction of the mucous membrane, etc.), and, finally, it may occur after several months from stricture of the œsophagus.

In small or medicinal doses it increases the amount of urine secreted, rendering it less acid; in larger or in long-continued doses it diminishes the coagulability of the blood, and may give rise to a cachectic condition, with paleness and œdema of the skin, passive hemorrhages, and general emaciation, a state identical with that occurring in scurvy.

Medical Uses.—Potassa in solution is used as an antacid to correct that *acidity of the stomach* which proceeds either from fermentation of the contents of the organ, or from an excessive amount of its proper secretion, and which is accompanied with heart-burn, sour eructations, aphthæ, spasm of the œsophagus, vomiting, gastric cramp, colic, tympanites, irregular diarrhœas, etc. In treating these conditions with alkalies the symptom is indeed palliated, but its cause must be removed to make a cure certain, and that is usually best secured by means of tonic medicines and regimen. For the relief of *calculous disorders*, potassa is less appropriate than soda and its carbonates. Twenty minims of solution of potassa largely diluted are said to prevent and also to relieve *strangury* from *cantharides*. Formerly, this medicine was considered as almost a specific in the treatment of glandular *scrofula*, but the influence of the hygienic conditions existing at the same time appears to have been underrated. It should not, however, be neglected, but given in the dose of five drops largely diluted after meals. Solution of potassa is useful in some cases of *acne rosacea;* and in the treatment of *boils* it has been thought efficient.

Externally, potassa is used chiefly as a caustic to promote the healing of callous ulcers and sinuses, and to destroy fungous granulations. It has been especially employed to destroy *chancres* in their first stage, and to cauterize *poisoned wounds*. It is much used in the treatment of *ingrown nail* and *paronychia*, and was formerly employed for opening *scrofulous abscesses*. It has been applied as a counter-irritant in diseases of the *hip-joint* and other joints, and for the purpose of exciting inflammation in the ends of *ununited fractured bones;* but these uses, as well as its application to *carbuncles*, *erectile tumors*, *varicose veins*, and to the spine in *tetanus*, are well nigh obsolete, having been superseded by more efficient and less painful remedies. The same may be said of its use in the treatment of *urethral strictures*. It is one of the most convenient agents for establishing *issues*. To prevent the caustic action from spreading laterally, a piece of adhesive plaster should be applied first, with an aperture of the size of the intended issue. Upon the skin thus exposed and moistened a small portion of fused potassa is laid, and the degree of its action regulated by the duration of its contact. The action may be arrested at any point by a sponge or cloth wet with vinegar. Milder action may be secured by applying the stick of fused potassa, duly covered, except at one end, with shellac varnish or sealing-wax, and maintaining its contact for a longer or shorter time according to the effect desired. For other uses of potassa, see Liquor potassæ, and Potassa c. calce.

POTASSA CUM CALCE, *U. S.*—Potassa with Lime.

Pulvis causticus cum calce, Pulvis causticus Viennensis (*Londinensis*).—*Vienna caustic*, E.; *Caustique* (*Poudre*) *de Vienne*, Fr.; *Wiener Aetzpulver*, G.

Preparation.—Take of Potassa, Lime, each a troyounce. Rub them together so as to form a powder, and keep it in a well-stopped bottle. *U. S.*

Properties.—This is a grayish-white powder, of a strongly caustic taste and alkaline reaction. When exposed to the air, it absorbs moisture and carbonic acid. Treated with diluted nitric or hydrochloric acid, it dissolves completely with slight effervescence, and yields a solution, in which both potassium and calcium are indicated by reagents.

Causticum cum potassa et calce, *F. P.*, is a stronger preparation, known in France as *caustique de Filhos*, and made by fusing one hundred parts of caustic potassa, adding thereto ten parts of powdered burned lime, and pouring the mass into lead tubes of suitable size to harden.

Causticum commune mitius.—Under this name, a preparation was formerly employed which was made either by intimately mixing equal weights of soft soap and powdered burned lime; *or*, caustic potassa was dissolved in three times its weight of water, and a sufficient amount of lime added until the whole was converted into a pasty mass.

Medical Action and Uses.—This caustic is milder in its operation than pure potassa. When applied in a dry state upon the skin, it absorbs moisture from it and from the air, and partially deliquesces. It is best employed after being reduced to a paste with a little alcohol. Its action may be limited laterally by means of adhesive plaster, and in depth by the duration of its contact. Its uses are the same as those of potassa. The sticks of Filhos' caustic may be protected from the air by waxed paper, by sealing wax, gutta percha, or varnish. For still further mitigating the caustic action of the potassa in this preparation, the alkali may be fused with gutta percha in any required proportion. Its uses are the same as those of potassa.

POTASSII ACETAS, *U. S.*, *Br.*—Acetate of Potassium.

Potassæ acetas, Br.; *Kali aceticum*, P. G.; *Acetas potassicus s. kalicus, Terra foliata tartari.*—*Acetate of potash* (*potassa*), E.; *Acétate de potasse*, Fr.; *Essigsaures Kali*, G.

Formula $KC_2H_3O_2$. Molecular weight 98.

Preparation.—Take of Acetic Acid a pint; Bicarbonate of Potassium a sufficient quantity. Add the bicarbonate of potassium gradually to the acetic acid until it is neutralized; then filter the solution, and evaporate cautiously, by means of a sand-bath, until a dry salt remains. Lastly, keep this in a well-stopped bottle. *U. S.*

Take of Carbonate of Potash twenty ounces; Acetic Acid two pints, or a sufficiency. To the acetic acid, placed in a thin porcelain basin, add gradually the carbonate of potash, filter, acidulate, if necessary, with a few additional drops of the acid, and, having evaporated to dryness, raise the heat cautiously so as to liquefy the product. Allow the basin to cool, and when the salt has solidified, and while it is still warm, break it in fragments, and put it into stoppered bottles. *Br.*

On adding carbonate or bicarbonate of potassium to acetic acid, an effervescence of carbonic acid gas takes place, and water and potassium acetate are formed; $K_2CO_3 + 2HC_2H_3O_2$ yields $2KC_2H_3O_2 + H_2O + CO_2$, and $KHCO_3 + HC_2H_3O_2$ yields $KC_2H_3O_2 + H_2O + CO_2$. On the application of heat, the carbonic acid which remains dissolved in the water is expelled, and the liquid should now have a neutral or preferably a slightly acid reaction, in which case it contains a slight excess of acetic acid. The first process directs the evaporation of this solution to dryness; but the second formula requires the dry salt to be fused by the cautious application of heat, so as not to char it, after which the melted salt is allowed to solidify. In making this salt, bicarbonate of potassium is preferable in being nearly free from impurities and yielding at once a salt perfectly soluble in water. Carbonate of potassium is less pure, but usually yields a clear solution with acetic acid, which, on being evaporated to dryness and again dissolved in water containing a little acetic acid, leaves some floccula of silica behind, from which it may be filtered and afterwards again evaporated.

Acetate of potassium may also be prepared from acetate of lead, by precipitating its solution with a slight excess of carbonate of potassium, filtering, acidulating the filtrate with acetic acid, and evaporating.

Properties.—Acetate of potassium is a white salt forming a crystalline soft mass if obtained by the process of the United States Pharmacopœia, or a dry granular powder, if the hot concentrated solution has been continuously stirred until dry. As directed by the British Pharmacopœia it forms a foliaceous satiny mass. It is very deliquescent in the air, dissolves at the ordinary temperature in less than half its weight of water, and in about three parts of stronger alcohol. The aqueous solution has a slight alkaline reaction, disengages acetous vapors on the addition of sulphuric acid, and yields with tartaric acid and with platinic chloride the precipitates of potassium salts. Ether added to the alcoholic solution of the salt, precipitates it as a crystalline powder.

Tests.—The solution of acetate of potassium in distilled water should not give a precipitate or turbidity on the addition of hydrosulphuric acid, hydrosulphate of ammonium, or ferrocyanide of potassium (absence of heavy metals), not with chloride of barium (sulphate), or, if sufficiently diluted, with nitrate of silver. The last named reagent often produces a slight turbidity, which does not disappear on the addition of nitric acid, showing the presence of a trace of chloride. The concentrated aqueous solution of the salt, on being dropped into acetic acid, should not produce any effervescence, proving the absence of carbonate.

LIQUOR KALI ACETICI, *P. G.*, s. *Kali aceticum solutum.* One hundred parts of acetic acid, specific gravity 1.040, are neutralized by forty-eight parts, or a sufficient quantity, of potassium bicarbonate, and the solution diluted with water until it weighs one hundred and forty-two parts. It has the specific gravity 1.176 to 1.180, contains one-third of its weight of dry acetate of potassium, and is convenient for dispensing the salt in mixtures.

Off. Prep.—It is used in preparing Liquor ferri acetatis, *Br.*

Physiological Action.—It acts upon the blood as a solvent and diluent, upon the glands and mucous membranes as a depurative, augments the secretion of bile, urine, and sweat, and does not readily disorder the digestion. In doses of from half an ounce to an ounce it is a mild laxative. It is decomposed in the system, and is discharged with the urine as carbonate of potassium, rendering this secretion alkaline, and increasing its quantity as well as its solid contents. In large and continued doses it is said to occasion renal catarrh, and even bloody urine.

Medical Uses.—The title *sal diureticus*, which was formerly applied to this salt, it is justly entitled to, and there is good reason to believe that, besides increasing the quantity of the urine secreted, it also promotes the disintegration, and discharge with that secretion, of various effete and noxious elements. It displays this virtue notably in chronic infarctions of the *liver*, accompanied with *jaundice*, in analogous congestions of the *spleen*, *uterus*, and *hemorrhoidal vessels*, and particularly in such conditions resulting from malarial poisoning. In like manner, probably, must be explained its virtues in *gout*, *lithiasis*, *furuncles*, *carbuncles*, and various *cutaneous affections*, as well as in *acute articular rheumatism*. In the last-named disease especially are its virtues conspicuous when it is given in such doses and so frequently as to render the urine alkaline. Like other forms of the alkaline treatment of this disease, it lessens the risk of cardiac complications. In this and other affections distinguished by an excess of uric acid, it acts in the same manner as the carbonates of the alkalies.

In several forms of *dropsy* its diuretic virtue is of extreme value. Most conspicuously is it efficient in the dropsy following scarlatina, and in other forms of tubular desquamative nephritis. But it is also very efficient in cardiac dropsy, and in ascites of hepatic origin. In an inferior degree it is useful in splenic dropsy also. According to circumstances it may be associated with squill, digitalis, parsley, broom, dandelion, etc. Under the title *potio Riverii*, acetate of potassium has long been employed in acute febrile affections as a *diaphoretic*. This draught is made by saturating two drachms of carbonate of potassium with vinegar, and adding six ounces of sweetened water. A tablespoonful of it every two hours is the proper dose.

This salt should always be administered in a large quantity of liquid, except when it is prescribed as a diaphoretic. In febrile affections, as a sedative, its *dose* is ten grains. In acute articular rheumatism thirty grains may be given every four hours. As an alterative it may be prescribed in the same or in still larger doses. As a laxative, the dose is about half an ounce.

POTASSII BICARBONAS, *U. S.*—BICARBONATE OF POTASSIUM.

Potassæ bicarbonas, Br.; *Kali bicarbonicum*, P. G.; *Kali carbonicum acidulum*, *Bicarbonas potassicus s. kalicus.*—*Bicarbonate of potash*, E.; *Bicarbonate de potasse*, Fr.; *Doppelt-kohlensaures Kali*, G.

Formula $KHCO_3$. Molecular weight 100.

Preparation.—Take of Carbonate of Potassium forty-eight troyounces; Distilled Water ten pints. Dissolve the carbonate of potassium in the distilled water, and pass carbonic acid through the solution until it is fully saturated. Then filter the liquid, and evaporate that crystals may form, taking care that the heat does not exceed 160° F. Lastly, pour off the supernatant liquid, and dry the crystals on bibulous paper. Carbonic acid may be obtained from marble by the addition of dilute sulphuric acid. *U. S.*

Take of Carbonate of Potash one pound; Distilled Water two pints; Hydrochloric Acid a pint and a half; Water three pints; White Marble in fragments one pound or a sufficiency. Dissolve the carbonate of potash in the distilled water, and filter the solution into a three-pint bottle, capable of being tightly closed by a cork traversed by a glass tube sufficiently long to pass to the bottom of the fluid. Introduce the marble into another bottle, in the bottom of which a few small holes have been drilled, and the mouth of which is closed by a cork also traversed by a glass tube, and place the bottle in a jar of the same height as itself, but of rather larger diameter. Connect the two glass tubes air-tight by a caoutchouc tube. The cork of the bottle containing the carbonate of potash having been placed loosely, and that of the bottle containing the marble tightly, in its mouth, pour into the jar surrounding the latter bottle hydrochloric acid previously diluted with the water. When carbonic acid gas has passed through the potash solution for two minutes, so as to expel the whole of the air of the apparatus, fix the cork tightly in the neck of the bottle, and let the process go on for a week. At the end of this time numerous crystals of bicarbonate of potash will have formed, which are to be removed, shaken with twice their bulk of cold distilled water, and, after decantation of the water, drained, and dried on filtering paper by exposure to the air. The mother liquor, filtered if necessary, and concentrated to one-half at a temperature not exceeding 110° F., will yield more crystals. The tube immersed in the solution of carbonate of potash, which should have as large a diameter as possible, may require the occasional removal of the crystals formed within it, in order that the process may not be interrupted. *Br.*

Carbonate of potassium, kept in flat, open vessels in localities where saccharine liquids are undergoing vinous fermentation, is gradually converted into bicarbonate.

In preparing bicarbonate of potassium, a rather concentrated solution of carbonate of potassium in water is made, into which carbonic acid gas is conducted. One molecule of this gas unites with one molecule each of potassium carbonate and water, forming two molecules of the bicarbonate, thus: $K_2CO_3 + H_2O + CO_2 = 2KHCO_3$. The bicarbonate being less soluble in water than the carbonate, a portion of it crystallizes out, the crystals being larger if they form slowly. To accomplish this, the British Pharmacopœia directs a peculiar arrangement of the apparatus, by means of which the generation of carbonic acid is regulated by the rapidity with which it is absorbed by the solution, an excess of it remaining in the apparatus displacing the acid liquid from the bottle containing the marble, thereby completely stopping the further generation of the gas until after partial absorption has taken place. When somewhat larger quantities of the salt are to be prepared, it is convenient to divide the solution among three or more vessels, and pass the gas successively through them. In all cases the delivery-tube of the gas dipping into the solution should be of large bore, and preferably widened in the shape of a funnel, which precaution will prevent the closing of the tube by the crystallizing bicarbonate. Since the commercial carbonate of potassium is usually contaminated with silicate, silica is separated by the carbonic acid in the form of floccula, and may afterwards be removed by agitating the crystals with cold water, and decanting the liquid with the suspended silica. The remaining solution is then filtered and evaporated, or the liquid may be heated to a temperature not exceeding 60° C. (140° F.), until the crystals are dissolved, then rapidly filtered while warm, and, if necessary, further concentrated at the temperature mentioned, and set aside to crystallize. The complete saturation of the solution with carbonic acid is conveniently ascertained by means of a solution of sulphate of magnesium, which yields no precipitate in the cold with bicarbonate, but a white one with carbonate of potassium. The crystals should be drained and dried at the ordinary temperature.

About 400,000 pounds of bicarbonate of potassium and saleratus are annually imported into the United States.

Properties.—Bicarbonate of potassium crystallizes in transparent, colorless, right rhombic prisms, which are permanent in the air, and have a saline and slightly alkaline, but not a caustic taste. When heated to near 200° C. (392° F.) it gives off carbonic acid and water, suffering a loss of 31 per cent. According to Poggiale, 100 parts of water dissolve at 10° C. (50° F.) 23.23 parts; at 20° C. (68° F.) 26.91 parts, and at 60° C. (140° F.) 41.35 parts of the salt; the solution has a slight alkaline reaction to test-paper, effervesces briskly on the addition of acids, and parts with one-half its carbonic acid slowly when evaporated in vacuo, and rapidly when heated to the boiling point. Fifty grains of the salt exposed to a low red heat leave 34.5 grains of a white residue, consisting of carbonate of potassium, which requires for exact neutralization 500 grain-measures of the volumetric solution of oxalic acid; and 20 grains of bicarbonate of potassium neutralize 14 grains of citric acid, or 15 grains of tartaric acid, *Br.* A less pure bicarbonate of potassium in a pulverulent state is met with in commerce under the name of *sal aëratus;* but much sold as such is bicarbonate of sodium.

Tests.—The presence of carbonate of potassium causes the bicarbonate to become moist on exposure, and its solution in cold water to yield a white precipitate with sulphate of magnesium, and a yellow or brick-red one with corrosive sublimate; the latter reagent produces a white precipitate with pure bicarbonate of potassium. Metallic salts, if present as impurities, remain behind on dissolving the salt in water, or are indicated by producing a precipitate on the addition of sulphuretted hydrogen. Other salts of potassium are best detected in the solution acidulated with nitric acid by white precipitates depositing on the addition of nitrate of silver (chloride), or of nitrate of barium (sulphate). When sodium salts are present as impurities, the salt will impart a yellow color to the flame of the blowpipe.

Composition.—Bicarbonate of potassium represents 47 per cent. K_2O, 44 per cent. CO_2, and 9 per cent. H_2O.

Pharmaceutical Uses.—In the preparation of Liqu. magnesii citratis, *U. S.*, *Br.;* Liq. potassæ, Liq. potass. arsenit., Liq. potass. citrat., *U. S.;* Liq. potass. efferves., *Br.;* Mistura potass. citrat., Potas. acetas, Potas. carbonas pura, Potas. citras, *U. S.*

Medical Action and Uses.—It increases the quantity of the urine and renders it alkaline. In this manner it dissolves and eliminates an excess of *uric acid* in the system. Even when *stone* actually exists in the bladder, this salt lessens the irritability of the organ, diminishing the pain and the frequent necessity of urination. Doubtless, also, its primary action in the *primæ viæ* is to neutralize the excessive acidity of their contents, and thus, from the start, to prevent irritation of the nervous system. In *jaundice*, depending upon high living or upon malarial poisoning, with enlargement of the liver, dyspeptic symptoms, constipation, and scanty and turbid urine, this salt is of signal advantage. In all of these cases, its virtues probably depend upon its power of increasing the alkalinity of the blood and rendering the secretions more liquid. In *cutaneous eruptions* depending upon, or connected with the previously mentioned conditions, its virtues are unquestionable. Although bicarbonate of sodium is more generally employed than the potassium salt in the treatment of *diabetes*, the latter is, nevertheless, of great utility, and is by some authorities preferred, as promoting more effectually the elimination of uric acid. It is prescribed in doses of from thirty to fifty grains in the twenty-four hours, dissolved in about three pints of water, which should be taken partly at intervals before breakfast, and partly at meals, with red wine.

The *dose* of bicarbonate of potassium is from twenty to sixty grains in a large proportion of water.

POTASSII BICHROMAS, *U. S.*—BICHROMATE OF POTASSIUM.

Potassæ bichromas, Br.; *Kali bichromicum.—Bichromate of potash*, E.; *Bichromate de potasse*, Fr.; *Doppeltchromsaures Kali*, G.

Formula $K_2Cr_2O_7$. Molecular weight 295.

Origin.—The metal *chromium* was discovered by Vauquelin, in 1797, in a Siberian mineral which is composed of chromate of lead; but it is more abundantly found as *chrome iron ore*, which is a compound of chromic and ferrous oxides, $FeO.Cr_2O_3$. It is met with in several localities in the United States, in Russia and Sweden, and is used in preparing the bichromate.

Preparation.—The ore is roasted, finely powdered, mixed with carbonate of potassium and chalk, and the mixture strongly heated in a current of air, which oxidizes the iron to ferric oxide, and the chromium to chromic acid, the latter combining with the potassium carbonate to chromate of potassium with the evolution of carbonic acid. To facilitate the oxidation, a small portion of nitrate of potassium is sometimes added, but is not necessary; the chalk is used merely for preventing the mixture from fusing. After the roasting has been completed, the mass is lixiviated with water, which dissolves neutral chromate of potassium, and the solution, after being acidulated with nitric or acetic acid, is evaporated and crystallized. Sulphuric acid is not adapted for this purpose, because the sulphate and chromate of potassium, being isomorphous, would crystallize together. The chrome iron ore may also be roasted with lime, in which case chromate of calcium is formed, which is dissolved in water and decomposed by carbonate of potassium. During the year 1876–1877, there were 2,471,669 pounds of bichromate and chromate of potassium imported into the United States.

Properties.—Bichromate of potassium crystallizes in red transparent four-sided prisms or plates, and melts below a red heat to a transparent liquid, which on cooling crystallizes and finally falls into a crystalline powder. At a higher temperature, the salt is decomposed into oxygen gas, chromic oxide and yellow chromate of potassium, which may be separated by dissolving the latter in water. Bichromate of potassium is insoluble in alcohol, and requires, at the common temperature, about 10 parts of water for solution, but much less at the boiling point; the solution has an orange-red color, an acid reaction, and a bitter metallic taste, and is deoxidized with the formation of chromic oxide or chromic salts on the addition of sulphuretted hydrogen, sulphurous acid, or of sulphuric acid and alcohol, or other organic matters. Heated with hydrochloric acid, chlorine is given off. The solution yields a pale yellow precipitate with chloride of barium, a yellow one with acetate of lead, and a purplish-red one with nitrate of silver, the three precipitates being soluble in nitric acid.

Tests.—As met with in commerce, the salt is usually pure. Its solution should not be precipitated on the addition of carbonate of potassium (absence of calcium salt), and after having been acidulated with nitric acid, should not be disturbed by chloride of barium (absence of sulphates).

Composition.—The salt is free from water, and represents 31.86 per cent. K_2O and 68.14 CrO_3; it may be regarded as a compound of chromic anhydrid with potassium chromate $=K_2CrO_4.CrO_3$.

Other Chromates.—CHROMATE OF POTASSIUM, K_2CrO_4; molecular weight 194.5. . It is obtained by adding carbonate of potassium to a hot solution of the bichromate as long as effervescence is observed; the solution changes in color to yellow, and yields on evaporation six-sided lemon-yellow crystals, which may be fused without decomposition and dissolve in about two parts of water, the solution having an alkaline reaction. It is employed as a reagent.

CHROMATE OF LEAD, $PbCrO_4$, the well-known pigment, known as chrome-yellow, is obtained by precipitating the solution of a lead salt with chromate or bichromate of potassium. It contains 68.9 per cent. of oxide of lead and 31.1 per cent. of chromic anhydrid. On being digested with dilute solution of potassa, or with chromate of potassium, it parts with one-half of its chromic acid, leaving a bright red basic compound, which, either pure or mixed with more or less chrome yellow, is used as a pigment, under the names of *American vermilion*, *chrome red*, and *chrome orange*.

Pharmaceutical Uses.—In the preparation of valerianic acid, and, dissolved in water, as a test liquid.

Medical Action and Uses.—Bichromate of potassium acts like chromic acid, but more mildly. It should therefore be preferred where the full escharotic action of the acid is not required. We have known it to act decidedly as a caustic upon the delicate integument behind the corona glandis, when applied for the removal of *venereal warts*. Ordinary warts of the softer sort may generally be destroyed by it.

POTASSII BITARTRAS, *U. S.*—BITARTRATE OF POTASSIUM.

Potassæ tartras acida, Br.; *Tartarus depuratus*, P. G.; *Cremor tartari*, *Kali bitartaricum*, *Bitartras potassicus s. kalicus.*—*Acid tartrate of potash*, *Cream of tartar*, E.; *Bitartrate de potasse*, *Crème de tartre*, *Pierre de vin*, Fr.; *Weinstein*, G.

Formula $KHC_4H_4O_6$. Molecular weight 188.

Origin.—Acid tartrate of potassium is contained in many acidulous fruits, but is collected altogether from the juice of the grape, in which it becomes insoluble after fermentation, and is deposited in the casks in crystalline crusts. These form the *crude tartar* or *argol*, and consist of potassium bitartrate, with calcium tartrate, coloring and extractive matters, yeast and other vegetable fragments. *Red argol* is deposited from red wines, and has a brownish-red color; *white argol*, obtained from white wines, is gray or brownish-white. Crude tartar is not used medicinally, and very little is collected in the United States; but from seven to nine million pounds are annually imported, and in addition thereto from one to one and a half million pounds in the refined or partly refined state.

Purification.—Crude tartar is boiled with water, much of the coloring matter precipitated by the addition of clay, the liquid filtered through animal charcoal, or otherwise clarified and crystallized. The operation has to be repeated several times. The amount of tartrate of calcium contained in crude tartar varies between about 5 and 15 per cent. Although this salt is insoluble in water, it dissolves to some extent in solutions of tartrates; hence it cannot be removed from cream of tartar by simple recrystallization. However, the crystals forming on the side of the crystallizing vats contain less of this impurity than the crusts deposited at the bottom, and by careful management the amount may be reduced to about 3 per cent.

To obtain it free from calcium salt, finely powdered cream of tartar is macerated for twenty-four hours with 8 or 10 per cent. of hydrochloric acid, previously diluted with water; or it is dissolved in boiling water, the same amount of hydrochloric acid added, and the solution continually stirred while it cools. The mother liquor is drained off, the crystalline powder washed with cold water, and dried. A considerable proportion of bitartrate of potassium remains in the mother liquor and may be utilized in the preparation of tartaric acid by neutralizing it with lime, when tartrate of calcium is deposited.

Properties.—When a hot solution of bitartrate of potassium is rapidly cooled, the salt separates in very small crystals, which float on the liquid, and from this behavior it has received the name *cream of tartar*. The larger crystals, which are deposited, were formerly distinguished as *crystalli tartari*. When quite pure they are colorless, but as usually seen are more or less opaque from the presence of calcium tartrate. But in this form it is rarely kept in the shops, where it is almost exclusively employed in the form of powder. This is white, somewhat gritty, and has a pleasant acidulous taste. Bitartrate of potassium requires about two hundred parts of cold and fifteen parts of boiling water for solution, is freely soluble, with the formation of neutral salts, in ammonia and potassa solution, and is insoluble in alcohol. It is more soluble in dilute hydrochloric acid than in water, and is precipitated from this solution by alcohol; the solutions in dilute sulphuric and nitric acids, however, when mixed with alcohol, deposit sulphate and nitrate of potassium. When heated in a crucible, it evolves inflammable gas and the odor of burnt sugar, and leaves a black residue containing charcoal and carbonate of potassium. Subjected to destructive distillation, carbonic acid, carbonic oxide, and various hydrocarbons are obtained in the gaseous state; also an aqueous liquid containing much acetic acid, a sublimate of pyrotartaric acid, various tarry products, and, in the retort, carbonate of potassium.

Composition.—Bitartrate of potassium does not contain any water of crystallization. Each molecule contains one atom of potassium, and 25 per cent. of its weight are represented by K_2O, and on ignition 36.7 per cent. of K_2CO_3 are left.

Tests.—The United States Pharmacopœia states that when bitartrate of potassium is treated with a hot solution of potassa, whatever remains undissolved is impurity. In this way only the coarser adulterations, such as *terra alba* (see p. 295), sand, etc., or tartrate of calcium if present as impurity to a considerable extent, can be detected. Cream of tartar has been adulterated with gypsum, chalk, alum, amylaceous substances (stale bread, etc.). These substances are best detected by treating the powder with an excess of ammonia, wherein it should be completely soluble, and the solution should not be precipitated by hydrosulphuric acid (absence of copper, iron, etc.), or by oxalate of ammonium (absence of calcium salts). The residue left by ammonia will acquire a blue color on the addition of iodine if starch is present; cold dilute hydrochloric acid added to the residue will leave terra alba, starch, and some gypsum undissolved, and produce effervescence if chalk is present. The acid solution, mixed with an excess of acetate of ammonium or sodium, should not yield white precipitates with ferric chloride (phosphates), ammonia (alumina), or carbonate of ammonium (calcium salt). Chlorides and sulphates are most conveniently detected in the aqueous solution of cream of tartar, which, after addition of a few drops of nitric acid, should not be precipitated by barium nitrate (sulphates) or silver nitrate (chlorides); "one hundred and eighty-eight grains heated to redness till gas ceases to be evolved, leave an alkaline residue, which requires for exact neutralization one thousand grain-measures of the volumetric solution of oxalic acid." *Br.* This last test would prove the absence of all admixtures and impurities.

Pharmaceutical Uses.—In the preparation of Acid. tartaricum, Antim. et potassii tartras (Antimonium tartaratum), Ferri et potassii tartras (Ferrum tartaratum), Potassii et sodii tartras (Soda tartarata), and Potass. tartras, *U. S.*, *Br.* It is an ingredient of Confectio sulphuris, *Br.*, and Pulv. jalapæ comp., *U. S.*, *Br.*

Medical Action and Uses.—In full doses cream of tartar is refrigerant, laxative, and diuretic; the last operation, however, is more evident after small doses given in a large proportion of water. It is apt to disturb digestion by causing flatulence and griping, and, when long continued, to impair nutrition. In excessive doses it may act poisonously, causing vomiting, purging, thirst, colic, and great exhaustion, which may even terminate fatally.

In *febrile* diseases a weak solution of the salt moderates vascular excitement, and augments the secretion of urine. For this purpose it is conveniently dissolved in lemonade. As a purgative it is frequently associated with sulphur, magnesia, or jalap. With sulphur or with confection of senna it forms a convenient laxative in *hæmorrhoids.* With jalap it is often used as a hydragogue cathartic in *dropsy*, and especially in anasarca; and as a diuretic in the same disease, dissolved in an infusion of juniper berries. With magnesia it has been recommended in *habitual vomiting* arising from gastric acidity and in pregnancy.

The *dose* of cream of tartar, as a cathartic, is from half an ounce to an ounce; as a diuretic from sixty to one hundred and twenty grains in water largely diluted, and taken in divided doses. For the same purpose the whey may be employed, prepared by adding one hundred and twenty grains of the bitartrate to a pint of milk.

POTASSII BROMIDUM, *U. S.*, *Br.*—BROMIDE OF POTASSIUM.

Kalium bromatum, P. G.; *Bromuretum potassicum s. kalicum.—Bromure de potassium*, Fr.; *Bromkalium*, G.

Formula KBr. Molecular weight 119.

Preparation.—Take of Bromine two troyounces; Iron in the form of filings a troyounce; Pure Carbonate of Potassium two troyounces and sixty grains; Distilled Water four pints. Add the iron, and afterwards the bromine, to a pint and a half of the distilled water, stirring the mixture frequently with a glass rod for half an hour. Apply a gentle heat, and, when the liquid assumes a greenish color, add gradually the pure carbonate of potassium, previously dissolved in a pint and a half of the distilled water, until it ceases to produce a precipitate. Continue the heat for half an hour, and then filter. Wash the precipitate with the remainder of the distilled water boiling hot, and again filter. Mix the filtered liquids, and evaporate that crystals may form. Lastly pour off the mother-water, and, having dried the crystals on bibulous paper, keep them in a well-stopped bottle. *U. S.*

Take of Solution of Potash two pints; Bromine four fluidounces, or a sufficiency; Wood Charcoal in fine powder two ounces; Boiling Distilled Water half a pint. Put the solution of potash into a glass or porcelain vessel, and add the bromine in successive portions, with constant agitation, until the mixture has acquired a *permanent* brown tint. Evaporate to dryness; reduce the residue to a fine powder, and mix this intimately with the charcoal. Throw the mixture in small quantities at a time into a red-hot iron crucible, and when the whole has been brought to a state of fusion remove the crucible from the fire and pour out its contents. When the fused mass has cooled dissolve it in the water, filter the solution through paper, and set it aside to crystallize. Drain the crystals, and dry them with a gentle heat. More crystals may be obtained by evaporating the mother-liquor and cooling. The salt should be kept in a stoppered bottle. *Br.*

In the first process, ferrous bromide is formed by the action of bromine upon iron, and the solution of this salt, which is of a green color, is decomposed by potassium carbonate, resulting in the production of potassium bromide, which remains in solution, and of a white precipitate of ferrous carbonate; $FeBr_2 + K_2CO_3$ yields $2KBr + FeCO_3$. The latter is very bulky, but by boiling it for some time is converted into a denser ferric hydrate which is more readily washed out with water than the carbonate. On concentrating the filtrate, crystals of potassium bromide are obtained.

On adding bromine to solution of potassa, five molecules of bromide and one of bromate of potassium are produced; $3Br_2 + 6KHO$ yields $5KBr + KBrO_3 + 3H_2O$. By evaporating the solution to dryness, mixing the salts with charcoal, and heating to redness, the bromate is deoxidized to bromide, while the oxygen unites with the charcoal forming carbonic oxide which escapes; $KBrO_3 + C_3$ yields $KBr + 3CO$. Dissolving in water and concentrating the solution will yield the bromide in crystals. Instead of deoxidizing with charcoal, the same result may be attained by passing sulphuretted hydrogen through the solution, when the hydrogen of the latter will unite with the oxygen of the bromate, forming water, while sulphur is liberated and requires to be separated by filtration; $KBrO_3 + 3H_2S$ yields $KBr + 3H_2O + S_3$.

Properties.—Bromide of potassium crystallizes in colorless cubes when pure. As met with in commerce the crystals are white, and, having been obtained from an alkaline solution, have a slight alkaline reaction. It is permanent in the air, has a pungent, saline taste, and, when heated, melts, congealing again to a transparent mass. According to Kremers (1856) one part of this salt dissolves at 0° C. (32° F.) in 1.87, at 20° C. (68° F.) in 1.55, at 40° C. (104° F.)

in 1.34, and at 100° C. (212° F.) in 0.98 parts of water. It is less freely soluble in alcohol, and shows to reagents the behavior of potassium salts and of hydrobromic acid.

Tests.—The aqueous solution of potassium bromide should be nearly neutral to test-paper, and on the addition of chloride of calcium should produce only a slight turbidity from the presence of a trace of carbonate. Sulphates if present would yield a white precipitate with chloride of barium, insoluble in hydrochloric acid. On the addition of hydrochloric acid, the solution should remain colorless; in the presence of bromate of potassium bromine would be liberated and impart a reddish or brownish-yellow color. If nitric acid, or preferably a drop of chlorine water, is added to the solution, on the further addition of a little starch paste a blue color should not be produced (absence of iodide). Nitrate of silver produces a white precipitate, similar to that with chlorides; but only the latter is readily soluble in *dilute* ammonia; hence on agitating with a little ammonia and supersaturating with nitric acid, no precipitate should be produced, or only a faint turbidity. A more delicate test for chloride is the following: To a solution of the salt are added bichromate of potassium and sulphuric acid, and the mixture distilled; the distillate will contain *chlorochromic anhydrid*, CrO_2Cl_2, and after neutralization with ammonia, will have a yellow color and show the reaction of chromates.

Physiological Action. *On Animals.*—Experiments on various animals demonstrate that the effects of bromide of potassium are not due to the action of the salt upon the nervous centres alone but upon all the parts which immediately fall under its influence. It is indeed correctly described as a sedative of the heart and of the cerebro-spinal centres, for when administered to animals by the stomach or hypodermically the following phenomena occur: paralysis of the hind legs and of the thoracic muscles, irregular and feeble action of the heart, paralysis of the iris, évacuation of the bowels, and death usually by asthenia, but sometimes preceded by tetanic spasms. Paralysis of motion precedes that of sensation, and the loss of both functions is primarily due, not to an impression upon the great nervous centres, but upon the nervous extremities, for the loss of function begins in the extremities and advances towards the spinal cord and brain, voluntary motion and the respiratory act not ceasing until after complete spinal paralysis. Administered by the stomach the first effect upon the circulation is to produce languor of movement in the capillary bloodvessels, which is due chiefly to the sedative action of the salt upon the heart, and, as a necessary consequence, a diminution of the calibre of those bloodvessels. The heart, however, continues to beat until all other signs of life become extinct. But if the bromide in a large dose is applied directly to the heart or injected into the veins, death takes place by syncope, the paralyzed heart remaining, after death, distended. Applied directly to the capillary vessels it primarily stimulates and contracts them. The opinion has been advanced, as the result of experiments, that it is not the bromine, nor the bromide of potassium, but the potassium alone, which occasions the striking phenomena of sedation in the nervous and muscular systems. It is probable that the diminished frequency and force of the heart may be due to this element, and hence the lowering of the temperature; but no other potassium salt than the bromide diminishes the reflex excitability, or occasions sleep, or produces either the acneiform eruption, or the group of phenomena described as bromism (Krosz). That the bromine is essential to the production of these effects is proved by their occurring when, instead of combinations of bromine with alkalies, hydrobromic acid, bromated acetic acid, bromo-benzol, etc., are employed (Steinauer).

On Man.—The functional effects of bromide of potassium, generally manifested after the prolonged use of the salt in daily doses of from forty to one hundred and twenty grains, are usually such as these: the fetid odor of bromine upon the breath, redness of the soft palate, and an increased or diminished secretion of saliva; diminution and even abolition of the reflex sensibility of the palate, the root of the tongue, and the epiglottis, without diminution of the sensibility of those parts to contact and to pain; frequently a craving appetite for food, but sometimes a complete abolition of this function; constipation, some diuresis, or else arrest of the urinary secretion; sedation or complete suspension of sexual desire; diminution and retardation of the menses; pulmonary catarrh; a general heaviness or inertness, drowsiness, diminished clearness of the intellect; sleep which is generally natural, but sometimes resembles the most profound lethargy; sedation of the excito-motor functions of the spinal marrow, and an impairment of the general sensibility; the memory, especially for words, is enfeebled, and they are often strangely misused; eruptions, of acne principally, sometimes of ulcers, or boils, or of eczema, appear upon the skin, which grows muddy or bronzed; the muscles are enfeebled, and their coördinated movements imperfect; the gait is unsteady and tottering, and frequently there is loss of flesh. In the more striking cases of bromism the patient is excessively feeble and depressed; the sight and hearing lose their acuteness; the gums are red, swollen, and painful; the nostrils filled with hardened mucus, and diarrhœa exhausts the strength; pulmonary catarrh impedes respiration, and occasionally death takes place, with febrile symptoms and coma. In exceptional cases mental derangement is superadded, with maniacal violence and hallucinations.

It has been remarked that children of from seven to fifteen years of age tolerate larger doses of the bromide than other persons, and are less apt than adults to become dull and sleepy, or to have their muscular coördination impaired. This peculiarity is probably due to the rapid elimination of the salt, especially by the salivary glands, the kidneys, and the skin.

All of the phenomena produced by bromide of potassium appear to depend upon its power of restricting the capillary circulation. This seems to be a legitimate inference from the inhibitory and paralyzing influence it exerts upon the spinal nervous system, including, especially, its anaphrodisiac and antispasmodic operation, and from its influence on the brain in producing its characteristic sleep and in palliating pain. If, as seems probable, it causes contraction of the capillary bloodvessels, as well as a sedation of the heart's action, the phenomena alluded to may be ascribed to these agencies, as may also those morbid alterations of nutrition above described. Since this judgment was written, the observations of Dr. Mary Putnam Jacobi on the human brain exposed by an opening in the cranium have been published. They led to the conclusion that bromide of potassium produces a contraction of the smallest bloodvessels and capillaries, the larger remaining the same, or, in other words, that it limits directly the nutrition, and, therefore, the activity of the organ.

Medical Uses.—As is usual in the history of medicines, the virtues of bromide of potassium were discovered accidentally. The high price of iodide of potassium, which is so largely used in the treatment of constitutional syphilis, caused a trial to be made of the bromide in the hope that it might serve as a substitute for the more costly salt. The result showed that the scientific anticipation was totally unfounded, but at the same time revealed the sedative anæsthetic and hypnotic virtues of the medicine, and led to its more suitable use in therapeutics, at first in allaying priapism and other forms of sexual excitement, then in hysteria and in hystero-epilepsy, and finally in epilepsy itself. Since then it has been employed in the following diseases.

In *sleeplessness* depending upon nervous excitement, exhaustion, and irritability, in hysterical and maniacal wakefulness for example, rather than upon cerebral hyperæmia as it occurs in sthenic inflammatory diseases, the utility of the medicine is most conspicuous. This fact is not altogether incompatible with the probable theory which ascribes the hypnotic virtues of the bromide to its power of diminishing the amount of blood in the brain, but is more in accordance with the view that it causes sleep by anæsthetizing the organ, precisely as it does the fauces and other parts when directly applied to them. It is a valuable substitute for opiates in those cases of infantile wakefulness which depend more upon nervous erethism than upon pain or any local disease. In the last named cases a dose of ten grains, repeated if necessary, will suffice; but in adults from twenty to forty grains should be administered every hour or two until the proper effect is obtained. This may be promoted by cold ablutions of the head or prolonged tepid baths.

Neuralgia occurring in connection with general nervous erethism induced by exhausting causes; or with a state of hypochondriac melancholy, with more or less functional derangement of the stomach, heart, etc.; or with an overstrained nervous system goaded by unsatisfied sexual desires, has been repeatedly palliated and sometimes cured by this medicine. The best result is most apt to be reached in the last-named form of the disease. But a case is on record in which a man of sixty-two, who had suffered from tic-douloureux for twenty-eight years, was completely cured in a fortnight by the daily administration of one hundred grains of the bromide, given in divided doses. (Peter.)

In almost all forms of *insanity*, attended with excitement and insomnia, this preparation is of great value, no other having an equal power of allaying the symptoms with so little risk of injury. In *delirium tremens* it is equally efficient, but is less so in mania-a-potu. In *chorea* no other medicine exerts so powerful a restraint upon the movements, or more frequently leads to a permanent cure. But the greatest triumph of bromide of potassium is shown by its control over *epilepsy*, a disease more intractable than any other that is not inherently fatal. When epilepsy is congenital, or is caused by traumatic or other substantial lesions, this medicine, like all others, may be altogether inefficacious. The nearer the disease approaches to a purely functional disorder, the more amenable it is to treatment, and, therefore, the more so in proportion as it is of recent origin, and before those alterations of nutrition have taken place in the blood-vessels and in the substance of the nervous centres which render the disease inveterate. Such at least is, as we conceive, the more judicious opinion; but, in the judgment of some, neither the cause, degree, nor duration of the disease enables one to judge how well or ill it may be affected by the medicine. All are, however, agreed that the medicine must be administered in full doses and for a long time; in daily doses amounting to not less than sixty grains, and gradually increased as its active power declines. Whether or not radical and absolute cures are ever made of genuine epilepsy is undetermined; but the great preponderance of opinion is unquestionably upon the negative side of the proposition. The most authoritative judgment is that the epileptic is never secure against a return of his attacks, and that if he is prudent he will, in spite of an apparent cure, continue to use the medicine at intervals for the remainder of his life; or, as one has phrased it, it should become, as it were, his daily bread.

In *tetanus*, idiopathic as well as traumatic, this bromide has exhibited decided curative powers, and some cases have recovered after enormous quantities of it had been taken. In one case which recovered about a pound of the salt was consumed in the treatment; and in another thirteen ounces were used in twenty days. In *poisoning by strychnia* the results have been equally striking and conclusive, and confirm clinically what physiological experiment had before demonstrated, that bromide of potassium is a true antagonist of strychnia. It is remarkable that a medicine supposed to have a special influence upon the nervous centres connected with the genital organs should not have proved more curative of *hysteria* than of epilepsy itself. Clinical experience, however, shows its influence over hysterical attacks to be very slight and transient; and yet, on the other hand, it is efficacious in certain *local hysterical spasms*, as of the eyelids, œsophagus, and facial muscles, connected with uterine irritation. *Infantile convulsions*, arising from teething and other excentric causes of irritation, have repeatedly been arrested by this medicine, which may be administered by the rectum if it cannot be given by the mouth, in doses of from five to ten grains repeated every hour. In some cases of *puerperal convulsions* it has proved equally efficacious, but is probably a less reliable remedy than the anæsthetics. In *whooping cough* bromide of potassium has been employed by the stomach and also by the inhalation of its atomized solution. By the former method the spasmodic element is eliminated indirectly, and by the latter through a direct anæsthetic action upon the larynx. In this manner one of the most dangerous factors of the disease is removed. For inhalation there may be used a solution of two grains of the salt in an ounce of water. *Spasmodic asthma* has been treated in the same manner, and with notable advantage. *Spasmodic vomiting*, due to reflex irritation, as in *pregnancy*, is sometimes effectually controlled by it, especially when full doses (sixty to ninety grains) are given either by the mouth or the rectum. The *vomiting of phthisis*, which is so serious a symptom in the advanced stages of the disease, may generally be controlled by applying a strong solution of the salt to the pharynx and larynx by means of a brush or by atomization. *Nervous palpitation* of the heart and *mercurial tremor* are favorably influenced by this bromide.

Bromide of potassium, it has already been stated, even when freely used by healthy persons, blunts, or suspends, both sexual desire and power; and it has been employed with great advantage when erections of the penis result from morbid conditions either of the sexual organs or of the nervous centres. There is no more effectual preventive of *chordee* produced by gonorrhœa, and of the persistent *erections* so frequently met with in infants, and those which sometimes follow the application of cantharidal blisters. The same is true of certain less ordinary cases of persistent *priapism*, as well as of the common examples of nocturnal *seminal emissions*, especially as they occur in young men of chaste life and sedentary habits, and in those who have been more or less addicted to self-abuse. Not less serviceable is it in relieving nocturnal *incontinence of urine* in children. It has also been used with excellent results in those cases of hysteroidal excitement which verge on *nymphomania*. In these several instances large doses of the medicine must be employed.

Several examples have been published which go to prove that bromide of potassium is occasionally successful in curing *intermittent fever* when quinia and arsenic have failed; and even when, after the cure of the paroxysmal attacks, the *spleen* remains enlarged, it is asserted that no other remedy so promptly and certainly reduces it to its normal dimensions as bromide of potassium. For this purpose it need not be prescribed in larger doses than fifteen or twenty grains a day. In the defective sight or *amblyopia* sometimes produced by intemperance, this bromide has been found very useful when given in doses at first of ten grains three times a day, and gradually increased until its specific effects upon the nervous system begin to show themselves. It probably acts by diminishing the congestion of the cerebral bloodvessels.

The association of the bromide of potassium with quinia, and also with iron, is said to prevent the headache, throbbing, and general discomfort, which some persons experience on taking those medicines, and also the nauseant and depressing effects which occasionally follow the use of opiates.

The anæsthetic action of the medicine upon the *pharynx* and *larynx* has already been referred to in connection with ulcerated states of these organs; the same influence is invoked for facilitating the use of the laryngoscope, and for lessening the irritability of the *urethra* when the introduction of instruments through it is required. In the treatment of *gangrenous sores* its antiseptic virtues may be invoked.

The commencing *dose* of bromide of potassium is from three to thirty grains, according to the age of the patient. It is necessary to repeat the dose several times a day, and, in most cases, to increase it until its specific effects begin to appear. It should then be reduced, or for a brief space of time suspended.

POTASSII CARBONAS.—CARBONATE OF POTASSIUM.

Potassæ carbonas, Br.; *Kali carbonicum, Carbonas potassicus s. kalicus.—Carbonate of potash (potassa)*, E.; *Carbonate de potasse*, Fr.; *Kohlensaures Kali*, G.

Formula K_2CO_3. Molecular weight 138.

Origin and Preparation.—Carbonate of potassium is contained in many mineral waters, and is met with in the animal economy chiefly after the administration of citrate or tartrate of potassium. Plants take their inorganic constituents from the soil, and when incinerated leave them behind as *ashes*. The ash of most plants contains potassium, sodium, calcium, and magnesium, in combination with chlorine, carbonic, sulphuric, phosphoric, and silicic acids, usually ferric oxide, and occasionally some other elements. As a general rule, plants grown near the seashore yield an ash rich in sodium, and those grown inland an ash in which potassium salts are predominating. Succulent plants or parts of plants generally yield a larger percentage of ash (calculated for the exsiccated substance) than dry or woody parts. The amount of ash and its constituents necessarily varies to a certain extent, being influenced by the nature of the soil, the age of the plant, and by various other causes; the composition of the ash and of its soluble portion must therefore vary for the same species. Among the vegetables which yield an ash rich in potassium salts must be mentioned *corn-cobs*, that is, the fully-developed axis of the fruit spikes of Zea mays, after having been deprived of the corn. Examined by H. Hazard (1872), they were found to contain on an average, when air-dried, 0.762 per cent. of carbonate of potassium, which may easily be obtained in a nearly pure state; and estimating the corn crop of the United States at 1,100,000,000 bushels, and 14 pounds of cobs to the bushel, he calculated that 115,000,000 pounds of this alkali could be obtained from that source alone.

At the present time this article is chiefly obtained in those countries, as in some parts of Europe and North America, where wood is cheap, or where its transportation to more remunerative markets is too costly, by burning the wood and lixiviating the ashes. The solution is obtained as concentrated as possible, by passing the weaker liquids through fresh portions of ash and evaporating them in iron vessels to such a consistence that on cooling they will solidify to a very hard mass; this constitutes the *crude potash* of the market. This crude potash is of a more or less deep brown, reddish-brown, or bluish color, due to organic impurities, and to iron, copper, or manganese; is deliquescent on exposure, and has a very caustic taste. It is not recognized by any of the Pharmacopœias.

POTASSII CARBONAS IMPURA, *U. S.;* Kali carbonicum crudum, *P. G.;* Cineres clavellati.—Impure carbonate of potassium, Pearlash, *E.;* Potasse impur, *Fr.;* Rohe Pottasche, *G.* This is prepared from the impure article just described by calcining it in suitable furnaces in contact with the air, whereby the water is driven off and the organic matters are oxidized. By treatment with water, lime, silica, and some other insoluble matters are left behind, and on evaporation a purer product of a whitish color is obtained.

POTASSII CARBONAS, *U. S.;* Kali carbonicum depuratum, *P. G.*—Carbonate of potassium, *E.;* Carbonate de potasse, *Fr.;* Gereinigtes kohlensaures Kali, *G.* The following directions for its preparation are given by the United States Pharmacopœia:—

Take of Impure Carbonate of Potassium thirty-six troyounces; Water two pints and a half. Dissolve the impure carbonate of potassium in the water and filter the solution; then pour it into an iron vessel and evaporate over a gentle fire until it thickens. Lastly, remove it from the fire, and stir constantly with an iron spatula until it forms a granular salt.

POTASSII CARBONAS PURA, *U. S.;* Potassæ carbonas, *Br.;* Kali carbonicum purum (s. e tartaro), *P. G.;* Sal tartari.—Pure carbonate of potassium, *E.;* Carbonate de potasse pur, *Fr.;* Reines kohlensaures Kali, *G.* According to the United States Pharmacopœia, this is obtained as follows :—

Take of Bicarbonate of Potassa in coarse powder twelve troyounces; Distilled Water twelve fluidounces. Put the bicarbonate of potassium into a capacious iron crucible; heat gradually until the water of crystallization is driven off; then raise the heat to redness, and maintain that temperature for half an hour. Having taken the crucible from the fire and allowed it to cool, dissolve its contents in the distilled water and filter the solution. Pour this into an iron vessel and evaporate over a gentle fire until it thickens. Lastly, remove it from the fire, and stir constantly with an iron spatula until it forms a granular salt.

Various methods of obtaining carbonate of potassium from other sources have been recommended, and to some extent are used. E. Meyer (1857) proposed to ignite an intimate mixture of 10 parts of *feldspar* (silicate of aluminum and potassium) with from 14 to 18 parts of lime, to boil the mass with water under pressure, and to evaporate the solution, at the same time conducting the products of combustion over the liquid, in order to convert the caustic potassa into carbonate and to precipitate the alumina which was in solution.

Large deposits of minerals containing potassium, besides other salts, are found in various localities and worked for the production of potash in its various compounds; the most prominent of which, at the present time, is Stassfurt, in Germany, where the carbonate is made by a process similar to that of Leblanc for soda, by heating the sulphate with lime and charcoal, whereby carbonate of potassium and an insoluble oxysulphide of calcium are formed. Balard (1865) found it advantageous to employ not pure sulphate of potassium, but a salt containing about 20 per cent. of magnesium sulphate, which leaves the product of ignition in a porous condition, so that it may readily be exhausted by water.

When an organic salt of potassium is ignited, the residue left contains carbonate of potassium. Cream of tartar, being the most common salt available for this purpose, was formerly more extensively employed than at present for preparing pure carbonate of potassium, hence the name *salt of tartar*, which is, however, in the United States usually employed as a synonym for *purified* carbonate of potassium. In making carbonate from the bitartrate of potassium, the latter is usually mixed with saltpetre, which should be entirely free from chloride, and then deflagrated by throwing the mixture in small portions into a red-hot crucible, when the potassium of both the bitartrate and nitrate is left behind as carbonate. If one part of saltpetre is used for three parts of cream of tartar, the residue has a black color due to finely divided charcoal, and is known as *black flux;* but if the saltpetre is increased so as to be equal in weight to the cream of tartar, the product, owing to its color, is called *white flux;* it usually contains nitrite of potassium. By exhausting the black flux with water and evaporating the solution, a very pure carbonate of potassium is obtained.

Since pearlash contains, besides carbonate, various other soluble salts of potassium and sodium, a pure carbonate cannot be obtained from it, though many of the foreign salts may be removed by the use of cold water in small quantities in which the other salts are less soluble than the carbonate. But by converting the carbonate into bicarbonate (see page 1104), the latter salt may be obtained nearly chemically pure, and when heated to redness will give off water and carbonic acid and leave an equally pure carbonate; $2KHCO_3$ yields $K_2CO_3 + H_2O + CO_2$. This is the process adopted by the United States Pharmacopœia. In the above-described operations, only silver or clean iron vessels should be employed for reasons explained under Potassa (see page 1099).

Properties.—Carbonate of potassium in its pure state is a white salt usually in the form of a granular powder, which is deliquescent in the air, forming a colorless or yellowish liquid of an oily appearance (*Oleum tartari per deliquium*). It is soluble in its own weight of cold water and in two-thirds its weight of boiling water, and from its concentrated solution may with some difficulty be obtained in transparent crystals containing 16.4 per cent. of water ($1\frac{1}{2}H_2O$). It is insoluble in alcohol, dissolves in dilute acids with effervescence, and has the chemical behavior of potassium salts. It has a strong alkaline reaction and a strongly alkaline but scarcely a caustic taste. 20 grains of it neutralize 17 grains of citric acid or 18 grains of tartaric acid. The impurer varieties closely resemble the pure salt, but are distinguished by the following

Tests.—POTASSII CARBONAS IMPURA: The greater portion of pearlash should be soluble in water, and "the soluble matter contained in 100 grains of it should neutralize not less than 58 grains of officinal sulphuric acid." *U. S.* This test would require pearlash to contain about 80 per cent. of K_2CO_3, an amount which is not too large, if the pearlash is to be examined in the anhydrous state. The requirements of the German Pharmacopœia, "that it should contain at least 65 per cent. of K_2CO_3, and not over 18 per cent. of water," are practically identical with the preceding.

POTASSII CARBONAS: It should be almost completely soluble in its own weight of water, and when the solution is treated with nitric acid in excess it should exhibit merely a faint cloudiness on the addition of barium chloride, afford only a slight precipitate with nitrate of silver, and should not be colored dark by sulphuretted hydrogen. The gelatinous precipitate which settles gradually from its acidulated solution is silica. The German Pharmacopœia requires that the salt should contain less than 18 per cent. of water, and about 80 per cent., or, in the anhydrous state, not less than 92 per cent. of K_2CO_3.

POTASSII CARBONAS PURA: It should be completely soluble in water, and, when supersaturated with nitric acid and evaporated to dryness, the residue should be entirely soluble in water (or leave only a little silica undissolved, *Br.*), and the solution should not be precipitated (only faintly precipitated, *Br.*) by chloride of barium or nitrate of silver. The absolute chemical purity demanded by the United States Pharmacopœia is only with difficulty attainable. 100 grains of the salt lose 16 grains when exposed to a red heat, *U. S.*, *Br.* 83 grains require for neutralization at least 980 grain measures of the volumetric solution of oxalic acid, *Br.* This test indicates a nearly pure salt, containing 98 per cent. of the crystallized carbonate, $2K_2CO_3.3H_2O$, the molecular weight of which is 330.

Other Tests.—The following additional tests will be found useful: *Sodium* salts will be detected in the nearly neutralized solution by the white cloudiness or precipitate occasioned on the addition of antimoniate of potassium, and by the yellow color imparted by the salt to an alcohol flame. *Nitrites* and *nitrates* are indicated by the purple or blackish-brown color appearing on the addition to the solution of a little ferrous sulphate, and afterwards of some strong sulphuric acid. *Cyanide* of potassium, if present, will yield a blue precipitate or color with a mixture of ferrous and ferric salt strongly acidulated with hydrochloric acid. *Phosphate* is indicated, if a white precipitate appears in the solution, previously acidulated with hydrochloric acid and again rendered alkaline by ammonia, on the addition of magnesium sulphate.

Pharmaceutical Uses.—Liquor kali carbonici: 11 parts of pure carbonate of potassium are dissolved in 20 parts of distilled water; the solution has the specific gravity 1.330 to 1.334. *P. G.*

Pearlash is only employed for preparing purified carbonate of potassium. In the preparation of most potassium salts the pure carbonate or the bicarbonate of potassium may be employed. Carbonate of potassium is employed in preparing Atropia, Liquor arsenicalis, *Br.;* Mistura ferri comp., Potass. sulphuretum, *U. S.*, *Br.;* and for Decoct. aloes comp. and Enema aloes, *Br.*

Medical Action and Uses.—Carbonate of potassium is less irritant than potassa, but more so than the bicarbonate. In large doses, although diluted, it acts as an irritant on the stomach, and even as a caustic when pure or but slightly diluted. It has been employed in baths in the treatment of *tetanus*, *puerperal convulsions*, *paralysis*, chronic *gout* and *rheumatism*, *glandular swellings*, *suppressed cutaneous eruptions*, etc. In all of these cases it probably acts through its counter-irritant rather than by its alkaline virtues.

Internally, carbonate of potassium has been much used, in common with other antacids, in the treatment of *gouty* and *dyspeptic* conditions attended with a highly acid state of the urine. It is most efficient when the tendency to this form of secretion, which probably depends upon the imperfect oxidation of effete matters, is corrected by bitter tonics and hygienic measures. Formerly, theoretical views of the action of alkalies led to the use of carbonate of potassium in various inflammations, membranous and parenchymatous, but especially in those attended with plastic exudation. It was hence extensively used in *membranous croup*, *pneumonia*, *peritonitis*, and *glandular enlargements*, and positive assertions were made of its curative powers; their value was, however, greatly impaired by the fact that, in general, mercury was associated with the alkaline medicine, as well as by leaving out of account the influence of hygienic measures, the natural tendency of the disease, etc. Very probably subacute inflammations of *lymphatic glands*, and enlargement of the liver, with *jaundice*, affecting intemperate eaters and drinkers, have been benefited by this medicine, since, like all the alkaline carbonates, it tends to render the blood more watery and therefore less nutritive, and less apt to produce congestions in parenchymatous organs. In this way, doubtless, it has been profitably used in hepatic and splenic *dropsy*. On the whole, there is nothing in carbonate of potassium to render it superior or even equal to the sodium carbonates for any purpose to which alkaline medicines are applied internally.

The *dose* of carbonate of potassium is from ten to thirty grains. For external use a solution of one hundred and twenty grains in a pint of water, or an ointment containing from ten to sixty grains of the salt in an ounce of lard, may be employed.

POTASSII CHLORAS, *U. S.*—CHLORIDE OF POTASSIUM.

Potassæ chloras, Br.; *Kali chloricum*, P. G.; *Kali oxymuriaticum*, *Kali muriaticum oxygenatum*, *Chloras potassicus s. kalicus.*—*Chlorate of potash*, E.; *Chlorate de potasse*, Fr.; *Chlorsaures Kali*, G.

Formula $KClO_3$. Molecular weight 122.5.

Preparation.—Take of Carbonate of Potash twenty ounces; Slaked Lime fifty-three ounces; Distilled Water a sufficiency; Black Oxide of Manganese eighty ounces; Hydrochloric Acid twenty-four pints. Mix the lime with the carbonate of potash, and triturate them with a few ounces of the water so as to make the mixture slightly moist. Place the oxide of manganese in a large retort or flask, and, having poured upon it the hydrochloric acid, dilute with six pints of water, apply a gentle sand heat, and conduct the chlorine as it comes over, first through a bottle containing six ounces of water, and then into a large carboy containing the mixture of carbonate of potash and slaked lime. When the whole of the chlorine has come over, remove the contents of the carboy, and boil them for twenty minutes with seven pints of the water; filter and evaporate till a film forms on the surface, and set aside to cool and crystallize. The crystals thus obtained are to be purified by dissolving them in three times their weight of boiling distilled water, and again allowing the solution to crystallize. *Br.*

On passing chlorine gas into a solution of potassa, hypochlorite and chloride of potassium are formed; $6KHO + 3Cl_2$ yield $3KClO + 3KCl + 3H_2O$. On boiling the solution, the hypochlorite is decomposed into chlorate and chloride; $3KClO$ yields $KClO_3 + 2KCl$. The entire reaction, therefore, results in the production of one molecule of chlorate and five of chloride of potassium, and the two salts must be separated by recrystallization. To avoid the loss of potassium salt, Graham (1841) proposed to substitute an equivalent quantity of lime for five-sixths of the potassa, and this is the process which is now generally followed in making the chlorate on the large scale, and the details of which, as recommended by the British Pharmacopœia, have been described above. It has the additional advantage that the previous preparation of caustic potassa is unnecessary. In the presence of water, hydrate of calcium reacts with chlorine in a manner precisely analogous to that of hydrate of potassium, yielding hypochlorite and chloride of calcium (see page 326), and, on boiling, the hypochlorite is decomposed into chloride and chlorate of calcium, the latter of which, by mutual decomposition with chloride of potassium, produces chlorate of potassium and chloride of calcium. It will be observed that the reactions in this process are apparently complicated; but, as explained above, the final results are expressed by the equation $K_2CO_3 + 6CaH_2O_2 + 6Cl_2 = 2KClO_3 + 5CaCl_2 + CaCO_3 + 6H_2O$.

In some chemical operations chloride of potassium is obtained, and this salt may be advantageously used in the preparation of chlorate by a process very similar to that of Graham, as was shown by Liebig (1842). In this case the reaction results as follows: $KCl + 3CaH_2O_2 + 3Cl_2 = KClO_3 + 3CaI_2 + 3H_2O$. Or chlorinated lime may be boiled with chloride of potassium, in which case the final products are likewise chlorate of potassium and chloride of calcium.

During the year ending June 30, 1877, nearly one and one-eighth million pounds of this salt were imported into the United States.

Properties.—Chlorate of potassium crystallizes in colorless, shining, rhomboidal plates, and has a cooling, saline taste. It is permanent in the air, melts without decomposition at 334° C. (633.2° F.), gives off oxygen at 355° C. (671° F.), at the same time it forms potassium perchlorate, and at a higher temperature parts with all its oxygen (39 per cent. of its weight), leaving potassium chloride. It requires, at 15° C. (59° F.), nearly 17 parts of water for solution; at 35° C. (95° F.), a little over 8 parts; and, at the temperature of boiling water, somewhat less than 2 parts. It is slightly soluble in ordinary alcohol, but is insoluble in absolute alcohol. It should never be triturated together with sulphur, sugar, tannin, or other readily oxidizable substances, except in the presence of water; or if dry mixtures are to be made, the ingredients should be powdered separately, and mixed by means of a sieve and without friction, in order to avoid violent explosions. As ordinarily met with in commerce, the salt contains traces of calcium chloride, from which it is freed by dissolving it in two or three times its weight of distilled water, and stirring the solution while cooling; it will then be obtained in small crystals, which, after draining and washing with cold water, are pure. When strong sulphuric acid is added to chlorate of potassium, *perchloric oxide* Cl_2O_4 is formed; this is a yellow, heavy gas, which, in the presence of combustible matter, or by a slight elevation of temperature, is decomposed with a powerful explosion into oxygen and chlorine.

Tests.—The aqueous solution of chlorate of potassium should not be precipitated by chloride of barium (sulphate), nitrate of silver (chloride), or oxalate of ammonium (calcium salt). After heating the salt to redness until gas ceases to be evolved, the residue should have a neutral reaction to test-paper, and should not produce a red precipitate with corrosive sublimate (absence of nitrate).

Other Potassium Salts containing Chlorine.—POTASSII CHLORIDUM, s. *Kalium chloratum*, s. *Sal digestivum Sylvii*, chloride of potassium, KCl, molecular weight 74.5. It is obtained in large quantities at Stassfurt from *carnallite*, a double chloride of potassium and magnesium, and forms white or colorless cubes or quadrangular prisms, which have a saline taste resembling that of table salt, and which are fusible without decomposition. It dissolves in three parts of cold and two parts of hot water, is slightly soluble in alcohol, but is insoluble in absolute alcohol.

POTASSII PERCHLORAS, $KClO_4$, perchlorate of potassium, molecular weight 138.5. To obtain it, chlorate of potassium is carefully heated until it begins to evolve oxygen, and is kept at this temperature until gas is no longer given off; and a portion of the residue, on being tested with strong hydrochloric acid, acquires only a faint yellow color. The saline mass is dissolved in water, and freed from chloride by recrystallization. Perchlorate of potassium is in colorless rhombic crystals, which have a slight saline taste, and when heated to about 400° C. (752° F.) is decomposed into oxygen gas and potassium chloride. It is insoluble in alcohol, and dissolves in $5\frac{1}{2}$ parts of boiling water, but requires at 15° C. (59° F.) 65 parts, and at 10° C. (50° F.) 88 parts of water for solution.

Pharmaceutical Uses.—Chlorate of potassium is an ingredient of Trochisci potass. chloratis, *U. S.*, *Br.*, and is used in the manufacture of permanganate of potassium. It enters also into the composition of fireworks, and of several blasting powders.

Physiological Action.—The large amount of oxygen contained in this salt early led to its being used to cure a variety of diseases, which, according to the fashion of the day, were supposed to depend upon putrefactive changes in the blood, etc. These theoretical notions met with their usual fate, and the medicine had been but little used for more than forty years when attention was attracted to it by its power of rapidly healing cancrum oris and aphthous ulcers of the mouth. No sensible effects are produced by it in daily doses of from fifteen to sixty grains, but in doses of from one to four or five drachms it renders the venous blood everywhere more florid, so that the gums and fauces are of a bright red color, and the teeth are whitened. The appetite is increased, and in children sometimes the bowels become loose, with greenish stools. It increases the flow of urine, and may be recovered from that secretion; sometimes it causes aching in the kidneys. It also passes off with the saliva, the bile, the milk, tears, nasal mucus, and perspiration. In excessive doses it may be poisonous. In one case three hundred grains were taken daily for four successive days by a consumptive patient. Obstinate vomiting and severe intestinal pain continued until death, after which inflammation of the mucous coat of the stomach was found. In another case half an ounce, largely diluted, was taken early in the morning; diuresis continued during the day, and, in the evening, vomiting, purging, and cramps occurred, with extreme prostration, and a cold, blue skin. The urine was scanty and dark, and then suppressed. For a week "violent enteritis, gastritis, and cystitis ensued, with incessant vomiting and intense pain." Death took place on the seventh day; and, on examination, the mucous membranes of the whole alimentary tract and of the bladder were disorganized, and crystals of the chlorate were found in the pelves of the kidneys. In a third case a hearty, well-developed little girl, two years and a half old, ate about half an ounce of the dry crystals of the salt. The only symptoms were persistent vomiting, with rejection of a portion of the undissolved salt, and a strong inclination to slumber, which became a lethargic condition, and ended in death after five or six hours. There were no indications of pain. (Kennedy, *Am. Journ. Pharm.*, March, 1878.)

The bright red color of the venous blood in certain cases when chlorate of potassium has been freely taken is generally ascribed to the oxygen which this salt so abundantly contains; but it is alleged, on the other hand, that it shares this action with the alkaline carbonates, and that in excessive doses it renders the blood not only dark but incoagulable. Its antiseptic powers, like those of common salt, are not due to the oxygen it contains. It acts as a depressor, and not, like oxygen, as a stimulant of the heart's action, and when injected into the veins of an animal it kills by arresting the heart.

Medical Uses.—The utility of this salt in curing *mercurial salivation* and mercurial *ulcers* of the mouth and throat is now attested by universal experience; but it is not so certain that it acts through the blood after absorption from the stomach, since the same favorable effects are observed when a solution of it is used as a topical application only. That it does not act through any relation it may have to mercury in the system is proved, not only by the fact just stated, but also by its equal efficiency in non-mercurial salivation, as, for instance, when the throat has been injured by caustic potassa, and in like manner, in every form of buccal ulceration, as *ulcerative stomatitis*, *aphthæ* (or follicular stomatitis), *gangrenous stomatitis*, *buccal* and *pharyngeal diphtheritis*, and the sore mouth produced by chronic *arsenical poisoning*. Although the contrary has been asserted, it is utterly useless in an affection often confounded with, but very different from, them,—*thrush*, or *muguet*, which is a parasitic growth from decomposed milk. It has been used internally, and also topically by atomized inhalations and in simple solution, for the treatment of *croup* (pseudo-membranous laryngitis), and although it may in a slight degree tend to soften the membrane, its favorable influence on the issue of the disease is not well established.

Several physicians have thought that a very dilute solution of this salt has been serviceable in low types of fever, and particularly in *scarlatina* and *typhoid fever;* but the ground of this opinion has, so far, been theoretical rather than practical, and the same remark is, perhaps, applicable to its alleged utility in *neuralgia*. Another example of the illusions which theoretical speculations may give rise to, is the statement that in a case of cardiac *cyanosis* it maintained oxygenation of the blood long enough for the patient to accommodate himself to the influence of the malformation under which he suffered; and that in a case of pleural effusion and in another of pleural hemorrhage, it sustained life long enough for nature to effect the cure. This nature probably did without reference to the chlorate of potassium. On the same principle have been explained numerous cases of prevented *miscarriage*. Whether the medicine acted as supposed, or acted at all, its virtues in these respects are at least testified to by the most eminent obstetricians of Edinburgh.

In *ovarian dropsy* this medicine is thought to have removed the disease, or arrested its development; but its cures of the sort are neither so numerous nor so well attested as those of *general dropsy* from renal disease. Its diuretic operation has been noted above, and its presence in the kidneys after death; but whether it acts as a direct stimulant of these organs or otherwise, the clinical proof of its efficacy in certain cases of dropsy appears established.

The utility of chlorate of potassium in the treatment of *ulcers* of the mouth naturally led to its use in other ulcerous affections, as those which follow syphilitic *buboes*, and other *abscesses*. Its cicatrizing powers are unquestionably very great. In some cases of *phagedenic sores* the pulverized salt has arrested the progress of the disease. Enemas of a moderately strong solution of the salt (ʒj to f℥ij–f℥iv) may be used in chronic dysentery, and will tend materially to heal the rectal sores, while those seated higher up in the bowel may be entrusted to astringents or to subnitrate of bismuth. An advantage which this salt possesses as a dressing for gangrenous sores and others discharging a *fetid secretion* is its deodorizing quality; it thus makes a suitable injection in *ozæna*, an appropriate gargle in certain cases of *fetid breath*, etc. A solution of sixty grains in four fluidounces of water may be used for these purposes. In the treatment of *cancroid* the topical application of the salt in strong solution has sometimes been followed by healing of the ulcer, if that existed, and less frequently by a removal of the tumor. It may, at the same time, be given internally.

The *dose* of chlorate of potassium for children under three years of age is about five grains three times a day, and for an adult from ten to thirty grains. It should be dissolved in hot water, and a sufficient quantity of gum and sugar added, to suspend the undissolved portion when the liquid grows cold. It is best administered before meals. As a lotion from fifteen to thirty grains in an ounce of water may be used. The iodates of potassium and sodium have been proposed as substitutes for the chlorate.

POTASSII CITRAS, *U. S.*—CITRATE OF POTASSIUM.

Potassæ citras, Br.; *Kali citricum, Citras potassicus s. kalicus.—Citrate of potash*, E.; *Citrate de potasse*, Fr.; *Citronsaures Kali*, G.

Formula $K_3C_6H_5O_7$. Molecular weight 296.

Preparation.—Take of Citric Acid ten troyounces; Bicarbonate of potassium fourteen troyounces; Water a sufficient quantity. Dissolve the citric acid in a pint of water, with the aid of a gentle heat, add the bicarbonate of potassium gradually, and, when effervescence has ceased, filter the solution and evaporate to dryness, stirring constantly, after a pellicle has begun to form, until the salt granulates. Keep it in a well-stopped bottle. *U. S.*

The process of the British Pharmacopœia is identical with the preceding, except that carbonate instead of bicarbonate of potassium is employed; six ounces of crystallized citric acid require about eight ounces of carbonate of potassium for neutralization. The potassium of the bicarbonate or carbonate unites with the citric acid, forming citrate of potassium, while carbonic acid is given off; $3KHCO_3+H_3C_6H_5O_7$ yields $K_3C_6H_5O_7+3CO_2+3H_2O$. On evaporating the clear solution, the heat must not be permitted to rise high enough to burn the salt; and continued stirring is necessary towards the end of the process to prevent the salt from forming a hard layer on the bottom of the vessel, and to obtain it in a granular condition. When dry, it may be triturated in a warm mortar, and may thus be rendered uniformly pulverulent.

Properties.—Citrate of potassium is a white granular powder, having a saline and slightly alkaline taste. It is deliquescent on exposure, dissolves readily in water, is insoluble in absolute alcohol, and forms with dilute alcohol an aqueous solution, upon which a stronger alcohol floats. Its solution remains clear on the addition of chloride of calcium till it is boiled, when a white precipitate of calcium citrate takes place, which is readily soluble in acetic acid. From its concentrated solution it may be procured in transparent needles which contain $H_2O = 5.7$ per cent. This water of crystallization is not completely expelled until the heat is raised to about 200° C. (392° F.), a portion being retained by the salt as prepared by the officinal process. This amounts to one-half a molecule, according to the British Pharmacopœia, which directs that 102 grains of it, heated to redness until gases cease to be evolved, shall leave an alkaline residue requiring for exact neutralization 1000 grain measures of the volumetric solution of oxalic acid; of the anhydrous salt, 97 grains would be sufficient.

Tests.—The aqueous solution of the salt should not have an acid reaction to test-paper, and should not effervesce on the addition of acetic acid (absence of carbonate), or produce with it a crystalline precipitate (absence of tartrate). The precipitates produced by chloride of barium and nitrate of silver are soluble in dilute nitric acid.

Medical Action and Uses.—The medicinal virtues of this salt are described under the heads of the Solution and the Mixture of Citrate of Potassium, in which forms it is most usually prescribed. In solution it is an arterial sedative and a diaphoretic habitually used in *febrile affections;* and unduly acid urine becomes neutral or alkaline under its administration. Its utility in fever is increased by adding to its solution spirit of nitrous ether or antimonial wine. The *dose* of the citrate of potassium is from twenty to sixty grains.

POTASSII CYANIDUM, *U. S.*—CYANIDE OF POTASSIUM.

Kalium cyanatum, Cyanuretum potassicum s. kalicum.—Cyanure de potassium, Fr.; *Cyankalium*, G.

Formula KCy or KCN. Molecular weight 65.

Preparation.—Take of Ferrocyanide of Potassium dried eight troyounces; Pure Carbonate of Potassium dried three troyounces. Mix the salts intimately, and throw the mixture into a deep iron crucible previously heated to redness. Maintain the temperature until effervescence ceases, and the fused mass concretes, of a pure white color, upon a warm glass rod dipped into it. Then pour out the liquid carefully into a shallow dish to solidify, ceasing to pour before the salt becomes contaminated with the precipitated iron. Break up the mass while yet warm, and keep the pieces in a well-stopped bottle. *U. S.*

This process was proposed by F. and E. Rogers (1834), and is generally followed in preparing potassium cyanide on the large scale. The reaction is explained by the equation $2K_4FeCy_6 + 2K_2CO_3 = 10KCy + 2KCyO + Fe_2 + 2CO_2$, showing that, besides cyanide, cyanate of potassium is also formed, carbonic acid gas is evolved, and iron is separated in the metallic state. Both salts must be well dried before they are mixed, otherwise considerable ammonia is given off; and if the carbonate is contaminated with sulphate, the fused mass will contain a corresponding amount of sulphide of potassium. A portion of the product remains in the crucible with the iron, but if it is dissolved with water it becomes contaminated again with ferrocyanide of potassium, which may be regenerated by digestion with sulphide of iron and crystallization to free it from potassium sulphide.

A less profitable process consists in heating dry ferrocyanide of potassium to redness, and in excluding the air until the residue has cooled. Nitrogen is liberated and escapes, and the cyanide of potassium remains mixed with carbide of iron; $K_4FeC_6N_6$ yields $4KCN + FeC_2 + N_2$. If too high a heat is applied, the cyanide of potassium is likewise decomposed. The mass requires to be extracted with water, and filtered and evaporated to crystallization. During this operation a part of the iron may again dissolve, forming ferrocyanide and caustic potassa; ammonia may likewise be produced, and the mother liquor contains variable quantities of formiate and carbonate of potassium.

Pure cyanide of potassium is best prepared by conducting gaseous hydrocyanic acid into a freshly made solution of potassa in strong alcohol, when the cyanide is precipitated as it forms.

Properties.—From its aqueous solution pure cyanide of potassium crystallizes in octohedrons or cubes, which melt at a dull red heat to a colorless liquid, congealing on cooling in cubical crystals. When perfectly dry it is inodorous, but when moist it is decomposed by the carbonic acid of the atmosphere, and has the odor of hydrocyanic acid. It has an alkaline and bitter taste, reacts upon test-papers strongly alkaline, is deliquescent on exposure, and is freely soluble in water, but is nearly insoluble in absolute alcohol. On heating the aqueous solution, the salt is partly decomposed into ammonia and formiate of potassium. It yields with nitrate of silver a white precipitate which is insoluble in dilute nitric acid, but dissolves readily in ammonia.

The impure officinal cyanide has similar properties, but is in white opaque pieces. When dissolved in water the cyanate contained in it is gradually decomposed with the formation of potassium and ammonium carbonates; $2KCNO + 4H_2O$ yields $K_2CO_3 + (NH_4)_2CO_3$. In the pure state cyanate of potassium crystallizes in a manner similar to that of the chlorate; it is inodorous, and has a saline taste similar to that of saltpetre; it yields with nitrate of silver a white precipitate, which is soluble in ammonia.

Tests.—Liebig observed that iodine, added to a solution of potassium cyanide, forms iodide of potassium and iodide of cyanogen, both being colorless compounds. Fordos and Gélis (1852) recommended this reaction for the estimation of pure cyanide in the commercial salt; this is dissolved in water, an excess of carbonic acid is added to convert any carbonate that may be present into bicarbonate, and afterwards an alcoholic solution of iodine until the liquid acquires a yellow color due to uncombined iodine. Since 1 molecule of potassium cyanide (65) requires 2 atoms of iodine ($2\times127=254$) for the production of the colorless iodides, every 254 grains of iodine used, when the yellow color makes its appearance, indicate 65 grains of pure potassium cyanide. However, the correctness of the results is materially affected by the liberation of hydrocyanic acid by the carbonic acid added, and, if the latter is omitted, by the presence of potassium carbonate or caustic potassa.

Medical Action and Uses.—The action of cyanide of potassium is identical with that of hydrocyanic acid, for which it may be substituted. A solution of it applied to the tongue causes a sensation of coldness, followed by irritation and constriction of the fauces. Allowed to remain in contact with the skin, a solution of the salt is apt to excite a papular and even a vesicular eruption; and applied in powder slightly moistened, or incorporated with lard, it may produce an eschar. In substance or solution applied to the broken skin it may cause toxical symptoms. Internally it has been fatal in doses of from three to five grains. The employment of this salt in photography has of late years greatly multiplied the number of cases of poisoning by its use. The symptoms produced by it in such cases are insensibility, muscular spasm or convulsion, a cold, clammy, and pale skin, glistening eyes and dilated pupils, stertorous breathing, fixed jaws, foam on the lips, feeble or insensible pulse of the heart and arteries, and death in convulsion or by asthenia. On examination, the body is rigid, the eyes bright, the cavities exhale the odor of hydrocyanic acid, the lungs are congested, the auricles may be full and the ventricles empty, the brain is engorged, and also the lining membrane of the stomach, which presents a dark red color streaked by the darker veins. In a word, its effects are, as above stated, those of hydrocyanic acid. (Compare Acid. hydrocyanicum dilutum.) Cyanide of potassium is used chiefly as a topical application for the relief of *headaches* associated with dyspepsia or with imperfect menstruation, or such as are generally included under the term sick-headache. It has also been employed internally, and, it is alleged, with remarkable success, in the treatment of acute articular *rheumatism;* but the testimony appears to us insufficient. It was given once or twice a day in doses of one or two grains, and in pilular form. A solution of from two to four grains of the salt in an ounce of water may be applied as a lotion to the head, and as the most rapid means of removing stains produced by *nitrate of silver.* It is, however, too dangerous an agent to be used without extreme caution.

POTASSII ET SODII TARTRAS, *U. S.*—TARTRATE OF POTASSIUM AND SODIUM.

Soda tartarata, Br.; *Sodæ et potassæ tartras*, *Sodæ potassio-tartras*, *Tartarus natronatus*, P. G.; *Natro-kali tartaricum*, *Sal polychrestum Seignetti*, *Tartras potassico-sodicus.*—*Rochelle salt*, *Tartarated soda*, E.; *Sel de Seignette*, *Soude tartarisée*, Fr.; *Seignettesalz*, G.

Formula $KNaC_4H_4O_6.4H_2O$. Molecular weight 282.

Preparation.—Take of Carbonate of Sodium twelve troyounces; Bitartrate of Potassium in fine powder sixteen troyounces; Boiling Water five pints.

Dissolve the carbonate of sodium in the water, and gradually add the bitartrate of potassium. Filter the solution, and evaporate until a pellicle begins to form; then set it aside to crystallize. Pour off the mother-water, and dry the crystals on bibulous paper. Lastly, evaporate the mother-water that it may furnish more crystals. *U. S.*

The directions of the British Pharmacopœia agree with the preceding, but are more precise, inasmuch as it orders, after the addition of the bitartrate, boiling for a few minutes, and then ascertaining whether the liquid has an acid or alkaline reaction, in which case a little carbonate of sodium or acid tartrate of potassium is to be added till a neutral solution is obtained. Since the molecular weight of bitartrate of potassium is 188, and one-half a molecule of crystallized sodium carbonate weighs 143, 16 parts of the former require $12\frac{1}{6}$ parts of the latter, if both salts are chemically pure. Owing to the presence of calcium tartrate in the one, and the loss of water of crystallization by the other, the proportions required must vary somewhat with different samples of the commercial salts; but there is no difficulty in rendering the solution exactly neutral if the directions of the British Pharmacopœia are followed. The reaction between the two salts is explained by the equation $2KHC_4H_4O_6+Na_2CO_3=2KNaC_4H_4O_6+CO_2+H_2O$; besides the double salt, water and carbonic acid are given off, the latter escaping with effervescence. It is advisable to keep the neutralized mixture for some time at a temperature of about 60° C. (140° F.), when much of the calcium tartrate will be deposited, and may be removed by filtration. Large and well-formed crystals are obtained if the solution is very slowly evaporated.

This double salt was first obtained in 1672 by Pierre Seignette, an apothecary of Rochelle in France, and was sold as a secret remedy. But in 1731 the process for obtaining it was communicated by Boulduc to the French Academy, and by C. J. Geoffroy to Sloane, of London.

Properties.—Tartrate of potassium and sodium crystallizes in large perfectly transparent six- or eight-sided prisms, or more frequently half-prisms. If crystallized from a solution containing calcium tartrate, they are white and more or less opaque. In our commerce the salt is most generally met with in the state of white powder. It has a mild saline, faintly bitterish, and cooling taste, is slightly efflorescent in dry air, melts when carefully heated to about 75° C. (167° F.), and after cooling remains liquid and soft for some time. By the heat of the water-bath it loses 19 per cent. of water of crystallization, and at 130° C. (266° F.), or, according to Fresenius, near 215° C. (419° F.), altogether 25.5 per cent. At a higher heat it is decomposed, and gives off inflammable gases which have the odor of burning sugar, and leave charcoal which contains the carbonates of potassium and sodium. This residue obtained from 141 grains of Rochelle salt requires for neutralization 1000 grain-measures of the volumetric solution of oxalic acid. At the ordinary temperature the salt requires about 2 parts, and at 37.5° C. (99.5° F.) 0.3 part of water for solution; alcohol dissolves only traces of it. The concentrated aqueous solution yields, on the addition of hydrochloric or acetic acid, a crystalline precipitate of cream of tartar.

Tests.—The solution in distilled water should be clear, of neutral reaction to test-paper, and should yield with the nitrates of barium and of silver white precipitates which are completely soluble in nitric acid (absence of sulphates and chlorides). With oxalate of ammonium it should produce no precipitate, or only a slight turbidity (calcium salt).

Off. Prep.—Pulveres effervescentes aperientes, *U. S.*

Medical Action and Uses.—In doses of from half an ounce to an ounce it operates as a gentle and cooling laxative, and seldom disagrees with the stomach. It is particularly acceptable in *Seidlitz powders*, which form an effervescing draught. In small and repeated doses it renders the urine alkaline. It is not incompatible with tartar emetic, with which it has sometimes been used as an emeto-cathartic, and also, in small doses, as a febrifuge. It may be given, as a purgative, in doses of about one ounce. As an antilithic, from sixty to one hundred and twenty grains may be taken, largely diluted, several times a day.

POTASSII FERROCYANIDUM, *U. S.*—FERROCYANIDE OF POTASSIUM.

Potassæ prussias flava, Br.; *Kalium ferrocyanatum*, P. G.; *Kalium borussicum*, *Cyanuretum ferroso-potassicum.*—*Yellow prussiate of potash*, E.; *Prussiate jaune de potasse*, *Ferrocyanure de potassium*, Fr.; *Ferrocyankalium*, *Blutlaugensalz*, G.

Formula $K_4FeCy_6.3H_2O = K_4FeC_6N_6.3H_2O$. Molecular weight 422.

Preparation.—This salt was discovered by Macquer (1752) in boiling Prussian blue with caustic potassa. The iron contained in it was for a long time supposed to be an impurity, even after Berthollet (1787) had shown it to be one of its essential constituents. The salt is now extensively prepared by heating in suitable iron vessels potash which is free from sulphate until it is melted, and introducing a mixture composed of one part of iron filings and 28 to 33 parts of charcoal obtained from blood, hoofs, horn, hides, leather, or similar animal substances rich in nitrogen. It is less advantageous to employ these substances in the uncharred condition. 100 parts of potash require about 75 or 80 parts of the charcoal or about 100 parts of the animal matter. An evolution of carbonic acid and inflammable gases takes place after each addition to the melted mass, and, when the whole fuses quietly, the *melt*, as it is termed, is ladled out, cooled, dissolved in water, decanted from the sediment, and crystallized. Before it enters commerce, it requires purification by recrystallization from water. The above quantities yield about 120 parts of melt and about 25 parts of crystallized ferrocyanide of potassium. The insoluble portion of the melt consists of charcoal, phosphate of calcium, and silica. The mother liquors, which furnish no longer well-defined crystals, are evaporated and used in another operation.

Properties.—Ferrocyanide of potassium crystallizes from water in large yellow four-sided tables or prisms, which are translucent and rather soft and friable. It has the specific gravity 1.83, a sweetish and saline taste, and dissolves with a yellow color in 4½ parts of cold and in 2 parts of hot water, the salt being precipitated from this solution by alcohol in pale yellow pearly scales. Above 50° C. (122° F.) the salt begins to lose its water of crystallization, of which it contains 12.8 per cent., and becomes anhydrous at 100° C. (212° F.), leaving a white friable mass, which melts below red heat, and at a higher temperature is decomposed into nitrogen gas and a mixture of potassium cyanide and carbide of iron. Exposed to light in the presence of moisture it is slowly decomposed, with the formation of Prussian blue. Its solution produces a dark-blue precipitate with ferric salts, a bluish-white precipitate with ferrous salts, a brown-red precipitate with salts of copper, and white precipitates with acetate of lead and corrosive sublimate. Heated with dilute sulphuric acid, hydrocyanic acid is given off. Alkalies fail to precipitate the iron from its solution; but, on fusing the salt with potassium carbonate, cyanide of potassium is formed, and metallic iron is separated.

Tests.—The concentrated solution of the salt should not effervesce on the addition of sulphuric acid (absence of carbonate), and, when diluted with water and acidulated with hydrochloric acid, should not produce a white precipitate with chloride of barium (absence of sulphate). Since nitrate of silver is precipitated white by ferrocyanide of potassium, the presence of chloride in the latter cannot be detected until after the salt has been decomposed by fusion with pure nitrate of ammonium, when the solution of the residue acidulated with nitric acid should not give a curdy white precipitate with nitrate of silver.

Pharmaceutical Uses.—Ferrocyanide of potassium is used in the preparation of Acid. hydrocyan. dilut., *U. S.*, *Br.;* Argenti cyanidum, Ferri ferrocyanid., Hydrarg. cyanid., and Potass. cyanid., *U. S.*

Allied Salt. FERRICYANIDE OF FERRIDCYANIDE OF POTASSIUM. *Red prussiate of potash*, $K_6Fe_2Cy_{12}$.—On passing chlorine gas into a cold solution of ferrocyanide of potassium, the liquid changes in color from yellow to red. When it ceases to produce a blue precipitate or color with ferric chloride, it is concentrated, and the crystals purified by recrystallization. It is in red transparent prisms, has a saline and slightly astringent taste, and dissolves in about four parts of cold water. On exposure to light the solution is readily altered, ferrocyanide being again produced, when it will yield a blue precipitate with ferric salt. The salt in its fresh solution is employed as a test, precipitating dark blue with ferrous, red-brown with mercurous, brownish-yellow with cupric, and orange-colored with argentic salts. It yields no precipitates with ferric, mercuric, or lead salts.

Medical Action and Uses.—It has been reputed, on very slender authority, to possess active medical properties, anodyne, sedative, and astringent. A thorough investigation of its action by Regnauld and Hayem led them to conclude that it is inoperative both as a chalybeate and a sedative, and that it may be administered for weeks in the daily dose of several grains without deranging the health or altering the composition of the urine. It is used only as a chemical test for iron, copper, and zinc.

POTASSII HYPOPHOSPHIS, *U. S.*—HYPOPHOSPHITE OF POTASSIUM.

Kali hypophosphorosum, Hypophosphis potassicus s. kalicus.—Hypophosphite de potasse, Fr.; *Unterphosphorigsaures Kali*, G.

Formula KPH_2O_2. Molecular weight 104.

Preparation.—This salt may be prepared in a manner similar to that by which hypophosphite of calcium (see page 318) is obtained. When a solution of potassa is boiled with phosphorus, hypophosphite of potassium is produced, which is freed from potassa by passing carbonic acid gas into the solution, evaporating and dissolving the hypophosphite by alcohol. It is also yielded by the double decomposition of hypophosphite of calcium and carbonate of potassium, when carbonate of calcium is precipitated, and hypophosphite of potassium remains in solution; $Ca2PH_2O_2 + K_2CO_3$ yields $CaCO_3 + 2KPH_2O_2$.

Properties.—It may be obtained in hexagonal tabular crystals; but, being extremely deliquescent on exposure, it is usually seen in opaque crystalline masses. It is very freely soluble in water and diluted alcohol, less soluble in absolute alcohol, but insoluble in ether. Heated to redness when not in contact with air, it evolves easily inflammable phosphoretted hydrogen. According to Rammelsberg (1872), the gas given off consists of hydrogen and phosphoretted hydrogen, and the residue of pyrophosphate and metaphosphate of potassium. Heated in the air it burns with a yellow flame, and when evaporated with nitric acid it detonates violently. When boiled with potassa, hydrogen is given off, *phosphite*, and after the solution becomes more concentrated, phosphate of potassium is formed. The solution yields with nitrate of silver a white precipitate, which rapidly turns brown and black, separating metallic silver; acidulated with hydrochloric acid, it causes a black precipitate of metallic mercury with corrosive sublimate, or with an excess of the latter a white precipitate consisting of calomel.

Tests.—The above reactions in connection with the ready solubility in water and alcohol prove the purity of the salt. Carbonate would be detected by the effervescence with acids; sulphate by a white precipitate with an acidulated solution of baryta, and phosphate by a similar precipitate with solution of chloride of ammonium and magnesium, rendered slightly alkaline by ammonia.

Medical Uses.—This preparation has been especially recommended in the treatment of *chronic bronchitis;* but there is no sufficient proof of its efficacy in that or in any other disease.

POTASSII IODIDUM, *U. S.*, *Br.*—IODIDE OF POTASSIUM.

Kalium jodatum, P. G.; *Kali hydrojodicum, Ioduretum potassicum s. kalicum.—Iodure de potassium*, Fr.; *Jodkalium*, G.

Formula KI. Molecular weight 166.

Preparation.—Take of Potassa six troyounces; Iodine in fine powder sixteen troyounces, or a sufficient quantity; Charcoal in fine powder two troyounces; Distilled Water a sufficient quantity. To the potassa, dissolved in three pints of distilled water boiling hot, gradually add the iodine, stirring after each addition until the solution becomes colorless, and continue the additions until the liquid remains slightly colored from excess of iodine. Evaporate the solution to dryness, stirring in the charcoal towards the close of the operation, so that it may be intimately mixed with the dried salt. Rub this to powder, and heat it to dull redness in an iron crucible, maintaining that temperature for fifteen minutes: then, after it has cooled, dissolve the saline matter with distilled water, filter the solution, evaporate, and set it aside to crystallize. An additional quantity of crystals may be obtained from the mother-water by evaporating and crystallizing as before. *U. S.*

The process of the British Pharmacopœia does not essentially differ from the preceding except in some of the details. In it one gallon (imperial) of potassa solution and twenty-nine ounces, or a sufficiency, of iodine, are directed for the production of a permanent brown tint. The liquid is evaporated to dryness, the residue powdered, mixed intimately with three ounces of charcoal, and the mixture, in small quantities at a time, is thrown into a red-hot crucible. When the contents are fused, they are poured out, and, after cooling, dissolved in forty ounces of boiling distilled water, and the solution filtered and crystallized.

On dissolving iodine in solution of potassa a reaction takes place precisely analogous to that which occurs in the action of bromine or chlorine upon the same liquid (see pages 1110, 1119); $6KHO$ and $3I_2$ yield $5KI + KIO_3 + 3H_2O$. The iodate of potassium may be separated by evaporating the solution to dryness, and treating the residue with alcohol, which dissolves the iodide of potassium only; or it may be deprived of its oxygen, and thus be converted into iodide. The deoxidation may be effected in the solution by means of sulphuretted hydrogen; but some loss of iodine is then unavoidable, and the salt is apt to contain sulphur. The saline mass left on evaporation, when heated to redness, gradually parts with its oxygen, but the reduction is effected at a lower temperature and more rapidly if the mass had been previously mixed with charcoal, starch, sugar, or similar organic matter. For effecting the mixing of the charcoal with the saline mass, the directions of the United States Pharmacopœia are very convenient; but for reducing the iodate it is best to operate as directed by the British Pharmacopœia. If the mixture, in small quantities, is thrown into a red-hot crucible, each portion deflagrates, carbonic oxide is given off, and iodide of potassium formed. The sudden evolution of the gas from a large quantity of the mixture heated together is likely to occasion loss. This reaction is explained by the equation $KIO_3 + C_3 = KI + 3CO$.

Various other processes have been suggested, and are serviceable, more particularly for preparing potassium iodide on a limited scale. The following deserve to be mentioned: Iodine is converted into hydriodic acid by the action of sulphuretted hydrogen (see page 46), and the acid neutralized by carbonate of potassium. Or iodide of iron is first prepared, and the green solution boiled with an equivalent quantity of carbonate of potassium, filtered from the oxide of iron, and evaporated. The iron will settle more rapidly if an additional quantity, equal to one-third of that used in preparing the solution of ferrous iodide, is added thereto before precipitation by potassa. Fuchs (1865) recommended prolonged digestion of 100 parts of iodine, 240 of water, 75 of potassium carbonate, and 30 of iron, until carbonic acid ceases to be given off; the solution is further concentrated, exposed in a warm place until all iron has been converted into ferric oxide, then dried, heated to incipient redness, and extracted with water.

Nearly all the potassium iodide consumed here is manufactured in the United States. Only 195 pounds were imported in the year 1876–1877.

Properties.—When entirely pure, iodide of potassium is in transparent colorless cubes, of a neutral reaction. As generally met with, however, it is crystallized from an alkaline solution, and the crystals are white and opaque, or merely translucent. Crystals of similar appearance are also obtained, according to Wittstein (1861), from neutral solutions at a somewhat elevated temperature, and, according to Erlenmeyer, from very concentrated solutions. Iodide of potassium has a pungent saline taste, melts when heated, and congeals on cooling to a pearly mass. At a bright red heat, and in contact with air, a trace of iodate is formed, a little iodine given off, and the mass acquires an alkaline reaction. It is permanent in the air, but in a damp atmosphere, or when of an alkaline reaction, is deliquescent. It is freely soluble in water; 100 parts of which, according to Mulder (1864), dissolve at 10° C. (50° F.), 136.1; at 20° C. (68° F.), 144.2; at 30 C. (86° F), 152.3; at 40° C. (104° F.), 160; and at 100 C°. (212° F.), 209 parts of the salt. It is likewise soluble in alcohol, requiring at the ordinary temperature 40 parts of absolute alcohol, 16 parts of alcohol sp. gr. .835, 8 parts of alcohol sp. gr. .850, and 1½ parts of diluted alcohol. On exposure to sunlight, the solutions of iodide of potassium acquire a yellow or brownish color from the liberation of iodine, the decomposition being due to the influence of ozone, according to Houzeau (1858), or to the presence of carbonic or other acid, according to Bastaudier (1876). Strong mineral acids liberate from the salt hydriodic acid and iodine. A mixture of the salt with chloride of ammonium becomes moist and brown on exposure, and when heated is decomposed, chloride and iodide of potassium being left behind. Baup observed that 100 parts of the iodide dissolved in 200 parts of water will dissolve 153 parts or 2 atoms of iodine, forming a dark red liquid, from which water throws down a portion of the iodine. If the salt is dissolved in about thirty times its weight of water, the solution takes up one atom of iodine. These solutions are completely decolorized when agitated with ether, chloroform, or bisulphide of carbon; but if the solution has been made with alcohol instead of water, carbon bisulphide fails to extract the iodine, although this element is removed by the solvent mentioned from the simple tincture of iodine (Jörgensen, 1870). An aqueous solution of iodine in iodide of potassium produces with subacetate of lead dark colored precipitates, which Dossios and Weith (1869) regarded as being mixtures of iodide of lead with finely divided iodine; but Piffard (1861) found the precipitate with acetate of lead, after drying, could be heated to 71° C. (159.8° F.) without evolving iodine, which could likewise not be extracted with simple solvents. These facts, it seems, point to the existence of compounds of one atom of potassium with one, two, and three atoms of iodine. (See also Liquor iodinii comp., p. 838, and Tinctura iodinii comp.)

Tests.—The aqueous solution, mixed with mucilage of starch, gives a blue color on the addition of a little chlorine water, the chlorine liberating iodine, which combines with the starch to blue iodide of starch. It gives a white crystalline precipitate of bitartrate of potassium on the addition of a concentrated solution of tartaric acid. The absence of *iodate* is recognized by adding mucilage of starch, and afterwards dilute hydrochloric or tartaric acid, when a blue color should not be developed. In the presence of iodate, both iodic and hydriodic acids would be liberated, and reacting with each other would set iodine free. On adding to the aqueous solution a solution of nitrate of silver, a pale yellowish precipitate is occasioned, which, after decanting the liquor, and on being agitated with ammonia, yields by subsidence a clear liquid, in which excess of nitric acid should cause no precipitate, or only a faint opalescence, owing to the sparing solubility of iodide of silver in ammonia. *Chloride* and *bromide* of silver being more freely soluble in ammonia, if present, would occasion a curdy white precipitate on the addition of nitric acid. *Carbonate* of potassium is indicated by the alkaline reaction of the salt upon moist test-paper; its presence is proven by the white turbidity occasioned in the aqueous solution on the addition of clear lime-water. Carbonate and sulphate of potassium are insoluble in 80 per cent. alcohol, which dissolves only small quantities of bromide and chloride of potassium. An adulteration of the iodide with more than mere traces of the last two salts, may be detected by treating the iodide with eight times its weight of warm alcohol, specific gravity .85, and after cooling by testing the undissolved portion. These adulterations may be estimated from the silver precipitate, which from ten grains of pure iodide of potassium weighs 14.15 grains, from the same quantity of bromide 15.8, and from the same quantity of chloride 19.2 grains. Moreover, the last two may be extracted from the former by ammonia, and, after acidulating this solution with nitric acid, collected and weighed separately.

If it is merely desired to ascertain the percentage of pure iodide, Marozeau's method is convenient and practical. It depends upon the formation of soluble potassio-mercuric iodide (see page 714), according to the equation $4KI + HgCl_2 = 2KI.HgI_2 + 2KCl$; 664 grains of pure iodide of potassium and 271 grains of pure corrosive sublimate yield a clear solution with water. The test may be applied by dissolving ten grains of the potassium iodide in half an ounce of water, and adding thereto gradually and with agitation a solution of four grains of corrosive sublimate in 996 grains of water until a permanent red turbidity is produced. The weight of the corrosive sublimate solution used indicates the weight of pure iodide of potassium in 1000 parts of that examined. If impurities other than bromide are present, it will usually be found that the largest cubical crystals are much purer than the small ones.

Pharmaceutical Uses.—Iodide of potassium is used in preparing Ammonii iodidum, *U. S.;* Hydrarg. iodid. rubr., Hydrarg. iodid. viride, Plumbi iodid., *U. S.*, *Br.* It is an ingredient of Linim. iodi, Linim. potass. iodidi cum sapone, *Br.;* Liquor iodinii comp. (iodi), Tinct. iodinii comp. (iodi), *U. S.*, *Br.;* Unguentum iodinii, *U. S.;* Ung. iodinii comp. (iodi), Ung. potassii iodidi, *U. S.*, *Br.*

POTASSII IODAS, Iodate of potassium, *E.;* Iodate de potasse, *Fr.;* Jodsaures Kali, *G.* KIO_3, molecular weight 214. This salt is left behind on treating the product of the reaction of iodine upon potassa with alcohol; or it may be prepared, according to L. Henry (1870), by diffusing 127 parts of iodine in cold water, passing chlorine into it until chloride of iodine, ICl, has been formed and dissolved in water, adding 122.5 parts of chlorate of potassium and heating, when chlorine gas will be evolved and iodate of potassium crystallize on cooling, $ICl + KClO_3$ yields $KIO_3 + Cl_2$. The salt crystallizes in translucent or milk-white cubes, dissolves in 13 parts of cold, and in 3.1 parts of boiling water, and is more freely soluble in solution of potassium iodide and insoluble in alcohol. When heated, the salt fuses, and at a high temperature parts with its oxygen, leaving potassium iodide. It detonates, but less violently than the chlorate, when thrown upon burning coal. On the addition of arsenious acid or stannous chloride, the solution separates iodine; if not too diluted, its solution yields white granular precipitates with salts of barium, lead, and silver.

Physiological Action.—Administered in large doses by the stomach to animals it causes efforts at vomiting, and, if this is prevented by ligature, they suffer depression, accompanied with diuresis, and followed by spasms and death. The mucous membrane is injected, soft, and ulcerated. Injected into the veins, it also causes convulsions speedily followed by death. In man it is very rapidly absorbed and eliminated by all the emunctories without undergoing any decomposition, but this discharge is mainly through the kidneys, for nearly nine-tenths of the amount used may be recovered from the urine. The elimination is not always rapid, for in some cases the salt may be detected in the urine several weeks after it had been taken. It has no uniform influence on either the amount or the quality of the urine secreted. The continued use of iodide of potassium excites eruptions of the skin, the most common of which is acne indurata. More rarely blood-blisters or watery blebs form. It is apt to cause salivation, much resembling that which occurs during pregnancy. The symptom is mild, is not accompanied with the fetor of mercurial salivation, and ceases when the medicine is suspended. A familiar effect of iodide of potassium is a coryza with lachrymation and a congested state of the eyes, nostrils, frontal sinuses, antrum Highmorianum, and throat; more rarely the larynx exhibits catarrhal symptoms with hoarseness, obstruction, and harassing cough, and sometimes very moderate doses have caused fulness of the head, giddiness, and trembling of the legs in walking. Sometimes, also, there has been impairment of vision, and articulation, and a partial paralysis of the vocal organs. These effects are often produced by a prolonged use of very small doses, but sometimes very large doses, such as forty or sixty grains a day, may be taken for weeks without causing any special phenomena. The addition of aromatic spirit of ammonia to solutions of the iodide is said to greatly diminish the tendency to produce such effects. In rare cases, iodide of potassium produces an effect which is not so unusual after the prolonged administration of iodine, atrophy of the testicles.

Medical Uses.—Iodide of potassium, although sometimes successful, is not as efficacious as iodine in relieving *mercurial sore mouth;* indeed, it often aggravates the local affection. At the same time, it is the most effectual means of *eliminating mercury* from the system, and thereby curing paralysis, neuralgia, and other symptoms which occur in chronic poisoning by this metal. The same is true of *lead poisoning* in its chronic form. If the iodide be given to a person by whom lead or mercury has been taken for a considerable period without producing characteristic toxical symptoms, those symptoms will presently be manifested, in consequence of the liberation of the metal by the salt; and, at the same time, the former may be detected in the urine, and sometimes in the saliva, by appropriate chemical tests. To prevent a renewal of the poisoning under this treatment, the iodide must be cautiously administered. This singular effect is illustrated in the treatment of *constitutional syphilis, i. e.*, of the skin, cellular tissue, bones, and nervous system by this medicine, in persons who had taken mercury during the earlier stages of the disease. It is not unusual for them to experience the full effects of mercurial salivation. Three different explanations have been proposed for the cure of constitutional syphilis by the iodide of potassium: 1. That it revives the mercury in the system and enables it to work its specific cure; 2. That it eliminates the mercury from the system and so removes an obstacle to the cure; and 3. That it cures syphilis by its intrinsic powers. These propositions are not incompatible with one another, and each may, in individual cases, be true. Clinical observation renders it probable that they are so. The successful use of the iodide in this disease depends greatly upon its dose, which should never be less than ten grains three times a day, and often must be twice or thrice as much.

The value of iodide of potassium in the treatment of *aneurism of the aorta* was discovered, as that of all really valuable medicines has been, "by the merest hazard;" and although the method which some have pursued in employing it included the absolute and prolonged repose of the patient, the share of the iodide in the results cannot fairly be challenged. In cases of aneurism of the aortic arch, "not only has relief of neuralgic pains and of the general distress followed its administration, but the local pressure-symptoms have been mitigated, and firm thrombosis has taken place within the sac, while the area of pulsation and of percussion-dulness has exhibited sensible reduction" (Walshe). The medicine must be given in doses ranging from ten to thirty grains twice or thrice daily, and, with occasional intermissions when iodism occurs, should be continued for weeks or months.

Numerous cases of *dropsy* owe their cure to this medicine, including ascites due to splenic or hepatic induration, and hydrothorax depending upon cardiac obstruction. It has cured acute hydrocephalus due to *granular meningitis*, but chiefly when mercury had been previously administered; and *chronic hydrocephalus* under similar circumstances. Even in *ovarian* dropsy it is claimed to have succeeded. In those intractable diseases it should never be neglected, nor even in *Bright's disease*, more especially in the interstitial form of it.

In *muscular rheumatism* iodide of potassium is one of the most efficient remedies in the various forms of this affection, but especially in acute lumbago, which it often cures with marvellous rapidity. In *sciatica* and other forms of rheumatic neuralgia it is sometimes of great advantage; and even in *angina pectoris* it may afford relief. It is worse than useless in acute *articular rheumatism*, but in the chronic forms, with thickening of the fibrous capsules of the joints and effusion within them it is often the most efficient remedy. It need not, however, be given in large doses for this affection, nor for *chronic gout*, in which also it has been found of service, but its use must be long maintained. In *chronic bronchitis* with asthma depending upon dilatation of the bronchia or upon thickening of their walls, the iodide is often signally beneficial. The paroxysmal affection is then subordinate to the lesion of nutrition; but pure nervous asthma is not benefited by the iodide. In many cases of *paralysis* due probably to pressure upon a motor centre or upon a nervous trunk, produced by syphilitic or other swellings, the medicine is often singularly efficient and should never be omitted from the treatment. In all of the affections mentioned in this paragraph it is probable that the iodide is operative by its causing the absorption of indurations which compress the source or the channels of nervous power. That it restrains nutrition generally, normal as well as abnormal, is shown by its emaciating operation upon the testes, mammæ, and ultimately on other organs, and that it, at the same time, promotes elimination is rendered probable by the history of its use in diseases of the skin and constitutional syphilis, etc.

The *dose* of iodide of potassium cannot be accurately defined; according to the object to be attained it should be given in small doses, as two or three grains, or very large ones, as from ten to twenty grains, three times a day, and always in a large quantity of liquid.

POTASSII NITRAS, *U. S.*—NITRATE OF POTASSIUM.

Potassæ nitras, Br.; *Kali nitricum*, P. G.; *Nitrum depuratum*, *Sal petræ s. nitri*, *Nitras potassicus s. kalicus.*—*Nitrate of potash*, *Nitre*, *Saltpetre*, E.; *Azotate* (*nitrate*) *de potasse*, *Nitre prismatique*, *Salpêtre*, Fr.; *Salpetersaures Kali*, *Salpeter*, *Kalisalpeter*, G.

Formula KNO_3. Molecular weight 101.

Origin and Preparation.—Saltpetre is produced near the surface of the earth wherever nitrogenous organic substances are undergoing decomposition in the presence of air, moisture, and potassium compounds. It is present in considerable quantities in the calcareous soil near dwellings of some parts of India.

This soil becomes impregnated with urine, and after it has been exhausted of its soluble salts, soon generates them again, the decomposition being hastened by the hot and moist climate. In several parts of Europe, nitrates are formed in a precisely analogous manner, either by collecting the urine of domestic animals in ditches which have been previously filled with a porous calcareous earth, or by mixing in the so-called *saltpetre beds*, animal and vegetable substances with wood ashes and marl or other material containing lime, and forming this mixture into mounds which are occasionally moistened with drainings from the dung pit, until after two or three years the salt accumulates in the outer layer of the heap, which is then removed, lixiviated with water, and left in contact with wood ashes in order to decompose the nitrates of calcium and magnesium which are usually present. In India, which furnishes the greater part of the nitre, the process of exhausting the earth is very similar, except that it is usually packed upon wood ashes, and the whole lixiviated.

In the Mammoth Cave of Kentucky, and in other localities of the United States, saltpetre has occasionally been procured and it may be obtained in variable quantities from most soils where vegetable and animal materials have been decaying, and from which it is taken up by the plants growing there, some of which are very rich in this salt. A. Boutin (1874) ascertained that *Amarantus melancholicus ruber* contains 16, and *Am. atropurpureus* even 22.77 per cent. of potassium nitrate calculated for the dry herb. The same salt crystallizes in some old extracts.

Since the Stassfurt mines have been worked, the large quantities of chloride of potassium obtained have also been utilized in the production of saltpetre, by a process of mutual decomposition effected with native nitrate of sodium (Chili saltpetre). Equivalent quantities of the two salts are boiled together with water until the chloride of sodium commences to separate in the boiling liquor, which is then concentrated, and the chloride removed as it crystallizes.

On the cooling of the solutions the crystallization of the nitre is usually disturbed by frequent stirring in order to better drain off the mother-liquor in which most of the foreign salts remain dissolved. Variable quantities of these salts, and particularly of sodium and potassium chlorides, are always found in crude nitre, which for furthur purification is redissolved in water, and granulated by evaporation and stirring. The last portions of adhering chlorides are in some places removed by percolating the granular powder with a concentrated solution of nitre in which they are dissolved, while the nitrate is recovered by boiling the solution and removing the sodium chloride as it separates.

Most of the saltpetre used in the United States is purified here from the foreign crude article, of which during the year 1876–1877 nearly ten and one-third million pounds were imported, besides 549,039 pounds of refined and partly refined nitrate of potassium. In the same period over thirteen and a half million pounds of chloride of potassium were likewise imported, a portion of which is used in the manufacture of saltpetre.

Properties.—Nitrate of potassium crystallizes in colorless, transparent, six-sided striated prisms, which frequently have cavities in the interior filled with mother-liquor, so that on trituration they yield a damp powder. It is often kept in the granulated state, and is then a white crystalline powder. When heated to 339° C. (642.2° F.), it fuses to a colorless liquid, and congeals again on cooling to a radiating crystalline mass; in the presence of even a small proportion of chloride of sodium the radiating arrangement is less distinct, at least in the centre of the mass, or entirely wanting. At a higher temperature it gives off oxygen, and afterwards oxygen and nitrogen, being gradually converted into nitrite, oxide, and peroxide of potassium. It is neutral to test-paper, has a pungently saline and cooling taste, and dissolves in water with a marked diminution of temperature. 100 parts of water dissolve at 10° C. (50° F.) 21.1, at 20° C. (68° F.) 31.2, at 30° C. (86° F.) 44.5, at 100° C. (212° F.) 247, and at

114.1° C. (237.4° F.), the boiling temperature of the most concentrated solution, 327.4 parts of nitrate of potassium. It is insoluble in absolute, and sparingly soluble in dilute alcohol. It is permanent in the air, but according to Mulder (1864) absorbs a considerable amount of water when kept in a confined atmosphere saturated with moisture. When thrown upon red-hot coal it deflagrates. Warmed with sulphuric acid and copper it evolves red nitrous vapors; and its solution, acidulated with hydrochloric acid, yields a yellow precipitate with perchloride of platinum.

Tests.—The aqueous solution of the salt is not affected by chloride of barium (absence of *sulphate*), nitrate of silver (*chloride*), carbonate of ammonium (*calcium salt*), or after the addition of carbonate of ammonium by phosphate of ammonium (*magnesium salt*). When mixed with a little potassium carbonate and afterwards with solution of antimoniate of potassium, a white precipitate should not be produced (absence of sodium salt). On mixing 101 grains (1 molecule) of nitrate of potassium with an excess of sulphuric acid, evaporating to dryness and igniting, the residue consists of sulphate of potassium and should weigh 87 grains ($\frac{1}{2}$ molecule). In the presence of nitrate of sodium, the weight is less.

Pharmaceutical Uses.—In the preparation of nitric acid and of collodion.

History.—Nitre must have been known from an early period, since it was used from time immemorial in the manufacture of gunpowder, both in China and India. The terms natron and nitrum are applied by Greek and Roman writers to soda and its carbonates, and yet nitre was an abundant and widely diffused natural product, known at all historical periods. It is mentioned by Geber, in the eighth century, as the source of nitric acid. He is also said to have employed it in medicine.

Physiological Action. *On Animals.*—In large but non-lethal doses, a solution of nitrate of potassium thrown into a vein increases the arterial blood pressure and reduces the frequency of the pulse. In lethal doses it causes a rapid fall in the arterial blood pressure and the pulse-rate, and death by syncope is preceded by epileptiform convulsions. In small doses it reduces the pulse-rate and lowers the temperature, but the latter effect is more persistent than the former. In the composition and condition of the blood no change takes place, unless the use of the salt be greatly prolonged, and then the coagulability of the blood is impaired. Injected into a vein near the heart it arrests the action of that organ; and injected into an artery supplying a limb it first of all paralyzes the muscles with which it comes primarily into contact.

On Man.—The action of nitrate of potassium upon man does not differ essentially from its action upon the lower animals. In small doses it is diuretic; in large doses it is a cardiac and nervous sedative and a purgative; and in excessive doses a local irritant poison, as well as a powerful sedative of all the vital functions. A small piece of the salt dissolved in the mouth occasions a sense of coolness in the part and a saline taste; given in small and repeated doses to healthy persons it does not clearly affect any function, although in some cases it appears to augment the secretion of urine, which is probably due to the local irritant action of the salt upon the kidneys, since a large proportion of it is eliminated, unchanged, with the urine. When large doses of the salt are given, however, this secretion is diminished and its specific gravity raised, chiefly by the nitre eliminated with the urine.

After large but non-poisonous doses, the following symptoms have been observed: general weakness, giddiness, confusion of ideas, and indisposition to mental and bodily exertion, weakness of the lower limbs especially, low spirits, a tendency to grow fatigued and to sleep, tinnitus, and a slow and weak pulse. The pulse may fall at last to twenty per minute, and continue at the same rate for seven or eight days after the medicine has been discontinued. The appetite and digestion are not usually impaired, and the bowels only occasionally loose.

As a rule, however, full medicinal doses do not tend to relax the bowels. The effects upon the pulse and nervous system are among those which have led to the recognition of a close analogy between the salt under consideration and the bromide of potassium, and to the extraordinary suggestion that the potassium in the latter compound is the real source of its soporific powers!

When poisonous doses of nitre are taken, as an ounce and upwards, there are symptoms of gastro-intestinal inflammation, and sometimes blood is vomited and passed by stool; the urine is diminished or suppressed; there is coldness of the extremities, a feeble and thready pulse, slow respiration, great debility, tremulousness, insensibility, blindness, deafness, and even convulsions. A case is on record in which a person, who had taken three ounces and a half of nitre, presented no marked symptoms at first, but at the end of five hours suddenly fell from his chair and expired. It is remarkable that poisoning by this substance generally ends in recovery, although for some time the patient may suffer from irritability of the stomach, colic, dysuria, and a sense of chilliness in the back and limbs with weakness of the latter. After death a florid color of the lips has been noted, and a similar hue of the blood, which, indeed, other salts, as chloride of sodium, chloride of magnesium, etc., produce; the stomach is apt to contain blood, and its lining membrane to be injected, softened, or corroded. The upper part of the small intestine may present a similar condition.

Medical Uses.—Nitre has long been used in acute *rheumatism*, given in a large amount of water or other mild diluent, as two or three drachms, and from that to an ounce, in about a quart of water, which quantity was taken in twenty-four hours. There is no lack of competent authorities who declare that it subdues the fever and pain and shortens the attack; while others of equal competency allege that it is useless therapeutically, and repulsive to the taste and stomach. We have no doubt that the latter is the truer judgment of the two. At the present day this method of treatment is hardly thought of in the acute, and still less in the chronic, form of rheumatism. The same remark applies to *pneumonia*, various *fevers*, etc., and even in *dropsy* the diuretic virtues of nitre are too uncertain to entitle it to any confidence. It has been claimed as a remedy for *scurvy*, on theoretical and unsubstantial grounds; and also upon the ground of its efficacy when dissolved in vinegar, without due consideration of the well-established virtues of the solvent in this disease. In *spasmodic asthma* inhalation of the fumes of burning paper impregnated with nitre renders the breathing freer and less stridulous, and sometimes, by repetition, cures the disease. The fumes may be employed by diffusion through the air of the patient's bedroom, or inhaled from a cigarette, or from thin linen paper impregnated with a solution of nitre, burned under a funnel from the mouth of which the patient inspires. Powdered nitre, moistened with water and applied to the face night and morning, is one of the best remedies for *freckles* (chloasma). A similar solution is useful in *bruises* and *abrasions*. Nitre may be prescribed in powder in doses of from ten to thirty grains or more, or in solution, which is preferable. The effects of an overdose of nitre are best palliated by the free use of water, or of some bland liquid, and by warm narcotic fomentations of the epigastrium.

POTASSII PERMANGANAS, *U. S.*—PERMANGANATE OF POTASSIUM.

Potassæ permanganas, Br.; *Kali hypermanganicum crystallisatum*, P. G.; *Hypermanganas potassicus s. kalicus.*—*Permanganate of potash*, E.; *Permanganate de potasse*, Fr.; *Uebermangansaures Kali*, G.

Formula $K_2Mn_2O_8$. Molecular weight 316.

Preparation.—Take of Caustic Potash five ounces; Black Oxide of Manganese in fine powder four ounces; Chlorate of Potash three and a half ounces;

Diluted Sulphuric Acid a sufficiency; Distilled Water two and a half pints. Reduce the chlorate of potash to fine powder, and mix it with the oxide of manganese; put the mixture into a porcelain basin, and add to it the caustic potash, previously dissolved in four ounces of the water. Evaporate to dryness on a sand-bath, stirring diligently to prevent spurting. Pulverize the mass, put it into a covered Hessian or Cornish crucible, and expose it to a dull read heat for an hour, or till it has assumed the condition of a semi-fused mass. Let it cool, pulverize it, and boil with a pint and a half of the water. Let the insoluble matter subside, decant the fluid, boil again with half a pint of the water, againt decant, neutralize the united liquors accurately with the diluted sulphuric acid, and evaporate till a pellicle forms. Set aside to cool and crystallize. Drain the crystalline mass, boil it in six ounces of the water, and strain through a funnel the throat of which is lightly obstructed by a little asbestos. Let the fluid cool and crystallize, drain the crystals, and dry them by placing them under a bell-jar over a vessel containing sulphuric acid. *Br.*

When binoxide of manganese is heated to dull redness with an excess of potassa, a portion of it is oxidized to manganic acid at the expense of a part of the oxygen of another portion of the binoxide, which is thereby reduced to manganic oxide. But if oxygen is at the same time conducted into the mass, all the manganese will be converted into manganic acid, which unites with the potassa, forming potassium manganate. It is more convenient to supply oxygen by means of an oxidizing agent, such as nitrate or chlorate of potassium, the former of which will supply an additional quantity of alkali for uniting with the manganic acid, while the latter will be converted into potassium chloride, which remains mixed with the manganate. In this case the result will be explained by the equation $6KHO + 3MnO_2 + KClO_3 = 3K_2MnO_4 + KCl + 3H_2O$. The proportions adopted by the British Pharmacopœia are those of Gregory, and refer to a nearly pure binoxide of manganese. If the article to be used should not contain at least 93 per cent. of MnO_2, a correspondingly larger quantity should be employed. The ignited mass contains, besides the manganate and chloride of potassium, all the mineral impurities which were present in the black oxide. It has a green color, and, when treated with a little cold water, yields a dark green solution, which may be evaporated over sulphuric acid in vacuo, yielding blackish-green crystals. These dissolve unchanged in solution of potassa, but yield with water a solution which rapidly acquires a red color from the decomposition of the manganate into permanganate, manganic binoxide, and potassium hydrate; $3K_2MnO_4 + 2H_2O$ yields $K_2Mn_2O_8 + MnO_2 + 4KHO$. On account of this change of color the green manganate was formerly known as *chameleon mineral.* The hydrate of potassium which is liberated in the reaction with water will dissolve a portion of the manganate without change until combined with carbonic, sulphuric, or other acid, when the whole of the manganate will be decomposed as stated. After the impurities and manganic peroxide have subsided, the clear liquid is drawn off, the sediment drained and washed upon asbestos or powdered glass, since a paper or muslin filter would decompose the permanganate, and evaporated to crystallization. The first crop or two of crystals are usually pure; subsequently they become mixed with chloride and sulphate of potassium, and require to be purified by recrystallization. Finally, the other salts accumulate in the mother liquors to such an extent that crystals of pure permanganate can no longer be obtained, and the liquids are advantageously used for disinfecting, bleaching, or other purposes.

Graeger (1866) proposed to utilize the manganic oxide, which may be obtained in large quantities and at little expense from the liquors in the preparation of chlorine. The production of the manganate is explained by the equation $Mn_2O_3 + KClO_3 + 4HKO = 2K_2MnO_4 + KCl + 2H_2O$. The process of Städeler (1868) for converting the manganate into permanganate of potassium by means of chlorine gas, and without separation of manganic peroxide, is apt to contaminate the product with small quantities of potassium chlorate.

In a process proposed by Squibb (1864), the formation of other crystallizable salts is avoided by heating the intimate mixture of potassa and manganic peroxide thoroughly to short of redness; while the mass is hot a small stream of water is directed upon it; the heating is renewed, and the operation several times repeated. The mass is exhausted with water, and after the permanganate has been crystallized, the mother liquor is evaporated, and used over again in place of a corresponding quantity of potassa.

Properties.—Permanganate of potassium is in dark purple, nearly black prismatic crystals, which are without odor, and have a sweet, astringent taste. A small quantity of it imparts to a large quantity of water a rich purple tint, which is destroyed by organic matter and deoxidizing agents. It requires 16 parts of cold and 2 parts of boiling water for solution. The solution of the pure salt may be boiled without being decomposed; but in the presence of potassa, a dilute solution acquires a green color from the formation of manganate, oxygen being given off at the same time; $K_2Mn_2O_8 + 2KHO$ yields $2K_2MnO_4 + H_2O + O$. When heated to redness it parts with a portion of its oxygen, and leaves a black residue from which water extracts potassium hydrate. When thrown upon red-hot charcoal it deflagrates, and on being triturated with sulphur or other inflammable bodies the mixture is decomposed with detonation. On mixing its solution in a closed vessel with glycerin, syrup, or other liquids containing organic matter, a similar decomposition, accompanied by explosion, will take place. A warm, concentrated solution of it mixed with nitrate of silver, and allowed to cool, deposits large crystals of permanganate of silver, which require over 100 parts of water for solution, and are decomposed on being boiled with water.

Tests.—The British Pharmacopœia requires 5 grains of the salt dissolved in water to be completely decolorized by a solution of not less than 44 grains of pure ferrous sulphate, acidulated with two fluidrachms of diluted sulphuric acid. This test depends upon the oxidation of 10 molecules (2780) of ferrous to ferric sulphate by one molecule (316) of pure permanganate of potassium. A dilute solution of the latter is not precipitated by nitrate of barium or of silver (absence of sulphate and chloride).

Off. Prep.—Liquor potass. permanganatis, *U. S.*, *Br.*

Physiological Action.—The readiness with which permanganate of potassium yields its oxygen to bodies having a strong affinity for that element accounts for its alleged utility in limiting putrefaction and correcting putrescent smells. For these purposes it was first used in 1857; but as regards the former of them the notion was erroneous, although exceedingly minute proportions of the salt neutralize the smell of putrefaction. A solution of one part in five thousand parts of water is promptly destructive of infusoria; but it does not destroy the germs upon which fermentation depends. Applied pure to the sound skin it produces a brown stain; upon mucous surfaces it causes neither pain nor irritation; but smarting and burning when applied to a raw surface. Internally it has been taken in doses of from eight to ten grains without injury. The stains it leaves upon the skin may be removed by a weak solution of sulphurous or of muriatic acid, or of sulphate of iron.

Medical Uses.—Internally, permanganate of potassium has been used in *diphtheria*, *diabetes*, and *acute rheumatism*, but without any beneficial results. Locally, it is chiefly employed to correct fetor, especially in *cancer*, corroding *ulcers*, *caries*, and *gangrene*. In these cases it is applied in a strong solution with a brush or sponge, or in a weaker solution upon pledgets and compresses of lint. A similar preparation has been made to *carbuncles* after incision. In *ozæna* it forms one of the best palliatives when applied with the nasal douche; and has also been used with great advantage in an atomized solution inhaled in *gangrene of the lungs.* Injections of the solution, and lint saturated with it, are among the best means of treating fetid *otorrhœa.* In the proportion of about three grains to an ounce of water it forms an excellent mouth wash and gargle when *foul breath* arises from carious teeth or from the altered secretions of the faucial glands. As a wash it palliates the fetid exhalations of the *feet* and *armpits* in certain persons; and is useful in purifying the hands from the smell acquired in dissecting rooms, in post-mortem examinations, and in various obstetrical and surgical manipulations. In *gonorrhœa* a solution of from one to ten grains in an ounce of water is a very efficient injection; in *leucorrhœa* a still stronger preparation may be employed, and the same may be applied to diminish the *lochial discharge*, and correct its fetor.

Water contaminated by organic matter may be purified and rendered palatable by adding to it drop by drop a solution of the permanganate until the pink color of the solution ceases to be destroyed after the lapse of twenty-four hours. The clear liquid may then be decanted and used without danger.

A solution of two grains of the salt to a fluidounce of pure water is most appropriate as a commencing injection for the vagina and urethra, and as a wash for simple wounds and ulcers; or the officinal solution, which contains four grains to the ounce, may be used. The latter is appropriate as a deodorizing and stimulant application; and a solution of eight grains to the fluidounce may be used for disinfecting purposes. Internally, it may be given in doses of from two to five grains, properly diluted.

POTASSII PHOSPHAS.—Phosphate of Potassium.

Kali phosphoricum, Phosphas potassicus s. kalicus.—Phosphate de potasse, Fr.; *Phosphorsaures Kali*, G.

Formula K_2HPO_4. Molecular weight 174.

Preparation.—This may be obtained from calcined bones in precisely the same manner as phosphate of sodium (see Sodii phosphas), only substituting in the process carbonate of potassium for carbonate of sodium. It is likewise obtained by adding carbonate of potassium to dilute phosphoric acid until the liquid has a slight alkaline reaction, and by evaporating.

Properties.—The so-called neutral phosphate of potassium or dipotassium orthophosphate is with difficulty obtained in irregular crystals; usually it is a white amorphous mass, of a saline taste, deliquescent in the air, and freely soluble in water. On the application of heat, it melts, and at a red heat is converted into pyrophosphate of potassium, which is likewise very deliquescent. When dissolved in water, it yields with nitrate of silver a yellow precipitate soluble in nitric acid, and with tartaric acid a white crystalline precipitate of cream of tartar.

Both the mono- and tripotassium orthophosphates crystallize more readily than the preceding salt, and are easily soluble in water.

Medical Uses.—It has been alleged to be useful in scrofulous and tuberculous disease; but there is no evidence of its utility. The *dose* is stated to be from ten to thirty grains, which may be given dissolved in water.

POTASSII SULPHAS, *U. S.*—Sulphate of Potassium.

Potassæ sulphas, Br.; *Kali sulfuricum*, P. G.; *Sulfas potassicus s. kalicus; Arcanum duplicatum, Tartarus vitriolatus, Sal polychrestum Glaseri.—Sulphate of potash*, E.; *Sulfate de potasse*, Fr.; *Schwefelsaures Kali*, G.

Formula K_2SO_4. Molecular weight 174.

Preparation.—This salt is obtained as a secondary product in many chemical processes, such as the preparation of iodine from kelp; of nitric acid from potassium nitrate; of hydrochloric acid from potassium chloride; and the purification of potash, etc. In the manufacture of the products of the Stassfurt mines, it is obtained by decomposing potassium chloride with a hot concentrated solution of schoenite (sulphate of magnesium and potassium), and by separating the sulphate of potassium from the double chloride of potassium and magnesium, which is formed at the same time, before the latter can crystallize.

Properties.—Sulphate of potassium crystallizes in transparent colorless and hard six-sided prisms, or pyramids, or combinations of the two forms. It has the specific gravity 2.65, dissolves in 10 parts of cold and 4 parts of boiling water, is insoluble in alcohol, and dissolves in 500 parts of diluted alcohol. The solution has a slight saline and bitterish taste, is neutral to test-paper, and when acidulated with hydrochloric acid gives with barium chloride a white, and with platinic chloride a yellow precipitate. When heated it decrepitates strongly, and when mixed with an excess of chloride of ammonium and ignited, leaves potassium chloride. It imparts a purple color to the flame.

Tests.—The solution of sulphate of potassium is not affected by sulphuretted hydrogen or sulphydrate of ammonium (absence of *heavy metals*); nor is it precipitated by oxalate of ammonium (*calcium*), antimoniate of potassium (*sodium*), or by nitrate of silver (*chloride*).

Off. Prep.—Pil. colocynth. comp., Pil. colocynth. et hyoscyami, *Br.;* Pulv. ipecacuanhæ comp., *U. S., Br.*

POTASSII BISULPHAS, $KHSO_4$, molecular weight 272.—Bisulphate or acid sulphate of potassium is the saline mass remaining in the retort on preparing nitric acid from nitrate of potassium and sulphuric acid (see page 58), and may be obtained in needle-shaped prisms, by dissolving it in less than its own weight of boiling water and cooling. The crystals are colorless and transparent, have a strongly acid taste, and acid reaction to litmus, are fusible when heated, congealing on cooling to a translucent mass, and at a higher heat are decomposed with the evolution of oxygen and sulphurous acid gas, neutral sulphate of potassium being left. The salt dissolves without change in two parts of cold water; but when dissolved in a larger quantity of hot water, neutral sulphate crystallizes on cooling, the liquid containing sulphuric acid. A like decomposition into neutral sulphate and acid is occasioned by alcohol.

Medical Action and Uses.—Under the name of Sal de duobus or Sal polychrest this salt was formerly used as a purgative. It is so in a smaller dose than other salines, but its action is apt to be harsh, producing colicky pain and burning in the abdomen. In several instances doses of from half an ounce to two ounces have caused fatal poisoning, and oftener alarming symptoms. Its *dose* as a purgative is from two to four drachms; but it is seldom prescribed, nor does any good reason appear that it should be so employed.

POTASSII SULPHIS, *U. S.*—SULPHITE OF POTASSIUM.

Kali sulfurosum, Sulfis potassicus s. kalicus.—*Sulfite de potasse*, Fr.; *Schwefligsaures Kali*, G.

Formula $KSO_3.2H_2O$. Molecular weight 194.

Preparation.—On passing sulphurous acid gas into a solution of carbonate of potassium until the carbonic acid has been expelled, the sulphite having the above composition will crystallize on evaporation over sulphuric acid.

Properties.—Sulphite of potassium crystallizes in oblique rhombic octohedrons, which are somewhat deliquescent, dissolve freely in water, are sparingly soluble in alcohol, show an alkaline reaction to test-paper, and have a bitter saline taste. When heated, these crystals evolve sulphurous acid, and leave behind a mixture of sulphate, sulphide, and hydrate of potassium. On exposure the salt is oxidized and gradually converted into sulphate. On adding sulphuric acid to its solution, the odor of burning sulphur is given off, but no turbidity from liberated sulphur is produced (difference from hyposulphite). The solution gives the reactions of potassium salts on the addition of tartaric acid or chloride of platinum. The commercial salt is usually in the form of white opaque fragments or powder, obtained by evaporating the aqueous solution.

Composition.—The salt contains 48.5 per cent. K_2O, 33 per cent. SO_2, and 18.5 H_2O.

Bisulphite of Potassium, $KHSO_3$; molecular weight 120.—It is prepared by passing into a concentrated solution of carbonate of potassium an excess of sulphurous acid gas and adding strong alcohol. The salt crystallizes in white needles, having a sulphurous taste, and neutral reaction to test-paper, and, on exposure, slowly evolving sulphurous acid gas.

Tests.—The presence of sulphate is detected by adding to the aqueous solution chloride of barium, when a white precipitate is produced which should be perfectly soluble in dilute hydrochloric acid; sulphate of barium is insoluble.

Medical Action and Uses.—The sulphite of potassium is believed to possess the same power of controlling fermentation and putrefaction which belongs to the sulphites of sodium and magnesium. But it is much less used than either. It may be given internally, in a very dilute solution, to the extent of from two drachms to half an ounce in the twenty-four hours.

POTASSII SULPHURETUM, *U. S.*—Sulphuret of Potassium.

Potassa sulphurata, Br.; *Kalium sulfuratum*, P. G.; *Hepar sulphuris.*—*Sulphurated potash*, *Liver of sulphur*, E.; *Sulfure de potasse*, *Foie de soufre*, Fr.; *Kalischwefelleber*, G.

Preparation.—Take of Sublimed Sulphur a troyounce; Carbonate of Potassium two troyounces. Rub the carbonate of potassium, previously dried, with the sulphur, and heat the mixture gradually in a covered crucible until it ceases to swell and is completely melted. Then pour the liquid on a marble slab, and, when the mass is cold, break it into pieces, and keep in a well-stopped bottle of green glass. *U. S.*

The different Pharmacopœias prepare this compound in a like manner, and use the sulphur and carbonate of potassium in the proportion given above. On heating the mixture, an evolution of carbonic acid takes place, causing the mass to swell, and when this ceases, the heat is finally raised to a dull redness, so as to produce perfect fusion (*Br.*), and continued until a small portion of the mass is found to be entirely soluble in twice its weight of water (*P. G.*). The crucible must be kept covered to prevent the sulphur from igniting, and after the melted mass has been poured out on a slab, flagstone, or into a porcelain mortar, it is either broken into suitable pieces, as soon as it has congealed (*P. G.*), or first allowed to cool, being in the mean time covered with a porcelain basin or bell-glass, so as to exclude the air as completely as possible (*Br.*). The yield from the quantities given in the formula is two troyounces, or a little over.

On fusing sulphur with carbonate of potassium, the latter is decomposed, with the evolution of carbonic acid gas, the sulphur uniting with the potassium to form a potassium polysulphide, a portion of which is oxidized by the oxygen of the carbonate, in excess over that contained in the carbonic acid gas, to form sulphate or hyposulphite of potassium; $4K_2CO_3 + 5S_2$ yields $K_2SO_4 + 3K_2S_2 + 4CO_2$, and $3K_2CO_3 + 4S_2$ yields $K_2S_2O_3 + 2K_2S_3 + 3CO_2$. But the degree of heat is likewise of importance, since at a high temperature the hyposulphite of potassium is decomposed into pentasulphide and sulphate; $4K_2S_2O_3$ yields

$K_2S_5 + 3K_2SO_4$. It is evident from this that products of very different composition are obtained by varying the proportion of the material, or if this be used in the same relative proportions, by the injudicious application of heat, by which a part of the sulphur may be sublimed. The directions of the Pharmacopœia should, therefore, be strictly adhered to.

Properties.—Sulphuret of potassium, when recently made or well preserved in closed vessels, is in fragments, breaking with a shallow conchoidal fracture, and having a liver-brown color, which in contact with moisture changes to greenish-yellow, or brown-yellow. It has an alkaline reaction to test-paper, and an acrid taste, and yields with water a yellow solution which has the odor of sulphuretted hydrogen, and evolves it freely on the addition of hydrochloric or sulphuric acid, sulphur being at the same time deposited. After boiling the hydrochloric acid solution until the sulphuretted hydrogen has been expelled, the liquid, freed from sulphur by filtration, will yield a yellow precipitate with chloride of platinum, and a white precipitate with chloride of barium. About three-fourths of its weight are dissolved by rectified spirit (*Br.*), the insoluble portion being mainly sulphate of potassium.

When intended for internal use, the compound should be perfectly soluble in water. For external use, the German Pharmacopœia recognizes an impurer article, *Kalium sulfuratum ad balneum*, which is made like the above, with the exception that impure carbonate of potassium (pearlash) is substituted for the purified.

If not protected from contact with air, sulphuret of potassium becomes greenish, and afterwards gray, being partly converted into carbonate through the carbonic acid of the air, and partly oxidized to hyposulphite, sulphite and sulphate, sulphur being at the same time liberated.

Tests.—The presence of sodium compounds is indicated by the yellow color of the flame when an alcoholic solution is ignited. Thirty parts of it dissolved in distilled water and well agitated with a solution of forty parts of sulphate of copper, should yield a filtrate free from copper and not precipitated by sulphuretted hydrogen (*Hager*).

Off. Prep.—Unguent. potas. sulphuratæ, *Br.*

Physiological Action.—Experiments on animals and observations on man show that the local action of this compound is that of an irritant and even a caustic. Taken internally in doses of several drachms it causes inflammation of the throat, stomach, and intestine, and sometimes speedy death. The corresponding symptoms are burning in the parts mentioned, vomiting, purging, fever, muscular trembling and spasm, and in fatal cases dyspnœa, a small and irregular pulse, venous congestion of the skin, and loss of sensibility and consciousness. After death the blood is fluid and dark, and the alimentary canal inflamed. In medicinal and long-continued doses it is said to give rise to a state of the blood such as mercury occasions, *i. e.*, a loss of coagulability, and at the same time to impair the digestion, producing flatulence and discharges of sulphuretted hydrogen.

Medical Uses.—The extremely offensive smell and taste of this preparation have caused its use as an internal medicine to be nearly abandoned; but even if these obstacles had not existed, it would scarcely have held its ground against the results of accurate observation. At one time it was thought to be a specific remedy for *membranous croup*, but longer experience showed that the supposed merits of the medicine were, as in so many other cases, due to errors in diagnosis, to mistaking spasmodic croup, which is seldom fatal, for pseudomembranous laryngitis, from which recovery is rare. It is no longer used, although once regarded as a specific, for *whooping cough;* nor for *pulmonary consumption*, in which it was formerly employed; nor yet for *scrofula*, especially of the glands, which it was once believed to cure; nor is it any longer prescribed as an antidote to acute *poisoning* by *lead*, *arsenic*, *mercury*, or *copper* salts. There is more reason to think it of service in chronic poisoning with mercury and lead. It has been used with doubtful advantage in the treatment of certain forms of *dyspepsia*, apparently those attended with mucous regurgitation or vomiting.

Externally, lotions and ointments made with sulphuret of potassium have been much used in the treatment of limited eruptions of *acne*, *impetigo*, *psoriasis*, etc., and for lessening *mucous* or *purulent discharges* from the nostrils, ears, vagina, etc. It is sometimes employed in the treatment of *scabies*, as in the following liniment; ℞. Potass. sulphuret. ℥vj; Saponis alb. Oij; Ol. olivæ, ℥iv; Ol. thymi, ʒij; M. (Jadelot); but less commonly than sulphur itself. It is, however, very efficient; although if thoroughly applied, after the skin is softened by a prolonged warm bath, it is apt to produce eruptions of eczema, which require time and treatment for their cure.

The action and uses of baths containing this preparation are as follows: About four ounces of the sulphuret are sufficient for a full bath. Such a bath, even at ordinary temperatures, stimulates the skin and is apt to cause sleeplessness, but these and corresponding effects are more decided when the temperature of the water is equal to that of the skin or above it. Hence these baths are contra-indicated when fever is present, or a tendency to hemorrhage exists. Such conditions apart, they are often very serviceable in *chronic rheumatism*, *scrofula*, *cutaneous eruptions*, and chronic *profluvia* from the bowels and urinary organs, and have been used in *lead palsy* and other *paralyses*. They excite copious sweating, and usually tend to produce papular and vesicular eruptions of the skin, particularly if the baths are prolonged, as they sometimes are for several hours. If these effects, and especially the perspiration, are wanting, a sense of fulness, and indeed a relative plethora, may be induced, which is not free from the dangers before alluded to. In such cases a douche directly applied to the suffering part is to be preferred.

Internally, the *dose* of sulphuret of potassium is from three to ten grains.

POTASSII TARTRAS, *U. S.*—TARTRATE OF POTASSIUM.

Potassæ tartras, Br.; *Kali tartaricum*, P. G.; *Tartras potassicus s. kalicus*, *Tartarus tartarisatus*, *Tartarus solubilis.*—*Tartrate of potash*, *Soluble tartar*, E.; *Tartrate de potasse*, *Tartre soluble*, *Sel végétale*, Fr.; *Neutrales weinsaures Kali*, G.

Formula $K_2C_4H_4O_6$. Molecular weight 226.

Preparation.—Take of Pure Carbonate of Potassium sixteen troyounces; Bitartrate of Potassium in fine powder thirty-six troyounces, or a sufficient quantity; Boiling Water eight pints. Dissolve the carbonate of potassium in the water, then gradually add bitartrate of potassium to the solution until it is completely neutralized, and boil. Filter the liquid, evaporate until a pellicle forms, and set it aside to crystallize. Lastly, pour off the mother-water, and, having dried the crystals on bibulous paper, keep them in a well-stopped bottle. *U. S.*

The process of the British Pharmacopœia is, in all essential details, the same. The proportions given, however, are nine ounces of carbonate of potassium, twenty ounces acid tartrate of potassium, and fifty ounces of water; the latter is very properly reduced to about two-thirds the proportional quantity ordered by the process given above, and it might even, without inconvenience, be still further reduced. In the reaction between the two salts, one molecule (188) of cream of tartar decomposes half a molecule (69) of carbonate or one molecule (100) of bicarbonate of potassium, forming the neutral tartrate; $2KHC_4H_4O_6 + K_2CO_3$ yields $2K_2C_4H_4O_6 + CO_2 + H_2O$, and $KHC_4H_4O_6 + KHCO_3$ yields

$K_2C_4H_4O_6+CO_2+H_2O$. Provided the salts are pure, it will be observed that 16 parts of anhydrous carbonate will require 43⅔ parts of bitartrate, and 9 parts of the former 24½ parts of the latter for complete neutralization. In both formulas there is a considerable excess of carbonate, which requires to be neutralized by the further addition of bitartrate. If the latter has been contaminated with tartrate of calcium, this salt may be decomposed by prolonged boiling with potassium carbonate, calcium carbonate being deposited. Calcium tartrate is soluble in a solution of potassium tartrate; and unless decomposed as stated, is best removed by evaporating the solution to dryness, granulating the salt, and treating it with twice its weight of *cold* water, when most of the calcium tartrate will be left undissolved. The same treatment and for the same reason is also advisable if potassium tartrate is obtained as a by-product in the manufacture of tartaric acid, by neutralizing cream of tartar, diffused in boiling water, with calcium carbonate, when potassium tartrate contaminated with calcium tartrate will remain in solution.

Properties.—Tartrate of potassium crystallizes in four- or six-sided colorless and transparent crystals, which in the presence of calcium tartrate are white and rather opaque. It is more frequently met with as a granular or fine white powder, has a saline bitterish taste, is without action on litmus paper, and, when heated, melts, gives off inflammable vapors with the odor of burning sugar, and leaves a black residue having an alkaline reaction. Heated with sulphuric acid it forms a black tarry fluid, evolving inflammable gas and the odor of burning sugar. It requires 240 parts of boiling alcohol for solution, but dissolves at 15° C. (59° F.) in two-thirds, and at the boiling point in about one-fourth its weight of water. Acetic acid added to its aqueous solution causes the separation of a white crystalline precipitate, consisting of bitartrate of potassium.

Tests.—When 113 grains are heated to redness till gases cease to be evolved, the alkaline residue will require for exact neutralization 1000 grain-measures of the volumetric solution of oxalic acid. (*Br.*) If sodium is present, a larger quantity of the acid solution will be required. Sodium would also be indicated by testing the aqueous solution of the alkaline residue left on ignition, with antimoniate of potassium, which will produce a white precipitate. Carbonate is detected by the effervescence on the addition of an acid; sulphate and chloride are recognized in the dilute solution of the salt on the addition of barium nitrate and silver nitrate, which will produce white precipitates, insoluble in nitric acid. Metallic salts, such as copper and iron, which may accidentally be present, are detected in the solution by sulphuretted hydrogen and sulphydrate of ammonium.

Other Soluble Tartars.—The name of *soluble tartar* was formerly applied also to other tartrates, of which two are still recognized by European Pharmacopœias.

TARTARUS BORAXATUS, *P. G.;* Cremor tartari solubilis, Kali tartaricum boraxatum, Borax tartarisata.—Boro-tartrate of potassium and sodium, *E.;* Tartro-borate de potasse et de soude, *Fr.;* Boraxweinstein, *G.* Two parts of borax are dissolved in twenty parts of distilled water, and digested with five parts of cream of tartar. When entirely dissolved, the liquid is evaporated with constant stirring, the resulting residue reduced to powder, and preserved in well-corked bottles. *P. G.* It is a white deliquescent powder, of an agreeable acidulous taste and acid reaction. It is soluble in its own weight of cold, and less than half its weight of boiling water, insoluble in alcohol, and when heated is decomposed, leaving a residue of borax, carbonate of potassium, and charcoal.

POTASSII TARTRO-BORAS.—Tartras borico-potassicus.—Boro-tartrate of potassium, *E.;* Tartrate borico-potassique, Tartre boraté, *Fr.;* Borsäureweinstein, *G.* Four parts of cream of tartar, one of boracic acid, and ten of water are heated together until dissolved; the solution is evaporated to dryness, and the residue powdered. *F. P.* It forms a white inodorous powder, or may be obtained in thin transparent scales, has an acidulous taste, is not deliquescent, and dissolves in two parts of cold water. When long kept, it becomes less soluble in water, but its solubility is restored on treating it with boiling water.

AMMONII ET POTASSII TARTRAS. Tartarus solubilis ammoniatus. Tartrate of ammonium and potassium, *E.;* Tartras de potasse et d'ammoniaque, *Fr.;* Weinsaures Ammoniak-Kali, *G.* $KNH_4C_4H_4O_6$; molecular weight 205.—It is prepared by diffusing one part of cream of tartar in two and a half or three parts of boiling water, adding carbonate of ammonium as long as effervescence takes place, filtering and crystallizing. It is well to render the solution alkaline by the addition of a little ammonia. The double salt crystallizes in transparent prisms, having a pungent and cooling saline taste, and becoming opaque on exposure from loss of ammonia. It is soluble in about two parts of cold and less than its own weight of hot water.

Medical Action and Uses.—This salt appears to promote the urinary secretion when given in small doses freely diluted, but in larger quantities it operates as a laxative. It is excreted by the kidneys as carbonate of potassium, in full doses rendering the urine alkaline. It may be used as a mild cooling purgative in all affections requiring saline aperients. It acts more gently than the sulphate of sodium or magnesium. Like other salines it renders the bile more liquid and promotes its secretion, and hence it may be used in cases of *hepatic* and *portal congestion*, and especially for the relief of *hemorrhoidal swellings.* It is not unusual to associate it with senna, manna, or rhubarb, which concurred in producing those effects; and with scammony and gamboge to mitigate their griping operation. This salt is not very often used at present. As a purgative its *dose* is from half an ounce to an ounce.

POTENTILLA.—CINQUEFOIL.

Fivefinger, E.; *Potentill*, Fr.; *Fingerkraut*, G.

Nat. Ord.—Rosaceæ, Dryadeæ.

Description.—The following species have been employed:—

POTENTILLA ANSERINA, *Lin.;* Silverweed, *E.;* Argentine, Ansérine, *Fr.;* Gänserich, Silberkraut, *G.*—This is indigenous to the northern hemisphere; has radical, interruptedly pinnate leaves, composed of nine to nineteen oblong, deeply serrate leaflets, which are silvery white and downy underneath. It has solitary, long-peduncled, yellow flowers, and produces thread-like runners, which take root at the nodes.

POT. FRUTICOSA, *Lin.*, *shrubby cinquefoil*, is likewise found in the northern hemisphere; is shrubby, about three feet high, has pinnate leaves, with five to seven linear or lance-oblong, entire, and silky leaflets, and numerous yellow flowers.

POT. RUPESTRIS, *Lin.*, a native of the mountainous parts of Europe and Siberia; has pinnate radical, and three-lobed stem leaves.

POT. PALUSTRIS, *Scop.*, s. Comarum palustre, *Lin.*—*Marsh cinquefoil* grows in cool, boggy localities in Europe and North America, has the leaves with five or seven lance-oblong, underneath whitish leaflets, and purple-colored flowers.

POT. ARGENTEA, *Lin.*—*Silvery cinquefoil* grows in dry fields in North America and Europe, has an ascending stem, palmately five-foliate leaves, and wedge-oblong, incised, and beneath silvery, canescent leaflets.

POT. REPTANS, *Lin.;* Creeping cinquefoil, *E.;* Potentille rampante, quintefeuille, *Fr.;* Fünffingerkraut, *G.*—It grows in moist fields in Europe and Asia, has slender, creeping stems, long, petiolate, palmately five-foliate leaves, oblong-obovate, deeply serrate leaflets, and single, axillary, long-stalked flowers.

Pot. canadensis, *Lin.*, *common cinquefoil*, grows in dry fields and woods of North America, resembles the preceding, but has the stem leaves on short petioles, the leaflets wedge-obovate, incised, and the flowers on peduncles about as long as the leaves.

With the exception noted, all the above species have yellow flowers; they are inodorous, and their roots and herbaceous portions have a slightly astringent and bitterish taste.

Constituents.—The plants contain a little tannin; bitter, mucilaginous, and other common vegetable principles.

Medical Action and Uses.—Creeping cinquefoil is almost identical in its qualities with P. tormentilla. It has been employed from ancient times in Europe, on account of its slight astringency, as a remedy for *diarrhœa*, *dysentery*, *leucorrhœa*, *passive hemorrhages*, *sore-throat*, etc., and is still used as a domestic remedy. It is generally given in decoction. The other species have similar properties.

PRENANTHES.—Rattlesnake-root.

Lion's-foot, White lettuce, Cancer-weed, Gall of the earth.

Prenanthes (Harpalyce, *Don*) alba, *Lin.*, s. Nabalus albus, *Hooker*.

Nat. Ord.—Compositæ, Liguliforæ.

Description.—This North American perennial grows in rich soil on the borders of woods, and flowers in July and August. The stem is three to six feet high, purplish and glaucous, branched above, and grows from a bitter, tuberous, spindle-shaped root. The leaves are petiolate, angular, hastate; the radical ones palmately 5- or 7-lobed, those of the stem ovate-roundish and sinuate-toothed; the flower-heads are in loose, racemose cymes, drooping; have a cylindrical involucre, with the linear, purplish, and white scales in a single row, and a few bractlets at the base, and contain from eight to twelve ochroleucous or purplish florets, with linear-oblong, striate, and unbeaked akenes, and a pale-brownish pappus composed of several rows of rough hairs. All parts of the plant contain a milky juice, and have a bitter taste. The variety *serpentaria* has the lower leaves almost palmately divided, and the stem leaves 3-lobed or deeply toothed.

No analysis of its constituents has been made.

Medical Action and Uses.—The extreme bitterness of the root of this plant caused it to be used as a domestic tonic in the Southern States. Nearly thirty years ago it was affirmed to be a certain remedy for the *rattlesnake's bite*, in confirmation of a long antecedent tradition. "The milky juice of the plant was taken internally, and the leaves, steeped in water, were applied to the wound, and frequently changed." No recent addition appears to have been made to these statements.

PRINOS, *U. S.*—Black Alder.

Winterberry, *Feverbush*, E.; *Prinos*, Fr., G.

The bark of Prinos verticillatus, *Lin.*, s. Ilex verticillata, *Gray*.

Nat. Ord.—Aquifoliaceæ.

Origin.—The black alder or winterberry is a shrub about eight feet high, growing in low swampy ground in Canada and the United States. It has alternate oval or obovate, acuminate, serrate leaves, about two or three inches long, downy on the veins beneath, and narrowed into petioles about half an inch long.

The small whitish flowers are diœciously polygamous, have a subrotate, six-parted corolla, usually six stamens, and are in little umbels, all on very short peduncles. The fruit is a globose, bright red, six-seeded berry, which is persistent in winter, grows in clusters, apparently verticillate, and has an acidulous and bitter taste. A closely allied species, Prinos (Ilex, *Gray*) lævigatus, *Pursh*, grows in wet grounds in the Northern States, und southward in the mountains to Virginia, and is distinguished by its lanceolate or lance-oblong and smooth leaves, and by the staminate flowers being on slender peduncles. Both flower in May and June, and ripen their fruit in October. Prinos glaber, *Lin.*, s. Ilex glabra, *Gray*, known as inkberry, is found near the coast from Massachusetts southward, but chiefly in the Southern States. It has coriaceous, smooth, lanceolate or oblong leaves, with a wedge-shaped base, and serrate near the apex; the berries are black.

Description.—The bark is in slender pieces, one-quarter or half an inch wide, or in fragments, about one-thirtieth or one-twentieth of an inch thick, fragile; externally of a brownish ash-color, with irregular, light-gray or whitish patches, lined with black, and sprinkled with minute black or small brown circular spots. Older bark is marked with short, transverse, oblong, shallow scars, often margined with ridges. The inner surface is pale-greenish or orange-yellow, shortly striate, otherwise smooth, and has frequently thin sections of the white wood adhering. The bark breaks with a short fracture, and shows upon transverse section a green color and a tangential arrangement of tissue. It is inodorous, and has a bitter taste.

Constituents.—The bark contains tannin, and, according to W. J. Lerch (1873), is free from berberina. The yellow coloring matter and bitter principle have not been isolated.

Medical Action and Uses.—The bark of black alder is astringent and tonic, and is popularly employed in *intermittent fever* and *diarrhœa*, as a topical application to *gangrenous* and other ill-conditioned *sores*, and both internally and locally in chronic *cutaneous eruptions*. It is prescribed in substance in doses of thirty grains, and in a decoction made with two ounces of the bark in three pints of water boiled to a quart, of which the *dose* is two or three fluidounces. A saturated tincture is also prepared with the berries as well as with the bark.

PRUNUM, *U. S.*, *Br.*—PRUNES.

Prunes, Fr.; *Pflaumen*, *Zwetschen*, G.

The fruit of Prunus domestica, *Lin.*

Nat. Ord.—Rosaceæ, Amygdaleæ.

Origin.—The plum tree is indigenous to Western Asia. It has been cultivated from a very early period, and is now met with in most countries having a temperate climate. A large number of varieties have been produced differing in the size, color, and shape of the fruit. The tree is about twenty feet high, without thorns, has oval-elliptic serrate leaves and whitish pedunculate flowers, either solitary or in twos. Some botanists consider the subglobular plums to be the cultivated varieties of Prunus insititia, *Lin.*, which resembles the other species, but is thorny and has elliptic or somewhat lanceolate leaves.

Description.—The dried fruit is a subglobular or oblong drupe of a dark blue or purplish-blue color, glaucous, shrivelled, with a shallow longitudinal furrow, the sarcocarp brownish-yellow, and the putamen hard, oblong, somewhat oblique, more or less flattened, smooth, or with irregular ridges. The seeds resemble the almond, but are smaller. The fleshy portion of the fruit has an agreeable, sweet, and acidulous taste; the seed has the taste of bitter almond.

Constituents.—Prunes contain sugar, pectin, albumen, malic acid, and various salts. The sugar of the different varieties varies in amount between about 12 and 25 per cent. of the weight of the fresh fruit.

Off. Prep.—Confectio sennæ, *U. S.*, *Br.*

Medical Action and Uses.—Prunes are nutritious and laxative, but in excess are apt to create flatulence and colic, owing chiefly to the indigestibility of their skins. When stewed with sugar they relieve *costiveness*, and are more efficient when thus prepared with senna, whose tendency to gripe they partially correct. For this reason they enter into the confection of senna.

PRUNUS VIRGINIANA, *U. S.*—WILD CHERRY BARK.

Ecorce de cêrisier de Virginie, Fr.; *Wildkirschenrinde*, G.

The bark of Cerasus serotina, *De C.*, s. Cer. virginiana, *Mich.*, s. Prunus serotina, *Ehrh.*

Nat. Ord.—Rosaceæ, Amygdaleæ.

Origin.—The wild cherry is a large North American forest tree, growing to the height of sixty or eighty feet, with the trunk undivided to the height of twenty or thirty feet. When grown in the open field it is usually much smaller. It has alternate lance-oblong, taper-pointed, petiolate leaves, which are three to five inches long, and are finely serrate with incurved teeth. The flowers are white and in elongated racemes, about four or five inches long, and terminal on the branchlets. The fruit is a small, globose, purplish-black drupe of a sweet and bitterish taste. The leaves were suggested by Prof. Procter (1858) as a substitute for cherry laurel leaves, and found to yield nearly one-tenth per cent. of hydrocyanic acid, when recently collected. This species has long been confounded with the *choke cherry*, to which Linnæus gave the name *Prunus virginiana;* it has also been called Prunus obovata, *Bigelow*, and Cerasus virginiana, *D. C.* It is shrubby, about eight or ten feet high, or arborescent, has thinner oval or obovate and abruptly pointed, sharply serrate leaves, short and close racemes, and red or purplish fruits of an astringent and bitter taste.

Description.—Wild cherry bark is met with in irregular fragments or slightly curved pieces; the thinner pieces are obtained from the branches and trunks of younger trees, are about one-sixteenth inch thick, externally of a blackish-gray or green-brownish color, smooth and somewhat shining; or, partly deprived of the exfoliating corky layer, and then of a greenish or light yellowish-brown. Older bark has usually the outer corky layer removed, is one-eighth inch and more in thickness, and has a rather uneven outer surface of a rust-brown color. The inner surface is smooth, somewhat striate, cinnamon-colored or rust-brown. The bark is brittle, breaks with a granular fracture, is radially striate upon transverse section, and yields a pale reddish-brown powder. It has a very slight odor while dry, but when macerated in water it develops the odor of bitter almond; its taste is astringent, aromatic, and bitter, with the flavor of bitter almond. The thick corky layer of old bark, if present, should be rejected. The bark should be collected in October.

Constituents.—Stephen Procter (1834) showed the bark to contain tannin, gallic acid, resin, starch, and other common vegetable principles, and obtained by distillation a volatile oil containing hydrocyanic acid. This volatile oil was further examined by Prof. Procter (1837, 1838), and found to agree in the main with the volatile oil of bitter almond, and, like this, to be produced from *amygdalin*, by the action of a proteid, resembling emulsin, or, perhaps, identical with it. It is coagulated or altered by heat, and the powdered bark, introduced into hot water, does not yield any volatile oil. J. S. Perot (1852) ascertained that the bark collected in autumn yielded three times as much hydrocyanic acid as that collected in April. From the latter he obtained .0478 per cent.; when gathered in October the yield was .1436 per cent., or $\frac{1}{7}$ grain HCy from 100 grains of the bark, which would therefore be equal to about seven or eight drops of officinal hydrocyanic acid. The same author ascertained also that the bitter principle of wild cherry bark is not due to phlorizin. J. L. Williams (1875) obtained the bitter principle by concentrating the aqueous infusion, mixing it with an equal bulk of alcohol, agitating with milk of lime, evaporating the filtrate, and exhausting the residue with hot alcohol, on the spontaneous evaporation of which a transparent, brownish, somewhat gelatinous, bitter mass was left; it was insoluble in ether, somewhat soluble in water, more soluble in alcohol, and was colored brown-red by sulphuric acid. The bark from the trunk as well as from the root was found by J. L. Lemberger (1871) to contain the largest proportion of tannin when collected in October, and to yield then also infusions of a dark wine-color.

Off. Prep.—Extract. pruni virg. fluid., Infus. pruni virg., Syrup. pruni virg., *U. S.*

Medical Action and Uses.—Wild cherry bark is tonic through its bitter principle, and more or less sedative through the hydrocyanic acid which it generates with water. For the latter effect, however, very large doses are required. It is more used in pulmonary *consumption* than in any other disease, under the impression that it improves the appetite and strengthens the digestion, while it palliates the cough and allays the irritability of the nervous system. It is a gentle and harmless palliative in this disease, and in cases of nervous *cough* produced by reflex irritation, or even by slight bronchial or laryngeal irritation. It is equally useful during *convalescence* from various acute diseases when febrile excitement is maintained by general debility of the system. *Palpitation of the heart* is reputed to be especially under its control. When this symptom depends upon organic causes, the medicine is inadequate to allay it except in a very slight degree; but when it is associated, as it more frequently is, with anæmic, chlorotic, dyspeptic, or nervous disorders, the bark is sometimes of real advantage.

The *dose* of the powdered bark is stated to be thirty or forty grains. The cold infusion and the fluid extract are more efficient and eligible preparations.

PSORALEA.—Psoralea.

Psorale, Fr.; *Psoralea*, *Drüsenklee*, G.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—The genus is characterized by a 5-cleft persistent calyx having the lowest lobe longest, by diadelphous, or sometimes monadelphous stamens, by a short one-seeded pod, the pointed end of which projects from the calyx, and by the glandular dots with which the calyx and frequently also the leaves are more or less covered. The following species have been employed:—

Psoralea melilotoides, *Mich.*, s. P. eglandulosa, *Ell.*, grows in dry soil in the Southern and Western United States, is a slender, erect, pubescent, and slightly glandular herb about two feet high, and has a spindle-shaped root, trifoliate leaves with oblong-lanceolate, rather obtuse leaflets, and long-peduncled, oblong, finally elongated spikes of purplish flowers; the legume is nearly orbicular and transversely wrinkled. The plant has a slight aromatic odor, and a somewhat spicy and bitterish taste. It flowers in June and July, and should be collected when in full bloom.

P. esculenta, *Pursh*, has a tuberous or turnip-shaped farinaceous edible root, which is known as *bread root*, and likewise as *Indian turnip*, and formerly as *pomme blanche* and *pomme de prairie*. It grows on the prairies from Wisconsin to Missouri and westward.

P. GLANDULOSA, *Lin.*, was formerly said to yield *yerba maté* (see page 740). It is a shrub of Chili, about six feet high, with rough glandular petioles, ovate-lanceolate, acute glandular leaflets, and white or blue flowers. The root is emetic, and the leaves have aromatic properties, their flavor resembling that of rue.

P. PENTAPHYLLA, *Lin.*, of Mexico, has a thick root, which is sometimes known as *white contrayerva*, from its color and medicinal properties.

P. BITUMINOSA, *Lin.*, of Southern Europe, is suffruticose, and has a disagreeable bituminous odor.

Several other species of Psoralea, in addition to the two named above, are indigenous to the United States. They all appear to contain resin and volatile oil, but have not been sufficiently analyzed.

Medical Action and Uses.—The leaves and the root have a bitter, pungent, and aromatic taste, which is most decided in the root. It has been described as a gentle, stimulating, and tonic nervine, and compared in its action to Chinese tea. It is said to have been used with advantage in chronic *diarrhœa* depending upon strumous conditions of the mesenteric glands; and in chronic *dyspepsia* attended with vomiting of food. The medicine has been administered chiefly in the form of a tincture prepared with several other plants besides psoralea, so that its special virtues cannot be extricated from the compound effect. As far as can be judged, it appears to partake of the qualities of aromatic and bitter tonics in general.

PTELEA.—SHRUBBY TREFOIL.

Hoptree, Waferash, E.

Ptelea trifoliata, *Lin.* *Nat. Ord.*—Rutaceæ, Xanthoxyleæ.

Description.—The hoptree is a handsome North American shrub growing southward and westward from New Jersey and Pennsylvania, chiefly, however, west of the Alleghanies. The shrub is about 8 to 12 feet high, with dark-brown branches, which, like the leaves, are downy when young. The *leaves* are alternate, petiolate, light green, and trifoliate, with sessile, pointed, indistinctly serrate, and finely pellucid-punctate leaflets, of which the lateral ones are ovate, very uneven towards the base, while the larger terminal one is elliptic or obovate and wedge-shaped at the base. They are from 3 to 5 inches long, when broken exhale a rather unpleasant odor, and have a bitter and somewhat astringent taste. The small greenish-white polygamous flowers are in compound terminal cymes, have a disagreeable odor, and are followed by a flat orbicular *fruit*, which is two-celled and two-seeded, and is surrounded by a circular membranous wing, the whole fruit being nearly an inch in diameter, and of a pleasant hop-like flavor. The fruit, leaves, and *bark of the root* have been employed. The latter is in fragments and irregular quills, of a brown color, longitudinally wrinkled, lighter and smooth on the inner surface, breaks with a short fracture, and has a bitter and pungent taste.

Constituents.—G. M. Smyser (1862) found in the leaves *tannin* and *gallic acid;* in the fruit a soft acrid *resin*, and in the bark a reddish-brown *resin*, soluble in ether and alcohol, and of a pungent and acrid taste. All parts contain volatile oil and other principles commonly met with in plants. Justin Steer (1867) isolated *berberina* from the bark, and regards it as the bitter and tonic principle.

Medical Action and Uses.—The bark of the root appears to be aromatic and tonic, and has been used in tincture and infusion for *dyspepsia*, and as a stimulant in *typhoid* febrile states. The leaves and young shoots have also been employed in strong infusion as anthelmintics.

PULSATILLA.—PASQUE FLOWER.

Herba pulsatillæ, P. G.—*Pulsatille, Coquelourde*, Fr.; *Küchenschelle*, G.

The flowering herb of Pulsatilla (Anemone, *Lin.*) pratensis, *Miller*, and of Pulsatilla vulgaris, *Mill.*, s. Anemone pulsatilla, *Lin.*

Nat. Ord.—Ranunculaceæ.

Description.—Both plants are indigenous to Central and Northern Europe, where they grow in sandy fields, and bloom in April and May. The first mentioned species has a dark brown, oblique, several-headed root, and pinnately two- or three-cleft, petiolate radical leaves, with linear acute segments, and at the base surrounded by several ovate lanceolate sheaths. The flowering scape is about six inches high, and bears a single nodding bell-shaped flower reflexed at the apex, varying in color between dark violet and light blue, and surrounded by a distant involucre composed of three palmately divided and cleft bracts with linear lobes. The numerous ovaries are prolonged into a feathery tail (style). All herbaceous parts are clothed with long, soft, silky hairs, are nearly inodorous, but when rubbed exhale a very acrid vapor, and have a burning acrid taste. The second species closely resembles the former, but has the flowers erect, and the sepals spreading above, but not reflexed.

A third species, *Pulsatilla* (*Anemone*, Lin.) *patens*, Mill., extends from Siberia through Eastern and Central Europe, and a variety of it, *var. Nuttalliana*, Gray (*Anem. Nuttalliana*, D. C., *A. Ludoviciana*, Nutt., is found in North America, from Illinois and Wisconsin west to the Rocky Mountains and south to Louisiana. Its purplish or whitish erect flowers are developed before the leaves, which are twice or thrice deeply three-parted, and have linear acute lobes.

Similar acrid properties are met with in most species of Anemone, which are distinguished from the section Pulsatilla chiefly by the styles being much shorter and not feathery. *An. nemorosa*, Lin., *wind-flower* or *wood anemone*, is a native of North America, Northern Asia, and Europe, has a long-petioled trifoliate leaf with ovate or elliptic cut and toothed leaflets, an involucre of three similar leaves, and a white or purplish flower. *An. coronaria*, Lin., has been employed in the Levant, where it is indigenous. It is sometimes met with in gardens. *An. sylvestris* and *An. ranunculoides*, Lin., indigenous to Northern Asia and Europe, are used in Siberia. All species lose some of their acrid properties by drying, and rapidly deteriorate on keeping.

Constituents.—The fresh plants of the section pulsatilla, when distilled with water, yield a distillate from which ether extracts a very acrid yellow oil, which is gradually, or more rapidly in the presence of water, converted into *anemonin* and *anemonic acid*, from which hot alcohol dissolves the former. Anemonin, which was first observed by Störk (1771), and investigated by Heyer (1779), forms colorless friable crystals, which are neutral, inodorous, and when fused, exceedingly acrid, soluble in chloroform, nearly insoluble in ether and water; the composition of these crystals, according to Fehling (1841), is $C_{15}H_{12}O_6$. Löwig and Weidmann (1839) and Fehling (1841) observed that boiling baryta water converts it into a brown amorphous acid. Anemonic acid is a white crystalline tasteless powder, insoluble in most simple solvents, and dissolves in alkalies with a yellow color. Similar results were obtained with American pulsatilla by A. W. Miller (1862) and F. E. Miller (1873).

The acrid principles of different species of Ranunculus and probably of some other plants, appear to be allied to, if not identical with, the above.

Medical Action and Uses.—The bruised fresh plant rubbed upon the skin irritates and may even vesicate it. Internally, it may inflame the stomach and bowels and even cause fatal convulsions. In medicinal doses, it is reported to act as a general excitant. Anemonin applied to the tongue occasions a severe burning pain, and persistently benumbs its sensibility. Internally, it acts as a general stimulant and a diuretic. Given to rabbits in the dose of from five to ten grains it reduces the pulse- and respiration-rate and the temperature, causes dyspnœa and stertor, debility, and then paralysis of the limbs, stupor, dilatation followed by contraction of the pupil, and death without convulsion. The characteristic lesions found on dissection are distension of the heart and great vessels and of the veins of the brain and medulla oblongata with dark blood.

Pulsatilla has been recommended in *amaurosis*, especially when depending upon gouty or rheumatic causes, in chronic *rheumatism* and *gout*, and in chronic diseases of the *skin* and phagadenic *ulcers*, but no sufficient grounds exist for its use in therapeutics. The powdered herb was formerly prescribed in doses of four or five grains; and an infusion made with from two drachms to four ounces of water was given internally, and a stronger one was used externally. A tincture was also employed.

PULVERES.—Powders.

Poudres, Fr.; *Pulver*, G.

Preparation.—All solid drugs may be reduced to powder, but the means by which pulverization is effected must vary very considerably, according to the nature of the drug. The large majority of crystallized chemical compounds are readily powdered by *trituration* in a porcelain or wedge-wood mortar; many of those which are insoluble or sparingly soluble in alcohol, may be powdered by *precipitating* them from their concentrated solution by pouring it slowly and with continual agitation into alcohol. Compounds which are insoluble in water may frequently be obtained in a more or less fine powder, which is either amorphous or crystalline, by means of double decomposition and *precipitation*. Soluble compounds may also be powdered by evaporating their solution, and, as it thickens, by stirring it continually so as to disturb crystallization or prevent the compound from separating as a solid mass. This process is termed *granulation*, and is equally applicable to fusible substances, which, after having been liquefied by heat, are stirred or triturated while they are cooling and congealing. Volatile compounds and elements (calomel, sulphur, etc.) may be finely powdered by *sublimation*, and by suddenly condensing their hot vapors in a large chamber with a current of air, or, if insoluble in water, with a current of steam.

In several of these processes the powder is not obtained of uniform fineness, and then requires to be *sifted;* or the finer particles are separated from the coarser by means of *elutriation*, which process consists in diffusing the powder in water, and decanting from the heavy sediment. The fine powder, which remains longest in suspension, is then permitted to subside, and, after withdrawing the liquid, dried. It is evident that only those substances are adapted to this treatment which are heavier than water, and which are entirely insoluble therein; elutriation is usually preceded by *levigation*, which is simply a process of trituration in the presence of sufficient moisture to render the mass soft. The operation is performed either in a mortar, or upon a slab by the aid of a muller.

Drugs which are composed of vegetable tissue, or which consist of exudations, cannot, as a rule, be reduced to powder by these means. In these cases *contusion* is required, and this is the method most frequently employed. The substance is placed in a rather deep mortar, and broken by perpendicular strokes with the flattened surface of a heavy pestle. The process is called *bruising* if the substance is to be broken merely into a coarse powder. If the drug contains a certain amount of oil or resin, the heat produced by the pounding will often render the material more or less soft or adhesive. This result is best prevented by exposing the drug to a low temperature, and powdering in the cold, when it will retain its pulverulent condition at ordinary temperatures, or, if it conglomerates, it may be rubbed into powder by slight trituration. Mortars made of iron or brass are best adapted for preparing powders by contusion.

Most of the vegetable powders are, however, prepared on a large scale at the drugmills by *grinding*, the grinding surface being a bed of hard stone upon which either iron balls or mill-stones are made to revolve. A draught is thereby created which carries the fine powder up to a certain height, and if this alone is collected, it is called a *dusted powder*. Oily seeds and similar material cannot profitably be powdered in this manner, because by the pressure and heat created by the grinding the oil rises to the surface and agglutinates a part of the powder. Such material is best ground or rather cut between horizontal mill-stones suitably prepared for the purpose. A number of drugmills, which may be worked by hand, have been constructed, and serve a good purpose for the use of the pharmacist, in preparing the coarser kind of powders; but none have been made which could be used with advantage for finely powdering moderate quantities. Some tough materials are conveniently reduced to powder by *rasping*.

Whether contusion or grinding is resorted to, the drugs to be powdered should be deprived of the moisture remaining in them, by exposing them in a drying-room to a temperature of about 50° C. (122° F.). Drugs, however, which owe their virtues to volatile oil, and which should be powdered in the air-dry condition, or on a small scale, are conveniently dried over burnt lime.

Fineness of Powders.—The United States Pharmacopœia designates five degrees of fineness; namely, *very fine* when passed through a sieve of eighty or more meshes to the linear inch; *fine* when passed through one of sixty meshes; *moderately fine* through one of fifty meshes; *moderately coarse* through one of forty meshes; and *coarse* if passed through a sieve of twenty meshes to the linear inch. The fineness of powders is often conveniently described as being of No. 20, etc., indicating that it has been passed through a sieve of that size.

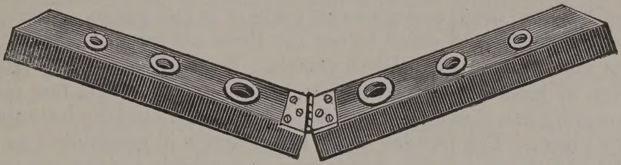
Compound Powders.—Since nearly all solid drugs may be obtained and kept in the state of powder, the Pharmacopœias give special directions only for those powders which are composed of two or more ingredients. In preparing these it is generally advisable to reduce each substance separately to powder; the powders are then weighed out, and mixed in a mortar, or are passed repeatedly through a suitable sieve. Some special observations will be made in connection with several officinal powders.

Dispensing of Powders.—In the majority of cases when powders are prescribed, the ingredients are such as are kept on hand pulverized or in such a condition that they may be easily powdered by trituration in a mortar. These ingredients are then weighed out first, and rubbed fine before the powders are added. Should soft substances such as extracts, or liquids such as volatile oils, be directed, they are triturated with the sugar, which usually is a constituent of magistral powders, until reduced to powder, when the other articles are added and well mixed. In most cases, perhaps, it will be of advantage not to use finely powdered sugar, but to employ sugar in small lumps, which, while being rubbed to powder in the presence of the other ingredients, will tend to cause their still greater subdivision through the prolonged attrition. There are, however, occasional exceptions to the procedure as described, for, in consequence of the elevation of temperature produced by the trituration, chemical processes are likely to be induced which would interfere with the stability of the powder; such instances are the mixing of oxidizing agents like chlorate of potassium with vegetable substances, which, under the pressure of the pestle, would cause an explosion; or the mixing of salts, which in the presence of a little moisture, would result in liquefaction, as in triturating together acetate of lead and sulphate of zinc. Compound powders of this nature ought invariably to be made by powdering the constituents separately in a mortar; if necessary, they should then be well dried, and finally mixed upon smooth paper with the aid of a spatula without exerting any friction.

Powders are rarely prescribed in bulk, except when intended for external use; in nearly all cases they are divided by the pharmacist, each dose being dispensed in a separate paper. Deliquescent and odorous powders are best dispensed in waxed paper (see p. 383).

Administration.—Powders are generally taken suspended in water, or in a liquid flavored with syrup or some pleasant aromatic. The nauseous taste will not always thus be disguised. To remedy this difficulty it has been customary in some countries to envelop the powder in a wafer of sufficient size and soften it by a brief immersion in water, when it may be swallowed without any inconvenience. *Cachets de pain* or *wafer capsules*, an elegant modification of this process, were introduced by Mr. Limousin (1873). The sheet wafer is punched into circular discs; these are dampened, and then pressed between two warmed plates of the desired shape, whereby they become concave on one side. A dose of the powder is placed on this side, the margin is very slightly dampened, and an empty disc is placed upon and fastened to it by sufficient pressure. Various apparatuses have been suggested for sealing the wafers; one of the simplest is shown in Fig. 141, the pressing surfaces consisting of the rims of concave pieces of brass or other metal.

Fig. 141.



Press for wafer capsules.

Granular Powders.—These are made in various ways. A method of granulating vegetable and similar powders was suggested by Dr. Thos. Skinner (1862), and is executed by triturating the powder with sufficient mucilage until a crummy non-adhesive mass is obtained, which is dried in thin layers, bruised, and separated by sieves into powders as desired; these granules may then be covered with tolu in the same manner as pills. Various saline mixtures, usually of an effervescing nature, have been granulated by powdering separately citric or tartaric acid, sugar, bicarbonate of sodium, carbonate of magnesium, etc., mixing them together by sifting, adding sufficient strong alcohol to render the mixture slightly damp and adherent, and rubbing with slight pressure through a No. 8 or other suitable sieve. After drying, the granules of the different sizes are separated by suitable sieves.

Preservation.—When perfectly free from moisture, powders may be preserved in hermetically sealed vessels; but if they attract moisture on occasional exposure, it is much better to keep them in a dry place inclosed in vessels which will admit the air but exclude the light. As a rule, powders will be found to keep well in good paper boxes unless they contain volatile oil.

PULVERES EFFERVESCENTES, *U. S.*—EFFERVESCING POWDERS.

Soda powders, E.; *Poudre gazeuse*, *P. aërophore*, *P. de Seltz*, Fr.; *Brausepulver*, G.

Preparation.—Take of Bicarbonate of Sodium in fine powder three hundred and sixty grains; Tartaric Acid in fine powder three hundred grains. Divide each of the powders into twelve equal parts, and keep the parts, severally, of the bicarbonate and of the acid, in separate papers of different colors. *U. S.*

The *Pulvis aërophorus*, P. G., is composed of ten parts bicarbonate of sodium, nine parts of tartaric acid, and nineteen parts of white sugar. Each substance is finely powdered and well dried before the three are mixed, when the powder may be kept unaltered in well-closed vessels. But if these are opened, and, from the deposition of moisture decomposition begins to take place, the change proceeds more rapidly in a closed than in an open vessel, should the latter be kept in a dry and airy place. The powder keeps much better if granulated as described above. Either form of powder may serve as a vehicle for the convenient and pleasant administration of other medicines, such as salts of iron, quinia, etc., which should not be mixed with the bicarbonate of sodium alone.

See this subject treated in *Proceedings Amer. Phar. Assoc.*, 1856, p. 49.

Medical Action and Uses.—The carbonic acid disengaged during the administration of these powders is a direct stimulant to the stomach and nervous system while it creates an agreeable sense of coolness in the abdomen. The tartrate of soda formed in the process is diuretic, antacid, and slightly laxative, and probably during *fever* is diaphoretic also. Soda powders are much used to relieve the feverish effects of imprudent eating, and to remove constipation. Each powder should be dissolved in about four ounces of water flavored with syrup if preferred, and the solutions being mixed should be taken while effervescing.

PULVERES EFFERVESCENTES APERIENTES, *U. S.*—APERIENT EFFERVESCING POWDERS.

Pulvis aërophorus laxans s. P. aërophorus Seidlitzensis, P. G.—*Seidlitz powders*, E.; *Poudre gazifère purgative*, *Poudre de Sedlitz*, Fr.; *Abführendes Brausepulver*, *Seidlitzpulver*, G.

Preparation.—Take of Bicarbonate of Sodium in fine powder a troyounce; Tartrate of Potassium and Sodium in fine powder three troyounces; Tartaric Acid in fine powder four hundred and twenty grains. Mix intimately the bicarbonate of sodium with the tartrate of potassium and sodium, and divide the mixture into twelve equal parts. Then divide the tartaric acid into the same number of equal parts. Lastly, keep the parts, severally, of the mixture and of the acid, in separate papers of different colors. *U. S.*

The Seidlitz powders of the French Codex contain about three-fourths the quantities ordered by the above formula.

Medical Action and Uses.—This preparation forms a convenient means of administering tartrate of potassium and sodium in an effervescing mixture. The acid powder should be dissolved in one or two fluidounces, and the saline in about six fluidounces, of water; the liquids should then be gradually mixed and drunk while effervescing. Seidlitz powders are very commonly employed to relieve moderate *constipation*, and the *feverishness* that attends the first stage of many slight disorders, especially those produced by "taking cold" or by an imprudent and excessive use of food and alcohol. Like other saline laxatives, this one is more appropriate in warm than in cold weather. If a very active operation is desired, one and a half or even two pairs of powders may be given at once; or, on the other hand, they may be administered in divided portions as a febrifuge medicine.

PULVIS ALOES ET CANELLÆ, *U. S.*—POWDER OF ALOES AND CANELLA.

Hiera picra, E.

Preparation.—Take of Socotrine Aloes in fine powder twelve troyounces; Canella in fine powder three troyounces. Rub them together until they are thoroughly mixed. *U. S.*

Medical Action and Uses.—When *menstruation* becomes scanty, or is suspended, in consequence of anemia, or chlorosis, or of a mere local atony of the reproductive organs, aloes is generally indicated, and doubtless the association with it of a stimulant aromatic increases its efficacy in such cases. This preparation was formerly much used under the name of *hiera picra Andromachi*. The *dose* is about twenty grains, and is best given in a wafer. It is sometimes taken in hot wine or spirit, which, however, lessens its purgative power.

PULVIS AMYGDALÆ COMPOSITUS, *Br.*—COMPOUND POWDER OF ALMONDS.

Confectio amygdalæ, Conserva amygdalarum.—Confection of almond, E.; *Conserve d'amandes*, Fr.; *Mandelconserve*, G.

Preparation.—Take of Sweet Almonds eight ounces; Refined Sugar in powder four ounces; Gum Acacia in powder one ounce. Steep the almonds in warm water until their skins can be easily removed; and, when blanched, dry them thoroughly with a soft cloth, and rub them lightly in a mortar to a smooth consistence. Mix the gum and the sugar; and adding them to the pulp gradually, rub the whole to a coarse powder. Keep it in a lightly covered jar. *Br.*

Medical Uses.—The compound powder of almond serves for the convenient preparation of the almond mixture, when mixed with water in the proportion of two and a half ounces to a pint.

PULVIS ANTIMONIALIS.—ANTIMONIAL POWDER.

Pulvis antimonii compositus, Pulvis Jacobi.—James's powder, E.; *Poudre antimoniale de James*, Fr.; *James's Antimonpulver*, G.

Preparation.—Take of Oxide of Antimony one ounce; Phosphate of Lime two ounces. Mix them thoroughly. *Br.*

This is intended as a simplified substitute for a nostrum which has enjoyed considerable reputation in Great Britain and elsewhere for more than a hundred years. Another formula, formerly recognized as yielding a good substitute, requires the ignition of a mixture consisting of one part of sulphuret of antimony and two parts of horn shavings, by throwing this in small quantities into a red-hot crucible, powdering the product and keeping again for some time at a red heat. The result of this process is essentially phosphate of calcium and oxide of antimony.

A somewhat similar preparation is known here as *Tyson's antimonial powder*, of which two kinds are sometimes employed. One designated as *No.* 1 consists of oxide of antimony 10 parts, and phosphate of calcium 90 parts. *No.* 2 is made by triturating oxide of antimony 10 parts and sulphate of potassium 45 parts into a fine powder, and adding 45 parts of phosphate of calcium.

Medical Action and Uses.—Antimonial powder acts in virtue of the oxide of antimony it contains, the phosphate of lime serving only to divide it minutely. Its action is essentially the same as that of tartar emetic, but slower in consequence of its inferior solubility. It is therefore less apt to act as an emetic than as a diaphoretic in *febrile states.* It may be given in *doses* of from three to fifteen grains.

PULVIS AROMATICUS, *U. S.*—AROMATIC POWDER.

Pulvis cinnamomi compositus, Br.—*Compound powder of cinnamon*, E.; *Poudre aromatique*, Fr.; *Aromatisches Pulver*, G.

Preparation.—Take of Cinnamon in fine powder, Ginger in fine powder, each two troyounces; Cardamom deprived of the capsules and in fine powder, Nutmeg in fine powder, each a troyounce. Rub them together until they are thoroughly mixed. *U. S.*

Nutmeg cannot be reduced to a fine powder without the addition of another absorbent powder. Grated as finely as possible, the nutmeg is gradually added, with constant trituration, to about one-half or more of the powdered cinnamon, and afterwards mixed with the remaining powders. The British Pharmacopœia omits the nutmeg, and directs powdered cinnamon, cardamom, and ginger, of each one ounce, to be thoroughly mixed, sifted, and lightly rubbed in a mortar. The German Pharmacopœia uses the same three ingredients in the proportion of 5, 3, and 2 parts.

Medical Action and Uses.—Aromatic powder may be given internally for the relief of *nausea*, *flatulence*, *colic*, or *diarrhœa*, in the dose of ten grains and upwards; but it is more commonly employed as an external stimulant, inclosed in a flannel bag, and saturated with a hot alcoholic liquor. In this way it is singularly efficient in allaying nausea and colic. Laudanum may be added to it in appropriate cases. Care should be taken to protect the linen from its stain, which is indelible. Instead of the officinal ingredients of this aromatic fomentation, the following will be found more efficient, viz.: equal parts of powdered cinnamon, ginger, allspice, and cloves, to which some add black pepper.

PULVIS CATECHU COMPOSITUS, *Br.*—COMPOUND POWDER OF CATECHU.

Preparation.—Take of Pale Catechu in powder four ounces; Kino in powder, Rhatany Root in powder, each two ounces; Cinnamon Bark in powder, Nutmeg in powder, each one ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep it in a stoppered bottle. *Br.*

Medical Uses.—This powder is especially useful in *diarrhœa* produced by debility, or by cold, after fever has disappeared. *Dose*, from ten grains to a drachm.

PULVIS CRETÆ AROMATICUS, *Br.*—AROMATIC POWDER OF CHALK.

Confectio aromatica, Lond.

Preparation.—Take of Cinnamon Bark in powder four ounces; Nutmeg in powder, Saffron in powder, each three ounces; Cloves in powder an ounce and a half; Cardamom Seeds in powder one ounce; Refined Sugar in powder twenty-five ounces; Prepared Chalk eleven ounces. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep it in a stoppered bottle. *Br.*

Medical Uses.—Aromatic powder of chalk is an excellent preparation for the cure of accidental *diarrhœas* produced by cold, or even by crude ingesta, provided the offending substance have been discharged. As the symptoms corrected by chalk and those relieved by the aromatic powder are in a great measure independent of each other, the proportion of these ingredients should vary; and hence their association in fixed proportion and in an officinal formula is unnecessary. The *dose* of this preparation is from thirty to sixty grains.

PULVIS CRETÆ AROMATICUS CUM OPIO, *Br.*— AROMATIC POWDER OF CHALK AND OPIUM.

Preparation.—Take of Aromatic Powder of Chalk nine and three-quarter ounces; Opium in Powder quarter of an ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep it in a stoppered bottle. *Br.*

Medical Uses.—This preparation is the same as the last except that it contains one grain of opium in every forty grains of the powder. It is therefore more efficient in the same class of cases. From ten to twenty grains may be given at a *dose.*

PULVIS ELATERII COMPOSITUS, *Br. Add.*—COMPOUND POWDER OF ELATERIUM.

Preparation.—Take of Elaterium ten grains; Sugar of Milk ninety grains. Rub them together in a mortar until they are reduced to fine powder, and intimately mixed. *Br.*

Medical Action and Uses.—This preparation is a convenient form for the administration of elaterium. *Dose*, from half a grain to five grains.

PULVIS GLYCYRRHIZÆ COMPOSITUS, *Br. Add.*— COMPOUND POWDER OF LIQUORICE.

Pulvis liquiritiæ (glycyrrhizæ) compositus s. P. pectoralis Kurellæ, P. G.—*Poudre de réglisse composée*, Fr.; *Brustpulver*, G.

Preparation.—Take of Senna in fine powder, Liquorice Root in fine powder, each two ounces; Refined Sugar in powder six ounces. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. *Br.*

Medical Action and Uses.—This preparation is a mild but efficient aperient in the *dose* of from thirty to sixty grains. A better form of it is essentially that of the German Pharmocopœia, and is composed as follows: ℞.—Senna, liquorice root, in fine powder, of each ℥j; Fennel seed, washed sulphur, in fine powder, of each ℥ss; White sugar in fine powder ℥iij. Mix thoroughly, pass through a fine sieve, and rub lightly in a mortar. S.—A teaspoonful in a glass of water at bed-time for the relief of habitual *constipation.*

PULVIS IPECACUANHÆ COMPOSITUS, *U. S.*, *Br.*—COMPOUND POWDER OF IPECACUANHA.

Pulvis ipecacuanhæ opiatus, s. Pulvis Doweri, P. G.—*Dover's powder,* E.; *Poudre de Dower,* Fr.; *Dower'sches Pulver,* G.

Preparation.—Take of Ipecacuanha in fine powder, Opium dried and in fine powder, each sixty grains; Sulphate of Potassium a troyounce. Rub them together into a very fine powder. *U. S.*

In this formula the sulphate of potassium is directed to be used in the unpowdered state; the crystals, being very hard, serve to grind the vegetable powders still finer during the necessarily prolonged trituration. The British and German Pharmacopœias order the same ingredients in the same proportions as given in the above formula, but direct all three to be powdered separately and then to be intimately mixed. The Dover's powder of the French Codex is nearly the same as that originally used by Dr. Dover, the chief difference being the substitution of dry extract of opium for opium; it is composed of sulphate and nitrate of potassium each 40 parts, and dry extract of opium, ipecacuanha, and liquorice root, each 10 parts, the whole to be made into a homogeneous powder.

Medical Action and Uses.—Dover's powder contains in every ten grains one grain each of opium and ipecacuanha, and eight grains of sulphate of potassium. The last-named ingredient is supposed to be entirely negative in producing the physiological effects, which are sleep and diaphoresis. The latter is, perhaps, favored by the ipecacuanha, but is essentially produced by the opium. If Dover's powder has the advantage of readily causing diaphoresis, it has the disadvantage of sometimes producing nausea, and leaving the mouth more pasty than opium does alone.

This preparation is of peculiar value in the forming stages of *muscular rheumatism,* for if it occasions sweating, it often terminates the attack. The use of hot drinks about an hour after the powder is administered will greatly promote its operation. Much the same statement may be made of its use at the commencement of acute *inflammations,* such as coryza, sore throat, laryngitis, bronchitis, pleurisy, pneumonia, enteritis, etc. It is of use in *hemorrhage* from internal organs, and especially from the uterus; in *diarrhœa* from transient causes or from intestinal disease, as in typhoid fever, tuberculosis, dysentery, etc.; in profuse *sweats* from phthisis or other debilitating causes. It has been recommended in *diabetes, Bright's disease,* and *calculous affections,* but in them it is less appropriate than is opium alone.

The ordinary *dose* of Dover's powder is ten grains; but in many cases doses only half as large, and repeated at longer or shorter intervals, are preferable. When full diaphoresis is desired, the dose may be fifteen or twenty grains, and its operation may be promoted by hot drinks, thick bed-clothes, etc.

PULVIS JALAPÆ COMPOSITUS, *U. S.*, *Br.*—COMPOUND POWDER OF JALAP.

Preparation.—Take of Jalap in very fine powder a troyounce; Bitartrate of Potassium in very fine powder two troyounces. Rub them together until they are thoroughly mixed. *U. S.*

Take of Jalap in powder five ounces; Acid Tartrate of Potash nine ounces; Ginger in powder one ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. *Br.*

Medical Action and Uses.—This is an efficient hydragogue cathartic particularly applicable to cases of hepatic and splenic obstruction with abdominal *dropsy*, and to other forms of dropsy in which the amount of the effusion constitutes an immediate source of danger. In the latter case the proportion of the bitartrate should be increased to from sixty to one hundred and twenty grains, and of the jalap to ten or fifteen grains. The *dose* of the compound powder of jalap is from ten to thirty grains.

PULVIS KINO COMPOSITUS, *Br.*—COMPOUND POWDER OF KINO.

Preparation.—Take of Kino in powder three and three-quarter ounces; Opium in powder one-quarter ounce; Cinnamon Bark in powder one ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep it in a stoppered bottle. *Br.*

Medical Action and Uses.—This preparation is one of the many in which opiates and astringents are associated, and which are chiefly used in cases of excessive *gastric* or *intestinal secretion*, including diarrhœa; it is also employed in the various *dyspeptic* derangements for which kino itself is used, and for lessening the secretion of urine in *diabetes*, and of perspiration in various forms of *hectic fever*. The *dose* is from five to twenty grains.

PULVIS OPII COMPOSITUS, *Br.*—COMPOUND POWDER OF OPIUM.

Preparation.—Take of Opium in powder one and a half ounce; Black Pepper in powder two ounces; Ginger in powder five ounces; Caraway Fruit in powder six ounces; Tragacanth in powder one-half ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep in a stoppered bottle. *Br.*

This powder is used in preparing Confectio opii (see p. 445), and contains 10 per cent. of powdered opium.

Medical Uses.—This powder contains the ingredients, in a dry state, of the confection of opium, and may be used for the same purposes. *Dose*, from two to five grains.

PULVIS RHEI COMPOSITUS, *U. S.*, *Br.*—COMPOUND POWDER OF RHUBARB.

Pulvis magnesiæ cum rheo, s. P. infantum, s. P. antacidus, P. G.—*Magnesia and rhubarb*, E.; *Poudre de rhubarbe composée*, Fr.; *Kinderpulver*, G.

Preparation.—Take of Rhubarb in very fine powder four troyounces; Magnesia twelve troyounces; Ginger in very fine powder two troyounces. Rub them together until they are thoroughly mixed. *U. S.*

The proportions of the British Pharmacopœia are the same, *light* magnesia being ordered, and the mixed powder directed to be passed through a fine sieve.

The formula of the German Pharmacopœia is as follows: Take of Carbonate of Magnesium sixty parts; Oil-sugar of Fennel (one drop of oil of fennel to two grams of sugar) forty parts; Powdered Rhubarb fifteen parts. Mix.

Medical Action and Uses.—There does not appear to be any reason for the existence of this compound powder, the ingredients of which may very well be mixed extemporaneously in proportions adapted to the peculiarities of each case. It is a good laxative in cases of acid *dyspepsia* with constipation, and of *diarrhœa* with acid stools, especially as it is apt to occur in children. The *dose* for an adult is from twenty to sixty grains; and for a child, from five to ten grains.

PULVIS SCAMMONII COMPOSITUS, *Br.*—COMPOUND POWDER OF SCAMMONY.

Preparation.—Take of Scammony in powder four ounces; Jalap in powder three ounces; Ginger in powder one ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. *Br.*

Medical Action and Uses.—The close resemblance of scammony to jalap in its mode of action in all useful respects, and its harsh and irritating operation in others, render the conjunction of the two purgatives apparently superfluous. It is possible, however, that cases may occur in which the ruder action of scammony upon the bowels may be useful as a derivant from the brain. The *dose* of the powder is from ten to twenty grains.

PULVIS TRAGACANTHÆ COMPOSITUS, *Br.*—COMPOUND POWDER OF TRAGACANTH.

Preparation.—Take of Tragacanth in powder, Gum Arabic in powder, Starch in powder, each one ounce; Refined Sugar in powder three ounces. Rub them well together. *Br.*

PULVIS GUMMOSUS, *P. G.*, is used for similar purposes, but has the following composition: Powdered Gum Arabic three parts; Powdered Liquorice Root two parts; Powdered Sugar one part.

Medical Uses.—This association of demulcents is hardly worthy of an officinal rank. It forms a dense mucilage used to suspend heavy powders, such as subnitrate of bismuth, etc.

PYRETHRUM, *U. S.*—PELLITORY.

Pyrethri radix, Br.; *Radix pyrethri romani.—Pellitory root, Pellitory of Spain*, E.; *Pyrèthre, Salivaire*, Fr.; *Römische Bertramwurzel*, G.

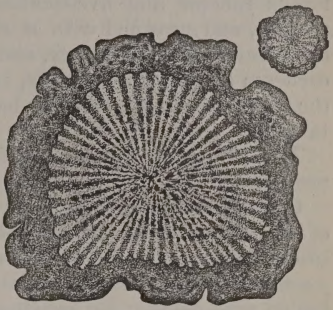
The root of Anacyclus pyrethrum, *D. C.*, s. Anthemis pyrethrum, *Lin.* Woodville, t. 20; Bentley and Trimen, Med. Plants, 151.

Nat. Ord.—Compositæ, Anthemideæ.

Origin.—The pellitory is a procumbent or ascending perennial, which is indigenous to Northwestern Africa and is occasionally cultivated in gardens. It resembles the chamomile, but has broadly oval, three-toothed, white ray-florets tinged with red beneath; and compressed obovate akenes, which have a short denticulate pappus; those of the outer rows have also a narrow wing. The root is shipped from Algiers and Tunis to Italy and France, and large quantities are sent to India by way of Egypt.

Description.—Pellitory root is nearly simple, two to four inches long, one-quarter to one-half inch thick, somewhat fusiform, and occasionally beset with a tuft of the hairy base of stem and leaves; annulate above, deeply wrinkled below, of a grayish or blackish-brown color externally, and brownish-white internally. It breaks with a short fracture, and presents a bark about one-eighth the thickness of the root, and a radiated meditullium containing slender ligneous and medullary rays. The bark contains about two, and the medullary rays about four or six irregular circles of shining resin-cells. The root is inodorous, and has an aromatic and acrid taste, exciting a prickling sensation in the lips and tongue and a glowing heat.

Fig. 142.



Transverse sections, magnified three diameters, of the roots of—*a*, Anacyclus pyrethrum, *D. C.*; *b*, Anacyclus officinarum, *Hayne.*

Constituents.—Pellitory root was analyzed by John, Gautier (1823), Parisel (1832), and Koene (1835); its acridity appears to reside in a brown *resin* and in two *fixed oils*, one having a dark brown, the other a yellow color. It contains also considerable inulin, a trace of tannin, mucilaginous matter, and other common constituents. Parisel's pyrethrin was a mixture of resin and fat.

Allied Root. Radix pyrethri, *P. G.*, s. *Radix pyrethri germanici*, German pellitory, *E.*; Pyrèthre allemande, *Fr.*; Bertramwurzel, *G.*—This is obtained from Anacyclus officinarum, *Hayne* (Bentley and Trimen, 152), which is not known in the wild state, but has been long cultivated near Magdeburg and in Saxony. It is an erect annual, resembling the preceding species in foliage and flowers, but the latter have a very convex disk. The root is from four to six inches long, about one-eighth inch thick, has few rootlets, is externally brown-gray, and internally dingy white. The bark is rather thick, and contains one irregular circle of rather large resin-cells; the meditullium consists of slender brownish wood wedges and whitish medullary rays, which are free from resin-cells. The root is inodorous, and agrees in taste with the preceding.

Off. Prep.—Tinctura pyrethri, *Br.*

Medical Action and Uses.—Pellitory is a powerful irritant, and acts as a rubefacient upon the skin. When chewed, it has an acrid taste, and excites a burning and prickling sensation in the mouth and fauces, and a copious flow of saliva. Its sialagogue properties have caused it to be used for the relief of *pains* about the *face* and *head.* Boiled in vinegar and applied to carious cavities in teeth, it is used to relieve *toothache.* In *paralysis* of the tongue or pharynx, and in relaxation of the *uvula*, it may be employed as a masticatory or in a gargle. Its powder has been recommended as a sternutatory in chronic inflammation of the *frontal sinuses.* Its *dose* as a masticatory is from thirty to sixty grains.

PYRETHRUM ROSEUM.—Persian Pellitory.

Persian insect flowers, E.; *Camomille de Perse*, Fr.; *Persische Bertramblumen*, G.

The flowers of Pyrethrum roseum, *M. B.*, and P. carneum, *M. B.*

Nat. Ord.—Compositæ, Anthemideæ.

Origin.—The two plants mentioned above are hardy perennials, resembling chamomile in appearance, and indigenous to Western Asia, from Persia to the Caucasus Mountains. The flowers are the parts employed.

Description.—The flower heads are about one and a half inch broad, and have an imbricate involucre, with a brown scarious margin, a convex naked and solid receptacle, about twenty-four ray-florets, and a large number of yellow disk-florets. The ray-florets are ligulate, nerved and three-toothed, the disk-florets tubular and five-toothed. The akenes are dark brown, angular, not winged, and crowned with a short membranous pappus. Pyrethrum roseum has rose-colored ray-florets, and anthers included in the tube of the corolla. Pyr. carneum has paler ray-florets, and anthers with their appendages projecting from the floret tube. The flowers have a peculiar, not very strong odor, and an acrid taste.

The flowers of *Pyr. cinerariæfolium* of Dalmatia are said to possess similar properties.

Constituents.—Hanaman and Koch (1863) ascribed the insecticide effects of the flowers to the volatile oil. Rother (1876) announced the isolation from insect flowers of an oleoresinous acid, *persicein;* another acid resinous substance, *persiretin;* and a readily soluble glucoside, *persicin*, yielding persiretin when boiled with acids. He ascribes the effects of the flowers to persicin. Semenoff (1876) claimed to have obtained from them a volatile substance, which is probably an alkaloid, and Jousset de Bellesme (1876) regarded a crystalline *alkaloid* as the active principle. The subject evidently requires further investigation.

The *quality* of insect powder, according to Kalbrunner (1874), is best ascertained by sprinkling four grains of it upon a fly contained in a vial, which should be stupefied in one minute, and killed in two or three minutes.

PYROXYLON, *U. S.*—PYROXYLON.

Pyroxylin, Br.; *Soluble gun-cotton, Gun-cotton*, E.; *Fulmicoton soluble*, Fr.; *Collodiumwolle*, G.

Preparation.—Take of Cotton freed from impurities half a troyounce; Nitric Acid three troyounces and a half; Sulphuric Acid four troyounces. Mix the acids gradually in a porcelain or glass vessel, and when the temperature of the mixture has fallen to 90° F. add the cotton; by means of a glass rod, imbue it thoroughly with the acid, and allow it to macerate for fifteen hours; then transfer to a larger vessel, and wash it first with cold water until the washings cease to have an acid taste, and then with boiling water. Drain the cotton on filtering paper, and dry it by means of a water-bath. If acids of the proper strength cannot be easily obtained, use for the above quantity of cotton of nitric acid having the specific gravity from 1.382 to 1.390 four troyounces, and of sulphuric acid having the specific gravity 1.833 ten troyounces, and proceed as directed. *U. S.*

Take of Cotton one ounce; Sulphuric Acid, Nitric Acid, each five fluidounces. Mix the acids in a porcelain mortar, immerse the cotton in the mixture, and stir it for three minutes with a glass rod, until it is thoroughly wetted by the acids. Transfer the cotton to a vessel containing water, stir it well with a glass rod, decant the liquid, pour more water upon the mass, agitate again, and repeat the affusion, agitation, and decantation, until the washing ceases to give a precipitate with chloride of barium. Drain the product on filtering paper, and dry in a water-bath. *Br.*

The first formula is nearly identical with that of the German Pharmacopœia. The French Codex has a similar formula, but somewhat different proportions; it directs the maceration of fifty-five parts of well-dried cotton in a mixture of one thousand parts sulphuric acid, specific gravity 1.84, and five hundred parts nitric acid, specific gravity 1.42, which has been cooled to 30° C. (86° F.).

A large number of formulas for preparing collodion cotton have been published, many with the nitric acid replaced by a nitrate, and the sulphuric acid correspondingly increased in quantity. Such mixtures may be made to yield as good results as the mixture of the two acids; but, owing to the separation of crystalline sulphates, it is more difficult to imbue the cotton thoroughly and uniformly with the mixture. Mann (1853) found the following proportions serviceable for one part of cotton: twenty parts potassium nitrate and thirty-one parts sulphuric acid, specific gravity 1.830 to 1.835; or ten parts potassium nitrate, and thirty-three parts sulphuric acid, specific gravity 1.80; the mixture is cooled to 30° C. (86° F.), and the cotton macerated at the same temperature for not less than one day, or more than six days. Good results will also be obtained with a mixture of seventeen parts sodium nitrate and sixty-eight parts sulphuric acid, specific gravity, 1.78; or of thirty-four parts sodium nitrate and sixty-six parts sulphuric acid, specific gravity 1.80; the cotton is introduced after twenty-four hours, and macerated for five days. Klie (1877) succeeded with proportions nearly identical with those of Mann's first formula.

In making collodion cotton it is essential that due attention be paid to the strength of the acids, or, if a nitrate is used, to its freedom from chloride; likewise that the temperature be permitted to fall as indicated before the cotton is introduced, and that the cotton be thoroughly imbued with the acid mixture. If introduced at too high a temperature, other insoluble nitro-compounds will be produced, or the cotton will dissolve; and portions not moistened with the liquid will not be acted on, and likewise remain insoluble. Small portions of the cotton may from time to time be examined, thoroughly washed with water, afterwards with alcohol, pressed, and then examined as to their solubility in a mixture of ether and alcohol. When these are found to be soluble, the cotton is withdrawn, or the whole mixture added to a large bulk of water, the cotton washed with water until free from acid taste, then pressed to free it from water, steeped in alcohol, and again pressed, after which it may be dried by exposure at a moderate temperature. The yield is usually about 140 per cent.

Properties and Composition.—Pelouze (1838) obtained explosive nitro-compounds by treating cotton, hemp, and paper with strong nitric acid. In 1846 Schoenbein announced the discovery of *gun-cotton*, and in the same year Otto published a process for preparing it by maceration in fuming nitric acid. In 1848 Maynard employed *collodion*. That gun-cotton is a nitrated substitution compound of cellulose was recognized at an early day; and that the weight of the product is greater than that of the cotton employed. Hadow (1855) distinguished three different compounds, namely, 1, *pyroxylin*, $C_{18}H_{21}(NO_2)_9O_{15}$, also known as *trinitrocellulose*, $=C_6H_7(NO_2)_3O_5$; 2, the compound $C_{18}H_{22}(NO_2)_8O_{15}$; and 3, $C_{18}H_{23}(NO_2)_7O_{15}$, of which the latter was called by Gladstone *cotton xyloïdin*, and has also been named *colloxylin*. The first weighs about 81 per cent. more than the cotton, is highly explosive, insoluble in ether and alcoholic ether, but soluble in acetic ether. The second shows an increase in weight of about 71 per cent., is soluble in ether-alcohol, but insoluble in glacial acetic acid. The third shows an increase of about 64 per cent., and is soluble in ether and glacial acetic acid, and is the variety aimed at in the preparation of collodion. Usually two or frequently even all three compounds are obtained at the same time. The cotton is apparently not altered in structure or appearance, and when these nitrated compounds are digested with sulphydrate of potassium they are again converted into cotton.

Similar nitrated compounds are also obtained from other carbohydrates; thus starch yields with concentrated nitric acid a transparent jelly of *xyloïdin*, $C_6H_9(NO_2)O_5$, and a similar change is produced in paper by dipping it into strong nitric acid, and afterwards washing with water.

Preservation.—When collodion cotton, particularly in the moist state, is kept in well-stopped bottles, it undergoes decomposition, frequently accompanied with the evolution of nitrous vapors, or with ignition and explosion. It is best preserved in a dry atmosphere, and inclosed in vessels which permit the free access of air.

Off. Prep.—The different kinds of Collodium.

Medical Uses.—This article is not used medicinally.

QUASSIA, *U. S.*—QUASSIA.

Quassiæ lignum, Br.—*Quassia wood, Bitterwood, Bitter ash*, E.; *Quassie, Bois amer*, Fr.; *Quaissienholz*, G.

The wood of Simaruba excelsa, *D. C.*, s. Quassia (Picræna, *Lindley*, Picrasma, *Planchon*) excelsa, *Swartz*. Steph. and Church, Med. Bot., t. 173; Bentley and Trimen, Med. Plants, 57.

Nat. Ord.—Simarubaceæ.

Origin.—This is a large tree common in the Island of Jamaica and in some other West Indian islands. It attains a height of 60 to 80 feet and a diameter of 2 to 3 feet, and in aspect resembles the common ash. It has imparipinnate leaves, with short-stalked oval-lanceolate entire leaflets and dense cymes of small white polygamous flowers, followed by black subglobular drupes of the size of a pea.

Description.—Jamaica quassia wood is imported in billets varying in length from three to six feet, and in thickness from ten to eighteen inches. It is usually deprived of the bark, is dense, tough, of medium hardness, yellowish-white in color, splitting lengthwise coarsely splintery, and is frequently marked with irregular black lines or patches, due to the mycelium of a fungus. On a transverse section are seen a minute central pith, numerous narrow medullary rays composed of two or three rows of cells, wood tissue containing large vessels, and irregular wavy concentric circles resembling annual rings. The wood is inodorous, and has an intensely and purely bitter taste. In the shops, it is usually found in raspings or chips, and the wood is turned into cups, which are sold as *bitter-cups* or *quassia cups*.

Constituents.—Winckler (1835) isolated the bitter principle *quasiin*, for which Wiggers (1837) found the composition $C_{10}H_{12}O_3$. It is obtained from the concentrated decoction by precipitating pectin with lime, evaporating the filtrate, exhausting the residue with alcohol, mixing with ether, filtering, and evaporating spontaneously. It crystallizes in small prisms or silky needles of a very bitter taste, is easily soluble in alcohol, less so in ether, and dissolves slowly in cold water. The alcoholic solution is precipitated by tannin. Acids, alkalies, and certain salts increase the solubility of quassiin in water.

Allied Drugs.—SURINAM QUASSIA, which is officinal on the continent of Europe, is the wood of Quassia amara, *Lin.*, a large shrub or small tree indigenous to Surinam. It is met with in commerce in billets about two or four inches in diameter, or in pieces not thicker than a finger; it has very fine, almost obscure medullary rays, and smaller vessels, and is therefore apparently less porous; otherwise, it closely resembles the preceding.

QUASSIA BARK OF SURINAM is about one-thirtieth of an inch thick, very fragile, externally of a gray color and nearly smooth, internally whitish and smooth.

QUASSIA BARK OF JAMAICA varies from about one-sixth to one-third inch in thickness, is externally blackish-gray, longitudinally furrowed and verrucose, and on the inner surface yellowish-white and smooth. When broken transversely, the fracture is smooth in the outer, and tough and fibrous in the inner layer; the latter portion is seen to be radially striate. Both quassia barks are easily removed from the wood, with the bitter taste of which they agree.

Off. Prep.—Extract. quassiæ, Infus. quassiæ, Tinct. quassiæ, *U. S.*, *Br.*

Physiological Action.—Quassia is fatal to flies and is sometimes used to preserve botanical collections from the ravages of insects. Rabbits and dogs have been killed by a concentrated preparation of the drug, the latter even by its application to the raw skin, and, when its effects were not fatal, it produced a partial paralysis of the limbs. Its bitter taste is more intense than that of most other stomachic tonics; like them, it excites the appetite for food and quickens digestion; but if too long continued it produces derangement of the stomach.

Medical Uses.—As a stomachic tonic in debilitated states of the digestion quassia enjoys a merited reputation, especially in *dyspepsia* with regurgitation or vomiting of the food, produced by an exhausted condition of the stomach, and accompanied more or less frequently with sick headache. Especially is it of use in *gastric vertigo*, when associated with bicarbonate of sodium. In atonic *diarrhœa*, due to irritation of the colon by accumulated feces, the medicine is also beneficial. Quassia was once held to be a remedy for *lumbricoid worms*, which it is chiefly because it improves the digestive powers. Enemas of infusion of quassia are efficient remedies for *ascarides* of the rectum.

The *dose* of the powder is stated at twenty or thirty grains; but it is seldom administered in this manner. The most appropriate form of the medicine is the infusion made with cold water.

QUERCUS.—OAK BARK.

Cortex quercûs.—*Écorce de chêne*, Fr.; *Eichenrinde*, G.

Nat. Ord.—Cupuliferæ.

Origin.—The oaks are shrubs or trees growing chiefly in the temperate zone and often forming extensive forests. They have monœcious flowers, the staminate ones in slender and naked catkins, and the pistillate flowers either single or in small groups, and followed by a one-seeded nut, the *acorn*, which is inclosed at the base by a *cup*, formed by the indurated scaly involucre. The leaves of some species are entire or nearly so, but most species have sinuately toothed or lobed or even pinnatifid leaves, which are coriaceous and evergreen, or mostly deciduous.

The European oak bark is obtained from Quercus robur, *Lin.*, which is a tall and stately tree and somewhat resembles the American white oak. Two varieties are known, which are regarded by some botanists as distinct species; one, *sessiliflora*, has the pistillate flowers and fruit sessile, while in the variety *pedunculata* they are raised upon a long peduncle. The European Pharmacopœias usually direct the bark to be collected from the branches or young stems.

The United States Pharmacopœia recognizes the bark of Quercus alba, *Lin.*, and of Qu. tinctoria, *Bartram.* The former species has smooth, and, on the lower side, pale glaucous leaves, and a saucer-shaped tubercled cup which is much shorter than the oblong acorn. The latter has the leaves somewhat pubescent on the lower surface and bristle-pointed on the lobes; the cup is coarsely scaly, hemispherical, conical at the base, and covers fully one-half of the globular-ovate acorn. Gray regards it as a variety of Qu. coccinea, *Wang.*, the *scarlet oak.* Of both species the inner trunk bark is collected. (See Bentley and Trimen, Med. Plants, 248, 250, 251.)

Description. QUERCUS ALBA, *U. S.*, *White oak bark.*—The bark is collected early in spring, and is usually deprived of the greater portion of the longitudinally fissured thick suberous layer. It is in nearly flat pieces, about one-quarter inch or more thick, of a pale brown color externally, with occasional patches of the gray scaly cork, internally somewhat lighter in color, and marked with sharp longitudinal ridges, produced by the bast-bundles projecting from the shrunken parenchyma. The bark is tough, breaks with a coarse fibrous fracture, has a faint tan-like odor and a strongly astringent taste. It is kept in the shops in the form of an irregular coarse and fibrous powder, which scarcely tinges the saliva.

QUERCUS TINCTORIA, *U. S.*, *Black oak bark*, *Quercitron bark.*—The bark resembles the preceding, but the suberous layer, which is generally removed, is of a blackish-brown color, and the inner bark of a deep-reddish-brown with a yellowish tint. Like the preceding, it is usually kept as a coarse powder; when masticated, it tinges the saliva bright brownish-yellow.

The bark of other species of Quercus is sometimes collected and medicinally employed.

Constituents.—The important constituent of oak bark is tannin; gallic acid does not appear to be present. The tannin produces with ferric salts a dark blue-black precipitate, but it is not identical with gallotannic acid, since, according to Stenhouse (1842), it is incapable of being converted either into gallic or pyrogallic acid. This *quercitannic acid* is yellowish-brown, amorphous, yields a brown precipitate with acetate of lead, and was found by Stenhouse (1862) to yield sugar when boiled with dilute sulphuric acid. Bowman (1869) determined the amount of tannin in young white oak bark, by means of gelatin, to be 11.21 per cent., and in the bark from older trunks only 6.34 per cent. The yellow coloring matter of black oak bark is *quercitrin*, which has been met with in many plants. It is obtained from the decoction of black oak bark on cooling, forms when pure a yellow crystalline inodorous and nearly tasteless powder, which is sparingly soluble in hot, and nearly insoluble in cold water. It dissolves in about five parts of alcohol, slightly in ether, is colored dark green by ferric chloride, and dissolved in alkalies becomes dark brown on exposure. Its formula is $C_{33}H_{30}O_{17}$. Treated with acids, it splits into the crystalline unfermentable sugar *isodulcite*, $C_6H_{14}O_6$, and into *quercetin*, $C_{27}H_{18}O_{12}$; the latter is likewise yellow and crystalline, is found ready-formed in a number of plants, is colored dark green by ferric chloride, precipitated brick-red by acetate of lead, sublimable, by alkalies resolved into *phloroglucin* and *quercetic acid*, $C_{15}H_{10}O_7$, and with fusing potassa yields *protocatechuic acid.* Gerber (1843) obtained from the bark of the European oak a bitter principle which may also be present in the bark of other species. A decoction of the bark of older branches with very dilute sulphuric acid is mixed with lime, precipitated with potassium carbonate, evaporated, and extracted with alcohol, on the evaporation of which *quercin* remains behind in white bitter crystals.

Other Product of Oak. SEMEN QUERCÛS TOSTUM, *P. G.*—Acorns are roasted in the same manner as coffee until they have acquired a brown color, when they are coarsely powdered. This is used as *acorn coffee* (Eichelkaffee, *G.*). According to Braconnot's analysis (1849), acorns contain starch, fixed oil, citric acid, uncrystallizable sugar, and another sugar which Dessaigne (1851) named *quercite*, $C_6H_{12}O_5$.

Off. Prep.—Decoctum quercus, *Br.;* Dec. quercûs albæ, *U. S.*

Medical Action and Uses.—In ancient times oak bark was used in the treatment of hæmoptysis and dysentery, and pessaries made of the bruised bark were employed to restrain uterine hemorrhage. The crushed leaves were applied to strengthen relaxed parts. In modern times it has been resorted to for the same purposes, and also to cure *bronchial flux.* It has been maintained that persons who work in tan-pits are never attacked with *intermittent fever*, and that they enjoy a like immunity from *phthisis.* Externally, the decoction, which is officinal, has been applied to all the purposes of vegetable astringents; indeed, oak bark is rarely used except in the form of decoction.

QUILLAIA.—QUILLAIA BARK.

Soapbark, E.; *Écorce de quillaya*, Fr.; *Seifenrinde*, G.

The inner bark of Quillaia saponaria, *Molina*.

Nat. Ord.—Rosaceæ, Roseæ.

Description.—The tree yielding quillaia bark is indigenous to Peru and Chili. The bark comes in flat pieces, sometimes two or three feet long, several inches wide, and one-quarter of an inch thick. The brown corky layer is usually removed, small patches of it merely adhering to the outer surface, which is otherwise nearly smooth, and pale-brownish white, like the inner surface. The bark is hard and tough, breaks with a splintery fracture, and shows upon transverse section a checkered appearance due to the tangential arrangement of the light-brown bast fibres and white bast parenchyma, and to the white narrow radial lines of the medullary rays. The bark has no odor, but its dust is acrid and sternutatory; it has a persistent acrid taste, and its infusion foams like a solution of soap.

Constituents.—Quillaia bark contains numerous minute crystals of sulphate of calcium, a small quantity of starch, and considerable *saponin*. The latter principle was isolated from quillaia bark by Le Beuf (1850), and may be obtained by displacing the powder with hot alcohol, and allowing the tincture to cool. The cold tincture retains some saponin in solution, together with resinous and oily matters, and, when evaporated and agitated with water, yields a permanent emulsion. In its pure state saponin is a white amorphous powder, which causes sneezing, is nearly inodorous, has a sweetish, afterwards acrid taste, is soluble in four parts of water, more soluble in weak than in strong alcohol, and insoluble in ether and volatile oils. Its aqueous solution is precipitated by baryta water, the precipitate being soluble in pure water, but not in baryta water (Rochleder). It has the composition $C_{32}H_{54}O_{18}$, and, when treated with acids, yields a saccharine body and a series of decomposition products, the final one being *sapogenin*, $C_{14}H_{22}O_4$, a sparingly soluble, white crystalline compound.

Medical Action and Uses.—Soap-bark owes its name, and the property of causing water in which it is macerated to froth, to the presence of saponin. Whether it possesses any of the virtues of other plants containing this principle (senega, saponaria), does not appear. It is, however, reported to be a sternutatory, and useful in *coryza*, and also as a febrifuge.

QUINIÆ SULPHAS, *U. S.*, *Br.*—SULPHATE OF QUINIA.

Chininum sulfuricum, P. G.; *Sulfas quinicus.*—*Sulphate of quinine, Disulphate or basic sulphate of quinia*, E.; *Sulfate de quinine*, Fr.; *Schwefelsaures Chinin*, G.

Formula $2C_{20}H_{24}N_2O_2.H_2SO_4 7H_2O$. Molecular weight 872.

Preparation.—Take of Yellow Cinchona in coarse powder forty-eight troyounces; Muriatic Acid three troyounces and a half; Lime in fine powder five troyounces; Animal Charcoal in fine powder, Sulphuric Acid, Alcohol, Water, Distilled Water, each a sufficient quantity. Boil the cinchona in thirteen pints of water mixed with one-third of the muriatic acid, and strain through muslin. Boil the residue twice successively with the same quantity of water and acid as before, and strain. Mix the decoctions, and, while the liquid is hot, gradually add the lime previously mixed with two pints of water, stirring constantly until the quinia is completely precipitated. Wash the precipitate with distilled water, and, having pressed, dried, and powdered it, digest it in boiling alcohol. Pour off the liquid, and repeat the digestion several times, until the alcohol is no longer rendered bitter. Mix the liquids, and distil off the alcohol until a brown viscid mass remains. Upon this, transferred to a suitable vessel, pour four pints of distilled water, and, having heated the mixture to the boiling point, add enough sulphuric acid to dissolve the quinia. Then add a troyounce and a half of animal charcoal, boil the liquid for two minutes, filter while hot, and set it aside to crystallize. Should the liquid, before filtration, be entirely neutral, acidulate it very slightly with sulphuric acid; should it, on the contrary, change the color of litmus paper to a bright red, add more animal charcoal. Separate the crystals from the liquid, dissolve them in boiling distilled water slightly acidulated with sulphuric acid, add a little animal charcoal, filter the solution, and set it aside to crystallize. Lastly, dry the crystals on bibulous paper with a gentle heat, and keep them in a well-stopped bottle.

The mother-water may be made to yield an additional quantity of sulphate of quinia, by precipitating the quinia with water of ammonia, and treating the precipitated alkaloid with distilled water, sulphuric acid, and animal charcoal, as before. *U. S.*

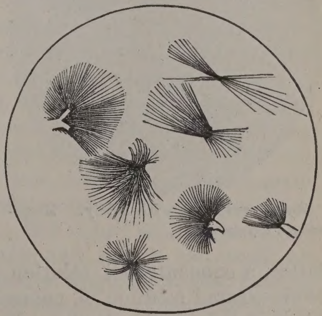
Take of Yellow Cinchona Bark in coarse powder one pound; Hydrochloric Acid three fluidounces; Distilled Water a sufficiency; Solution of Soda four pints; Diluted Sulphuric Acid a sufficiency. Dilute the hydrochloric acid with ten pints of the water. Place the cinchona bark in a porcelain basin, and add to it as much of the diluted hydrochloric acid as will render it thoroughly moist. After maceration with occasional stirring for twenty-four hours, place the bark in a displacement apparatus, and percolate with the diluted hydrochloric acid, until the solution which drops through is nearly destitute of bitter taste. Into this liquid pour the solution of soda, agitate well, let the precipitate completely subside, decant the supernatant fluid, collect the precipitate on a filter, and wash it with cold distilled water until the washings cease to have color. Transfer the precipitate to a porcelain dish containing a pint of distilled water, and applying to this the heat of a water-bath, gradually add diluted sulphuric acid until very nearly the whole of the precipitate has been dissolved, and a neutral liquid has been obtained. Filter the solution while hot through paper, wash the filter with boiling distilled water, concentrate till a film forms on the surface of the solution, and set it aside to crystallize. The crystals should be dried on filtering paper without the application of heat. *Br.*

The preparation of sulphate of quinia from cinchona bark involves the following processes: 1, extraction of the alkaloids in the form of a compound soluble in cold water; 2, precipitation of the alkaloids; and, 3, combination with sulphuric acid and separation of the various sulphates from one another and from coloring matter and other foreign principles. The alkaloids are easily extracted from the bark by water acidulated with hydrochloric or sulphuric acid, and are then in solution as hydrochlorates or sulphates. If an elevated temperature has been resorted to, derivatives of tannin and other principles will separate on cooling, and must either be filtered off or converted into insoluble compounds, which takes place on the addition of lime; this decomposes likewise the salts of the alkaloids, chloride or sulphate of calcium being formed, while the alkaloids are precipitated, together with the excess of lime employed, and the kinic acid remains in solution as kinate of calcium. The alkaloids are taken up from the lime precipitate by boiling alcohol, and left behind in an impure condition on the evaporation of the solvent. Soda cannot be profitably employed for precipitating the acid decoction unless it has been allowed to cool and filtered from the precipitate; or, still better, the bark is exhausted in the cold, and the acid infusion rendered very slightly alkaline by caustic soda. The precipitate thus obtained will be less deeply colored than the residue left on the evaporation of the alcohol as described before, and consists mainly of the mixed cinchona alkaloids. As obtained by one or the other process the impure alkaloids are mixed with water, heat is applied, and sulphuric acid is dropped in, care being taken to leave a portion of the alkaloids and much coloring matter undissolved, which are removed by filtration; the hot filtrate may be treated with purified animal charcoal to remove remaining coloring matter, or even without this treatment will deposit crystals of the desired salt. If, however, sufficient sulphuric acid has been used to dissolve the whole of the impure alkaloids, the excess of the former has formed freely soluble sulphates, which would not crystallize on cooling. It is then necessary to remove not only coloring matter, but likewise the excess of sulphuric acid, which is accomplished by treatment with unpurified animal charcoal, the calcareous matter of which combines with the excess of the sulphuric acid, and on cooling the filtrate the same sulphate will crystallize that is obtained by the action of an insufficient quantity of the acid upon an excess of the impure alkaloids. The first crop of crystals are neither sufficiently white nor free from other cinchona alkaloids, and require to be purified by two or three recrystallizations, when the sulphate of quinia, being the least soluble of the corresponding salts of the cinchona alkaloids, will crystallize first, leaving the coloring matter in the mother liquor with the remaining alkaloids.

Numerous modifications of the processes described have been proposed, and are probably used by the manufacturers of cinchona alkaloids, and since it is often more economical, in the manufacture of quinia, not to use a costly bark rich in this alkaloid, but rather a cheaper one containing a smaller percentage of quinia, and, in addition thereto, a larger proportion of the other alkaloids, it is obvious that modifications of the processes will not unfrequently be found necessary.

Instead of exhausting the bark with acidulated water, the natural combination of the alkaloids is sometimes broken up by a base, for which purpose ammonia, soda, and lime have been proposed. The two former remove tannin, kinic acid, cinchona red, and other colored compounds, but at the same time dissolve a portion of quinia and the other alkaloids. By digesting the bark with lime-water, some of the principles mentioned are dissolved, and the liquid may be utilized for preparing kinic acid; or milk of lime may be mixed with the powdered bark, and the mixture digested for some time, dried, and powdered. It contains then the calcium compounds of kinic acid, etc., which are nearly insoluble in strong alcohol, methylic and amylic alcohol, either of which solvents may be used in extracting the liberated alkaloids, which are then converted into sulphates, and purified as stated above.

Fig. 143.

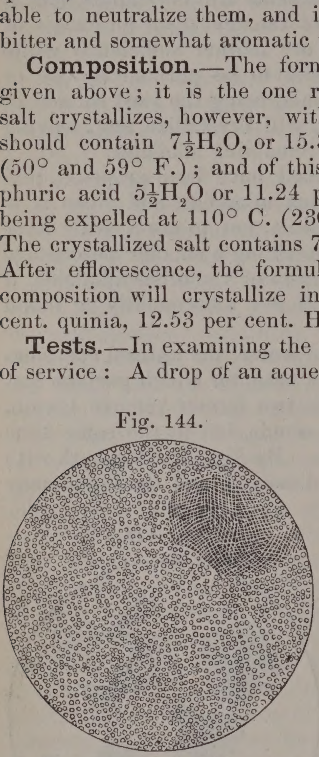


Quinia sulphate. Microscopic crystals.

Properties.—Sulphate of quinia crystallizes in thin, snow-white, flexible needles, which have a silky lustre and a purely bitter taste. A drop of a concentrated solution evaporated on the slide of a microscope crystallizes in stellate groups of thin needles or spikes. It effloresces rapidly on exposure, and when heated loses its water of crystallization completely, and at 160° C. (320° F.) becomes phosphorescent on trituration. It requires, according to Van Heijningen, 740, according to Jobst and Hesse, 788 parts of water for solution at 10° C. (50° F.), and at the boiling temperature about 30 parts. It is freely soluble in acidulated water, the solution in diluted sulphuric acid being fluorescent, with a blue color. It is more soluble in alcohol than in water, dissolves in 40 parts of glycerin, is insoluble in fixed oils, and nearly insoluble in chloroform and in ether. Chloride of ammonium, nitrate of potassium, and some other salts increase its solubility in water, while it is less soluble in the presence of sulphate of sodium and of magnesium. On adding to its solution an excess of chlorine water followed by ammonia, an emerald-green color is produced; and if, after chlorine water, ferrocyanide of potassium is added and then ammonia, the solution turns of a deep red. Dissolved in distilled water, it yields white precipitates with nitrate of barium and with ammonia, the latter precipitate being soluble in an excess of the reagent. It is likewise precipitated by potassa and soda, their carbonates and bicarbonates, by lime-water, tannin, and the other general reagents for alkaloids. Its solution in water or dilute acid remains unchanged when kept in the dark; but exposed to sunlight, it turns yellowish and brown. Flückiger (1878) named this brown product *quiniretin*, and found it to be of the same composition as quinia, but destitute of alkaline reaction, and, though soluble in acids, it is not able to neutralize them, and is not precipitated by tannin; it has, however, a bitter and somewhat aromatic taste.

Composition.—The formula of crystallized sulphate of quinia has been given above; it is the one recognized by the British Pharmacopœia. The salt crystallizes, however, with $8H_2O$; but, according to Jobst and Hesse, it should contain $7\frac{1}{2}H_2O$, or 15.3 per cent., when dried between 10° and 15° C. (50° and 59° F.); and of this amount it loses in a dry atmosphere or over sulphuric acid $5\frac{1}{2}H_2O$ or 11.24 per cent., the remaining $2H_2O$ or 4.09 per cent. being expelled at 110° C. (230° F.), and reabsorbed on exposure to moist air. The crystallized salt contains 73.55 per cent. quinia and 11.12 per cent. H_2SO_4. After efflorescence, the formula is $2C_{20}H_{24}N_2O_2.H_2SO_4.2H_2O$, and a salt of this composition will crystallize in white permanent needles; it contains 82.87 per cent. quinia, 12.53 per cent. H_2SO_4, and 4.6 per cent. water of crystallization.

Fig. 144.



Quinia sulphate with KSCy. Microscopic crystals.

Tests.—In examining the purity of sulphate of quinia, the following tests are of service: A drop of an aqueous solution of a quinia salt mixed with a drop of a solution of potassium sulphocyanide, will at once become turbid, and under the microscope show a large number of minute globules, which even after a day are not aggregated into groups or crystals. The other cinchona alkaloids show a very different behavior under the same conditions. When 10 grains of the salt are agitated in a test-tube with 10 minims of officinal water of ammonia and 60 grains of ether, and allowed to rest, the liquid separates into two transparent and colorless layers, without any white or crystalline matter at the surface of contact (*U. S.*). This is a modification of the test proposed by Liebig, and will detect cinchonia and cinchonidia, which remain undissolved, and quinidia, if present in larger proportion than 10 per cent. For detecting the latter, a concentrated solution of the salt in water is made, and mixed with a concentrated solution of potassium iodide, which will precipitate sparingly soluble hydriodate of quinidia. Traces of this alkaloid will usually be detected in commercial sulphate of quinia, but are unobjectionable; cinchonia and cinchonidia should be absent. The German Pharmacopœia has adopted a test proposed by Kerner (1862), which depends upon the greater solubility of quinia in ammonia-water than the other cinchona alkaloids; it is applied as follows: 2 grams of the salt are agitated, and then macerated for half an hour with 20 cubic centimeters of distilled water; of the filtered solution 5 c. c. are introduced into a test-tube, and upon the surface of this liquid are carefully poured 7 c. c. of ammonia-water sp. gr. .960; the test-tube is then closed with the finger and gently agitated, so as to mix the liquids, and the result should be a perfect solution, free from any deposit. In order to succeed with this test it is necessary that the temperature and strength of ammonia solution should be strictly adhered to. Since 20 grams of water are unable to dissolve 2 grams of officinal sulphate of quinia, and since the sulphates of the other alkaloids are more freely soluble in water, it is obvious that the solution prepared as directed does not represent the quinia salt, but contains a much larger proportion of the other sulphates if they are present. Kerner required for 5 c. c. of pure quinia sulphate 6.8 c. c., of quinidia sulphate 78 c. c., and of cinchonidia sulphate 81 c. c. of ammonia-water, sp. gr. .960, while 0.5 c. c. of the solution of cinchonia sulphate remain turbid after the addition of 150 c. c. of ammonia-water. A minute quantity of cinchonia present with the quinia sulphate may at first dissolve in the ammonia, but will separate in flakes on standing.

Hydrochlorate of cinchonia resembles sulphate of quinia in appearance, and has been occasionally substituted for it. It is easily detected by the aqueous solution yielding a curdy precipitate with nitrate of silver, and a voluminous precipitate with ammonia which is not dissolved by an excess of the precipitant or on being agitated with ether.

Other fraudulent admixtures or substitutions are recognized as follows: *Mineral impurities* by the fixed residue left on igniting a portion of the salt upon platinum foil; *ammonia salts* by the ammoniacal odor given off on heating a portion of the salt with dilute potassa solution; *stearic acid*, *starch*, *cotton fibre*, and similar insoluble substances by their insolubility in dilute sulphuric acid; *gum* by its insolubility in alcohol; *salicin*, *phlorizin*, and *sugar* by the red or brown color occasioned with warm concentrated sulphuric acid; *mannite* and other substances soluble in water, by boiling a portion of the suspected salt with solution of baryta, passing carbonic acid gas into it, and evaporating the filtrate; pure sulphate of quinia thus treated will leave only an insignificant residue.

Off. Prep.—Ferri et quiniæ citras, Pil. quiniæ sulph. (quiniæ), *U. S.*, *Br.*; Quiniæ valerianas, *U. S.*; Tinct. quiniæ, Tinct. quiniæ ammoniata, Vinum quiniæ, *Br.*

As the salts of quinia are more generally used than any other preparation or derivative of cinchona, we shall here present a summary of what should be known of this invaluable medicine, and which is not stated under other heads.

Medical History.—A knowledge of the curative powers of Peruvian bark was not due to sagacious prescience or scientific investigations, but to the simple fact that in the early part of the seventeenth century the Spanish conquerors of Peru learned its virtues from the native Indians. Carried to Europe, scientific bigotry condemned what unenlightened savages had discovered, and one religious body zealously spurned a priceless boon that had been introduced by another whose faith they derided. About the middle of the seventeenth century, a large quantity of the bark was brought from America, and at a great council of the Jesuits was distributed to the members, who afterwards carried it all over Europe; hence it was called Jesuits' bark. But it had still to encounter the sneers of the learned and the hate of bigotry, and it was not until an English quack succeeded in curing by its means men of high rank, that fashion broke down the prejudices which reason could not remove. Thenceforth cinchona was everywhere applied to the cure of malarial fevers and fevers of a typhoid type, as well as to various other diseases.

The discovery of the active principles of cinchona, imperfectly made by Duncan in 1803, was perfected by Pelletier and Caventou in 1820, as far as regards quinia and cinchonia. Quinidia was discovered partially in 1833, but perfectly isolated in 1852. The introduction into practice of quinia and cinchonia dates from 1820–1821.

Physiological Action.—The earlier experimenters with quinia upon the lower animals and upon man concluded that in small doses it acted as a stimulant of the nervous and circulatory systems, and in large doses as a direct sedative, producing general muscular and cardiac debility, and, when poisonous doses were given, great acceleration of the pulse, coma, and stertorous breathing. After death, the lungs and brain were found engorged with blood. Later investigations have furnished minuter and more extensive information, according to which the action of quinia upon the economy may be described.

Small and frequently repeated doses given to animals increase the *pulse-rate* even until death; at first they augment the force of the heart's contraction and then diminish it, although the rate of its movements progressively increases. Poisonous doses, especially when injected into the veins, annihilate the heart's contractility, producing rapid death; yet if the operation is not promptly fatal the respiratory movements cease before those of the heart. In such cases the rate of the blood current is retarded, whether the observation be made in the first stage of action of the medicine when the bloodvessels are contracted, or subsequently, when, under its prolonged influence, they have become dilated. In the theoretical language of the day, the increased pulse-rate in the first or lower grade of action is due to stimulation of the excito-motory centre of the heart and paralysis of its regulating apparatus. According to some, the increase and afterwards the decline in the heart's force should be ascribed to paralysis of the vagi, and an action upon the nerve-centres controlling the bloodvessels, first stimulating and then paralyzing them. According to others, they do not depend upon any action upon the vagi, but solely upon an influence directly exerted on the intra-cardiac ganglia.

Whatever be the physiological explanation of the fact, there can be no doubt that in the greater number of experiments on man the pulse-rate falls under the full influence of quinia, whether in health or in disease, and that at the same time its force is diminished. This action is generally believed to be attended with a fall of temperature as its necessary consequence; but although such is probably the case, it occurs by no means uniformly, unless the dose be very large. In the latter case, it appears to depend in part, and on the one hand, upon the slowness, and on the other hand, upon the hurried and inefficient character of the respiratory movements, as well as upon a like action of the heart. Theoretically, in moderate doses, quinia stimulates the trophic centres and quickens tissue change; but in larger doses it has the opposite effect. The recent important sphygmographic experiments of Dr. Mary Putnam Jacobi upon a human brain exposed by an opening in the cranium, confirm these statements and prove that "by a tonic dose of quinia (5 grains) the energy of the cardiac systole is increased; the tonus and elasticity of the walls of cerebral vessels are also increased, so that the blood is forced rapidly on through the capillaries, thus diminishing the resistance to the cardiac systole. More blood is admitted to the brain, but the intercranial pressure is lessened." But after a sedative dose of twenty grains there resulted "diminished energy of the cardiac contractions, unfilled cerebral arteries, and great diminution in intercranial pressure."

Numerous observations concur in rendering it probable that, in very large doses, quinia may lessen the coagulability of the *blood*, and that this effect is sometimes produced by medicinal doses; but that such an effect occurs uniformly cannot be maintained. It has also been affirmed, and, on the other hand, denied, that the number of the white blood-cells and their power of emigration are diminished by the operation of quinia. The affirmative proposition seems to be the more probable. It also appears that the white corpuscles which emigrate have, for the most part, a single nucleus, while previously the greater number are multi-nucleated; and further that the red corpuscles become larger under the influence of quinia.

In regard to the action of quinia upon the *nervous system*, experiments upon animals demonstrate that it deranges, enfeebles, and finally extinguishes nervous action. The animal subjected to observation staggers, becomes agitated, and sometimes convulsed, and then assumes a dull, inanimate expression, and subsides into a state of apparent debility and torpor, with impaired vision and widely dilated pupils. When five or six grains of sulphate of quinia are taken by an adult man at a single dose, or two or three times that quantity in the course of twelve hours, there is apt to be some heaviness and confusion of thought, headache, buzzing in the ears, vertigo, and unsteadiness of gait. Larger doses occasion, in addition, a sense of fulness, tension, and pulsation in the head; the face becomes suffused and animated, the eye is bright, epistaxis sometimes occurs, the patient is restless and agitated, and complains of muscular twitching in the limbs. After several hours these phenomena are followed by some degree of exhaustion, and a disposition to sleep, with slight torpor and muscular debility. If as much as thirty grains are given daily, for several days, in divided doses, there may be observed great depression, apathy, somnolence, unsteadiness of gait, impaired sight and hearing, and dilatation of the pupils; the general sensibility is obtuse, and the limbs tremulous. If, finally, the dose has been excessive, complete loss of consciousness may occur, sight and hearing fail, the skin lose its sensibility, and the limbs their power of motion.

The usual and most probable interpretation of these phenomena is that quinia in moderate doses primarily stimulates the nervous centres and increases the amount of blood circulating in them; that in excessive doses it diminishes the supply of blood to the same parts, and that this diminution results mainly from the depressed power of the heart. The most important fact in support of this view is that the giddiness, confusion of sight, and faintness caused by quinia subside as soon as the patient lies down.

On the *respiratory organs*, the primary action of quinia is stimulant, slightly increasing the rate of breathing. Poisonous doses occasion dyspnœa and noisy respiration, which is also jerking, interrupted, retarded, and finally arrested, death taking place with symptoms of asphyxia. In some cases, the sputa have been bloody. Doubtless these latter phenomena are due to a paralyzing influence exerted by quinia upon the respiratory nervous centres, coupled with an analogous action of the drug upon the cardiac nerves and ganglia. According to certain experiments upon rabbits (Strassburg), quinia does not diminish the exhalation of carbonic acid, even while lowering the temperature.

On the *digestive organs* small doses of quinia, as of all pure bitters, stimulate the appetite and digestion; but in large and continued doses it irritates the stomach and confines the bowels at first, although it may afterwards cause diarrhœa.

The fact that when quinia cures intermittent fever it also contracts the *spleen* if that organ is enlarged, is a familiar one. It is also known that when quinia is largely administered to animals for various experimental purposes, the spleen is found pale and hard, and its capsule wrinkled. These effects occur even when all the nervous trunks supplying the organ are divided. Hence, it is concluded that quinia must act upon the internal nervous system of the spleen (Binz). The function of the organ, it is added, being to form the white corpuscles of the blood and to prepare various oxidized substances, and especially uric acid, for excretion, and quinia having the power of restraining both of these operations, necessarily the organ appropriated to them must contract in proportion to the restriction of its functions.

Quinia, being almost wholly excreted with the *urine*, sometimes occasions irritation of the urinary passages, causing in different cases micturition, retention of urine, and even hæmaturia. These facts tend to explain the occasional occurrence of *abortion* or premature labor in females taking very large doses of quinia for the cure of periodical fevers, particularly when the tendency to the accident is increased by general ill-health, or malarial cachexia. There is more reason to apprehend abortion or premature labor from these causes than from the use of moderate doses of quinia, which rather tend to counteract their injurious action. When, under such bad conditions of health, labor sets in, with feeble and ineffectual pains, quinia in moderate doses will, like other spinal nerve stimulants, often render the contractions of the uterus more energetic and efficient. That there is no tendency in quinia to bring on contractions in the gravid and quiescent uterus, has been proved by abundant experience, and is supported by experiments upon animals with young and near the end of gestation. Among the latter must be included the case of a gravid cat that died of direct poisoning by quinia without a sign of labor.

Quinia and cinchonia both occasionally produce erythematous or papular *eruptions* (urticaria, roseola) of the skin, which sometimes are followed by exfoliation of the cuticle. A lichenoid eruption has been produced by a bath containing sulphate of quinia. When this salt is applied to the denuded cutis it occasions severe burning and smarting pain, and sometimes forms a superficial eschar.

Quinia in excessive doses may be dangerous, and even fatal, to life. A description of the symptoms in a single case will include all that is important. In nine hours after three drachms of sulphate of quinia had been taken at a single dose, the patient, an adult male, lay motionless and pallid, the fingers were bluish and cold, and the whole surface cool, the respiration slow and suspirious, the pulse regular but slow and hardly perceptible, the pupils widely dilated, the sight and hearing almost extinct, and the voice extremely feeble; the thirst was great, the tongue pale and moist, and the breath cold. Although it has been alleged that no case of death from quinia has occurred (Binz), these symptoms were observed in four recorded fatal cases. One, a child of eight years, died from taking eight grains of this salt, in two doses, within three hours. In other cases partial loss of hearing or of sight has followed the use of the medicine, and lasted for several weeks. On the other hand, enormous doses have sometimes been used without any serious consequences.

Sensible physiological effects are seldom observed when the dose of sulphate of quinia is less than four grains; those produced by a dose of six grains may be expected in about an hour, and by fifteen grains in about a quarter of an hour. The duration of the sensible effects is in the direct ratio of the dose administered; those from six or eight grains may last for two or three hours, and from fifteen grains for four or five hours. Larger doses maintain their action for a proportionately longer period.

Other things being equal, the functional disturbance is of shorter duration in children than in adults; but in old age they are apt to be both more decided and more prolonged. These facts depend probably upon the more rapid elimination of quinia by the kidneys in young than in old persons. It is more operative, in the same dose, in females than in males.

Like many other medicines, quinia is stimulant in small, but sedative in large doses; but it differs from other stimulants in the duration of its action, which is long sustained, and entitles it to be called a tonic stimulant. In the smallest medicinal doses it is purely tonic, in larger doses stimulant, and in the largest sedative, acting in each case upon the cerebro-spinal nervous system, and through the ganglionic nervous system upon the heart. It possibly, also, modifies the vital elements of the blood, in large doses checking their development. It appears, therefore, that by its combined influence upon the nervous system and upon the blood, it is capable of restraining all the processes which develop heat, organic changes, and muscular motion.

The experiments and observations made during the last century gave rise to a belief that cinchona had a special power of correcting or limiting putrefaction and fermentation, and hence it was employed as a specific remedy for all diseases in which these processes were conceived to be taking place in the blood. Among these were the continued and periodical fevers. Modern doctrines regarding these diseases involve a similar idea, and the efficacy of quinia in curing them is attributed to its power of destroying and disintegrating vibriones, bacteria, and analogous organisms. It is in fact "a powerful antizymotic" (Binz). One part of quinia dissolved in twenty thousand parts of water will in a few minutes begin to enfeeble Parameciæ, in two hours will destroy their vitality, and in a few hours more cause their disintegration.

There appear to be some differences between quinia and cinchonia in their mode of action. Thus the latter is said to be more poisonous to frogs and dogs than the former. In man, also, sulphate of cinchonia does not so speedily produce buzzing in the ears and disordered vision, but, on the other hand, it more constantly occasions, and in smaller doses, a peculiar pain and sense of oppression in the frontal region, distress about the præcordia, subsultus tendinum, general debility, and faintness.

Medical Uses. *Malarial Diseases.*—The antizymotic doctrine above described is thought to be supported by the power of quinia to prevent and cure malarial diseases, which are assumed to depend directly upon the introduction into the blood either of certain low and infinitely minute organisms, or of a specific poison which accumulates in the system and tends to destroy its albuminous elements with the production of fever. This doctrine is at present only probable, perhaps only hypothetical, and yet none other so well explains the fundamental practical rule that the paroxysm of fever is not directly prevented by the primary action of quinia, whose phenomena are evident, but that the curative operation is developed hours or even days after those sensible phenomena have disappeared. No medicine which operates simply by exalting or depressing the organic actions, possesses this peculiarity, which is difficult to comprehend except upon the supposition that its eliminative or antidotal, and not its dynamical action is the chief agent in the cure of miasmatic diseases. Moreover, the efficient dose of quinia in these diseases has no relation to the sensible effects which it produces; indeed, in all simple intermittents, and in the great majority of other forms of periodical fevers, the cure is effected without the necessity of inducing the slightest degree of quinia intoxication. It is possible that, in addition to the modes of action here alluded to, quinia may be curative of malarial diseases by directly supplying to the blood that peculiar constituent upon which animal fluorescence depends, and which is found to be greatly diminished at least in chronic intermittent fever, and to regain its normal proportion as the patient regains his health.

Whether the salts of cinchona act by modifying the powers of the nervous system, or as antidotes to a material morbific cause, they are equally efficient in *preventing* and in *curing periodical fevers*. Their power has been tested in all parts of the world; and it is now certain that a person under the impression of a dose of quinia or cinchonia, even within the limits of sensible cinchonism, may be exposed to malarial influences without danger. Indeed, a dose of from two to five grains, once or twice a day, has been found sufficient for this purpose.

Formerly the notion prevailed that in order to render the treatment even of simple periodical fevers efficient, the gastro-intestinal tube should be thoroughly cleansed by emetics and cathartics, and that sometimes mercury should be exhibited. Experience has proved that these methods, founded upon theory for the most part, are generally unnecessary and sometimes injurious; the conditions they are intended to remove depending mainly upon the malarial poisoning for which quinia is the specific cure. It may, as a rule, be administered without preliminary medication, in the dose of from five to eight grains during the intermission in *simple intermittents*. The result of a careful observation of different methods of administering the medicine, has been clearly to prove that the anti-febrile influence of quinia does not cöincide with its physiological operation either in time or degree. A period of at least twelve hours should, if possible, intervene between the last dose of the medicine and the hour of the expected attack; and, according to the severity of the paroxysms, the dose should be larger or smaller, single or divided. When once the paroxysms have been arrested, the medicine should be suspended until twenty-four or thirty-six hours before the seventh day, reckoning from the last paroxysm, when it should be repeated in the original dose. At the next hebdomadal period it should be prescribed in half the quantity, and still further diminished in the third week. In *congestive intermittents* while it may be necessary sometimes to employ depletion, evacuants, and revulsives, and the stimulant shock of the cold dash, these and all other agents are comparatively worthless without quinia. It must be administered to the extent of not less than thirty grains during the intermission, by the mouth preferably, but, if this cannot be, by the rectum, or even hypodermically. Immediate effects are not to be expected, the reaction is slow and not violent.

In *remittent fever* a preparatory emeto-cathartic treatment appears to be more distinctly indicated by the gastro-hepatic symptoms than in intermittent fever; yet observation proves that in this case also the local disorders are under the control of the miasmatic poison, and that when it is eliminated, or neutralized, they cease. If the physician is able to choose the time for administering the medicine, it should be done as soon as the remission sets in, and from twelve to eighteen grains of quinia should be given in two or three doses, at intervals of an hour; but if the paroxysm has already begun, and if the symptoms are urgent, as occurs in the congestive forms of the disease, no time should be lost; the medicine should be administered in doses twice as large as those just named, and at shorter or longer intervals, according to the duration of the remission. After control has been obtained over one paroxysm, the medicine may be exhibited in half the original doses, or less, for several periodical revolutions.

The prevalence of *yellow fever* in certain localities where periodical fevers also prevail gave rise to the grave error that its nature is the same as theirs, and that it may be cured by their specific remedy. The experience of competent judges has led to the following conclusions: 1. That quinia is not a specific for yellow fever as it is for periodical fevers of every type. 2. That, in mild cases which would probably recover under good nursing and an expectant treatment, the medicine may sometimes hasten recovery. 3. That, on the whole, the results depending upon quinia are no better than, if, indeed, they are as good as, those of the treatment of symptoms which is sanctioned by general experience, and which the skill of the physician must modify to suit the genius of each epidemic of the disease.

Various *inflammatory affections* assuming a periodical type under the miasmatic influence are more successfully treated by quinia than by any other means. The more important of such affections are *pneumonia* and *dysentery.*

Many functional disorders of the spinal nervous system assume more or less distinctly a periodical type, quite independently of a specific poison. Among these may be enumerated *spasmodic asthma, laryngismus stridulus, whooping-cough*, periodical *palpitation of the heart, hiccup*, and, above all, *neuralgia.* In the last-named disorder quinia divides with arsenic the honor of the greatest number of cures, as it also does in malarial fevers and other diseases of like origin. Cases of intermittent *paralysis*, of the hemiplegic form, and also of periodical *aphonia*, have been cured by the same means; but they were miasmatic in nature. In these cases the operation of the remedy was generally stimulant and not sedative, since they were cured by comparatively small doses of quinia. But in some of the above, and in still other affections of the nervous system, the cure has been brought about by large or sedative doses of quinia. Thus, in *whooping-cough*, it is claimed that when muriate of quinia is prescribed in doses of as many times a grain and a half as the patient numbers years, and especially when it is administered in the evening, unless it is carelessly given, it never fails either to cure the disease absolutely, or to render it mild and innocuous, provided serious complications do not exist.

The curative effects of quinia in *sunstroke* are attested by numerous physicians, especially in the East Indies, where this accident is of more frequent occurrence than elsewhere. It is claimed that, whereas the mortality from heat apoplexy in that country was formerly more than fifty per cent., the success of the treatment by quinia has been constant. The medicine is most effectually administered hypodermically, by several punctures, in each of which a grain and a half is introduced.

The history of the treatment of *acute articular rheumatism* by cinchona and by quinia is instructive, for it leads one to entertain serious doubts concerning the mode of action of these medicines. More than a century ago bark came into vogue for the cure of rheumatism, and was administered in doses representing not more than two or three grains of quinia, after depletion, emesis, and purgation. Until the introduction of quinia its efficacy was almost unquestioned; yet nothing can be plainer than that bark as formerly used can produce no such effects as quinia employed as it is at the present day. The former could only act as a stimulant, the latter only as a sedative. This was the first disease in which the modern doctrine of treating febrile affections was applied, a doctrine which would seem to teach that disease is in its phenomena alone, and not in the organic condition out of which they spring. Enormous doses of the medicine were given, even to the amount of two hundred grains in one day; but although far smaller and less poisonous doses were usually administered, and marvellous cures were fully set forth, the common sense of physicians revolted against the method, and it is now practically abandoned. Quinia, however, in tonic doses is of service in that condition of debility which is apt to follow or accompany the use of the really efficient treatment for acute articular rheumatism, the alkaline. It prevents the development of the scorbutic cachexia, and an increase of the weakness that denotes a tendency to such a result.

A precisely similar succession and antagonism of opinions occurred in the history of the use of bark in *typhus*, as that which has just been sketched. Originally employed to counteract "putridity," it was used beneficially, because it acted as a stimulant, and was combined with other stimulants, as in the famous, and still officinal, "Huxham's tincture." In more recent times quinia was employed as an antiphlogistic and sedative in very large doses, and not a few witnesses were found to give the most positive testimony in its favor. That they were utterly mistaken is now certain. Quinia has not been shown to be of any service in typhus except at the critical stage, when a full tonic dose may reduce the pulse and give a favorable turn to the disease.

One of the latest and highest authorities in medical science uses the following language: Quinia does not put an end to an attack of *typhoid fever* as it does to one of intermittent fever. In the first-named disease it has no specific operation, but only so weakens the putrid ferments that they run their career less destructively. . . When quinia is useless the disease must either have assumed an exceptional and complicated form, or the medicine must have been imperfectly administered (Binz). This author reproaches those physicians who treat typhoid fever expectantly, and wait and watch who will hold out longest, the patient or the fever. Perhaps it may be better so to wait than to make use of means which tend to aggravate the patient's danger as well as to increase his discomfort, and which neither lessen the duration of the disease nor its rate of mortality—and quinia does neither.

What has been said concerning the foregoing disease is equally applicable to *puerperal fever*, *scarlet fever*, *smallpox*, and *erysipelas*. There is very little doubt that tonic and stimulant doses of quinia are serviceable in them, and that sedative doses of the medicine are mischievous. In each affection it is useful in proportion as the symptoms assume a typhoid character: thus it is advantageous in all cases of *septicæmia*, whether arising from primary blood diseases or from traumatic causes, but in this, as in the other affections enumerated, only in small and repeated doses. This medicine has also been alleged to be more efficacious than any other in the radical treatment of *diphtheria;* but as yet satisfactory clinical proof of the statement has not been furnished. As a tonic in this disease its utility is generally recognized. The same may be said of its use in the treatment of *asthenic pneumonia;* and of *hectic fever* from whatever cause it may arise. In the numerous allied cases, also, of *profuse sweating* connected with general debility from exhausting diseases, whether during their progress, or following their active symptoms into convalescence, quinia, especially with aromatic sulphuric acid, is one of the most reliable remedies that can be employed.

In close pathological relation with the last-mentioned state are numerous local affections in which quinia is of great value. Such, for example, are *scrofulous ulcers* and *abscesses, scrofulous inflammations of the eye,* chronic *mucous fluxes* of the *pharynx, larynx, bronchia, stomach, bowels,* and *urinary organs.* It is one of the best remedies for scarlatinous and other forms of *albuminuria,* especially when associated with tincture of chloride of iron.

In auditory *vertigo* (mal de Ménière), the persistent use of quinia has in several cases removed the complaint entirely. Although the medicine has no power of originating contractions in the gravid uterus, it undoubtedly, during *slow labor,* with insufficient expulsive pains, and an exhausted condition of the system, revives the uterine energy, favors the rapid and safe termination of labor, and tends to prevent exhausting hemorrhages. The dose should not exceed ten grains.

The state of muscular debility and nervous excitability which often occurs during the second stage of *whooping-cough* is apt to be improved under the influence of bark or quinia, as has been well known since the time of Cullen. More recently sulphate of quinia has been used in free solution as a draught, or else atomized, under the impression that its curative action was local. But equally good results have been obtained from it when administered by the rectum. It is apt to fail in severe cases and when complications exist. The dose should be from one-half a grain to three grains three times a day.

Hay fever has been treated successfully with injections into the nasal passages of a warm watery solution of quinia of the strength of from one-eighth to one tenth of one per cent. At the same time it should be given internally in doses of not less than five grains three times a day.

A solution of quinia, of the strength of two or three grains in an ounce of water, has been used with advantage as an injection for *gonorrhœa.* It has also been injected into the pleural cavity in cases of *empyema,* and applied, as a dressing, to *ulcers* and suppurating *sinuses.* In these cases there is no sufficient reason for believing that it acts otherwise than as a substitutive irritant.

Administration.—The *dose* of sulphate of quinia as a tonic is one grain three or four times a day. In simple intermittent or mild remittent fever, six or eight grains are sufficient to avert the paroxysm; in severer cases of these affections the dose must be raised to fifteen or twenty grains, and in those of a malignant type to thirty, forty, or even sixty grains, given, in both of the latter cases, in divided doses. Intermittent neuralgia requires doses sufficient to produce the physiological effects of the medicine in a marked degree, and the same is true of the various febrile and inflammatory affections in which the medicine is intended to produce sedation.

The most usual and efficient mode of administering sulphate of quinia in small doses is in solution, rendered more perfect and stable by the addition of aromatic sulphuric acid, in the proportion of one drop of the acid to each grain of the sulphate. It is also administered in powder, enveloped in a wafer or in a thick mucilage or jelly, or in pills coated with gelatin or gold or silver leaf, in capsules, or, finally, in the form of compressed lenticular pills of disulphate of quinia. In all of these forms the concentrated action of the medicine upon the stomach tends to irritate it, and hence the solution already mentioned should be preferred. Its bitter taste may be masked by the addition of a little chloroform; and the mixture should be flavored with syrup or tincture of orange peel, with extract of liquorice, or with syrup or fluid extract of liquorice root. Tannic acid has been used to mitigate the bitterness of quinia in solution; it does so, indeed, but at the expense of rendering the medicine almost inert, by forming with it a tannate. Moreover, it contains but 42 per cent. of quinia, whereas the sulphate contains 85 per cent., and the muriate 82 per cent. The last-mentioned salt is much less stable than the sulphate, but when freshly prepared is preferable on account of its superior solubility. It is a convenient associate for tincture of chloride of iron in solution. Spirit of nitrous ether is said to dissolve "quinia" in the proportion of about two drachms of the latter to an ounce of the former. By the rectum, sulphate of quinia may be exhibited in the same doses and with nearly the same effect as by the mouth, provided it be given in watery solution. Probably the muriate is to be preferred for this purpose.

The hypodermic injection of solutions of the sulphate and also of the muriate of quinia has been extensively practised; but the tendency of the sulphate to cause pain, inflammation, abscess, gangrene, and even tetanus, more than counterbalances the advantages derived from the facility of its administration and the promptness of its effect. The risks alluded to should restrict the use of this method to cases in which delay may be dangerous. The bromohydrate of quinia is very soluble in water, and is alleged to be entirely unirritating, and, therefore, to be well adapted for hypodermic use. It contains a larger proportion of quinia than the sulphate.

QUINIÆ VALERIANAS, *U. S.*—VALERIANATE OF QUINIA.

Chininum valerianicum, P. G.—*Valerianate de quinine*, Fr.; *Baldriansaures Chinin*, G.

Formula $C_{20}H_{24}N_2O_2.C_4H_8O_4.12H_2O$. Molecular weight 644.

Preparation.—Take of Valerianic Acid half a troyounce; Sulphate of Quinia two troyounces; Diluted Sulphuric Acid, Water of Ammonia, Water, each a sufficient quantity. Dissolve the sulphate of quinia in a pint of water, with the aid of diluted sulphuric acid; then add water of ammonia in slight excess, and wash the precipitated quinia with water until freed from sulphate of ammonium. Dissolve the valerianic acid in five pints of water heated to 180° F., add the quinia to the solution, and, when it is dissolved, set the whole aside for several days to crystallize. Decant the mother-water from the crystals, dry them on bibulous paper, and keep them in a well-stopped bottle. By evaporating the mother-water at a temperature not exceeding 120° F., more crystals may be obtained. *U. S.*

This is essentially the process of Wittstein. Quinia is first produced by decomposing the sulphate with ammonia, and the alkaloid is dissolved in the warm valerianic acid.

Properties.—Valerianate of quinia crystallizes in pearly rhomboidal tables or white needles, having a weak odor of valerianic acid and a bitter taste. When heated to 90° C. (194° F.) it fuses to a transparent liquid, and on cooling congeals to a glass-like mass, which is completely soluble in alcohol. The salt dissolves in 110 parts of cold and 40 parts of boiling water, and on continued boiling is partly separated in the anhydrous state as a resinous mass. It is soluble in six parts of cold and one part of boiling alcohol, and is slightly soluble in ether. On adding dilute sulphuric acid to the aqueous solution it becomes fluorescent, and with chlorine water and ammonia an emerald-green color is produced.

Composition.—The salt contains 50.31 per cent. of quinia, 16.15 of valerianic acid, and 33.54 per cent. of water of crystallization.

Tests.—Admixtures with salts of cinchonia, ammonium, or fixed bases, etc. are detected in the same manner as in sulphate of quinia.

Other Salts of Quinia.—Quiniæ bisulphas, Chininum bisulfuricum, *P. G.*, *Bisulphate of quinia*, $C_{30}H_{24}N_2O_2.H_2SO_4.7H_2O$, is obtained on dissolving the ordinary sulphate of quinia in dilute sulphuric acid, and evaporating to crystallization. It crystallizes in transparent prisms or needles which have a strongly bitter taste, are soluble in two parts of alcohol, and dissolve in about eleven parts of cold water, yielding a fluorescent solution. The salt fuses by the heat of a water-bath, and contains 60 per cent. of quinia. When digested with carbonate of calcium, it is converted into the disulphate.

Quiniæ hydrochloras, Chininum hydrochloricum, *P. G.*, $C_{20}H_{24}N_2O_2.HCl.3H_2O$.—This is prepared by dissolving quinia in warm dilute muriatic acid, avoiding an excess of the acid. It crystallizes in white stellate shining needles, which are soluble in 24 parts of cold water, in about 3 parts of alcohol, and 9 parts of chloroform. It is frequently prepared by double decomposition between sulphate of quinia and barium chloride, and should always be tested in dilute solutions with sulphuric acid, which should not produce any turbidity.

Quiniæ quinas.—*Kinate* (*quinate*) *of quinia* may be prepared by decomposing kinate of barium with sulphate of quinia, and evaporating. H. Collier, who recommended it (1878) for hypodermic use, describes it as being amorphous, of neutral reaction, and freely soluble in water. A convenient strength of the solution is one part of the salt in four of the liquid.

Quiniæ lactas crystallizes in silky needles on evaporating a solution of quinia in lactic acid; it is soluble in water and alcohol.

Quiniæ phosphas, $2C_{20}H_{24}N_2O_2.H_3PO_4.2H_2O$, separates as a white silky crystalline mass from the solution of quinia in warm dilute phosphoric acid.

Quiniæ sulphovinas.—Carles (1878) prepares the neutral salt by dissolving 16.6 parts sulphovinate of sodium and 42.8 parts of quinia sulphate, the former in 200, the latter in 600 parts of alcohol, mixing the solutions, filtering from the precipitated sulphate of sodium, and evaporating. It crystallizes with difficulty in prisms, dissolves in three parts of water at 15° C. (59° F.), in a less amount of alcohol, and dissolves likewise in acetic ether and glycerin, but not in strong ether or benzol.

Quiniæ tannas, Chininum tannicum, *P. G.*—It is produced by adding a solution of 3 parts of tannin in 30 parts of cold water to a solution of 1 part of quinia sulphate in the same amount of water, with the aid of some sulphuric acid. It is a pale yellow, amorphous, bitter, and somewhat astringent powder, which is slightly soluble in cold alcohol and water, and melts when introduced into boiling water. By modifying the process so as to use water at a temperature not exceeding 70° C. (158° F.), using sulphuric acid barely sufficient to dissolve the quinia salt, washing the precipitate with water, and drying it at the ordinary temperature, tasteless tannate of quinia is obtained, according to A. Bernick (1878). In testing it, Jobst (1878) recommends a weighed portion to be mixed with milk of lime, the mixture to be dried and exhausted with chloroform, on the evaporation of which the cinchona alkaloids are left behind.

Medical Action and Uses.—Valerianate of quinia, which is very unstable, and often falsified, has no therapeutic virtues which entitle it to an officinal rank. It has been vaunted in *nervous headache* and other *neuralgiæ* of the nerves of the head, face, and chest, and even in *hysteria* and *epilepsy.* When the joint actions of valerian and of quinia are desired, it is better to associate the sulphate of quinia with the oil or the fluid extract of valerian, or to prescribe these substances separately. The *dose* of valerianate of quinia is four or five grains.

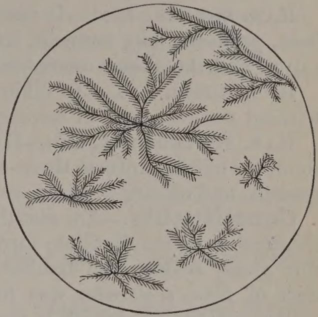
QUINIDIÆ SULPHAS.—SULPHATE OF QUINIDIA.

Sulfate de quinidine, Fr.: *Schwefelsaures Chinidin (Conchinin)*, G.
Formula $2C_{20}H_{24}N_2O_2.H_2SO_4.2H_2O$. Molecular weight 836.

Preparation.—The mother-liquors from the recrystallization of sulphate of quinia yield on concentration a crop of crystals consisting chiefly of this salt, which is purified by treatment with animal charcoal and by recrystallizing it. On adding to the mother-liquors a considerable excess of ammonia, cinchonia will be precipitated and quinidia dissolved; the solution deposits the alkaloid quinidia, together with impurities, on the addition of soda. The alkaloid may then be dissolved in dilute sulphuric acid, and the salt purified by recrystallization.

Properties.—Sulphate of quinidia crystallizes in needles which resemble those of the quinia salt, but are less matted. It dissolves in 350 parts of cold water, and in 32 parts of absolute alcohol, and when heated to 120° C. (248° F.) parts with its water of crystallization (8.6 per cent.). Its solution in dilute sulphuric acid shows the fluorescence of quinia solutions, and strikes an emerald-green color on the successive addition of chlorine water and ammonia, and a red color on the successive addition of chlorine water, potassium ferrocyanide, and ammonia. Its aqueous solution, however, is precipitated by iodide of potassium, and when a drop of it is mixed with a drop of solution of potassium sulphocyanide, the microscope reveals groups of radiating feathery crystals. For the characteristics of the alkaloid, see page 419.

Fig. 145.



Quinidia sulphate with KSCy. Microscopic crystals.

The above sulphate may likewise be obtained with $6H_2O = 12.64$ per cent.; on dissolving it in dilute sulphuric acid and crystallizing, the so-called acid sulphate of quinidia is produced, which is freely soluble in cold water.

Tests.—De Vrij (1878) advises testing this salt as follows: 1 gram of it is dissolved in 50 grams of hot water, and 0.5 gram potassium iodide added; a sandy crystalline precipitate must fall, and after some hours the mother-liquor, on being tested with ammonia, should not produce an appreciable precipitate. Should the precipitate with potassium iodide be resinous, the salt contains cinchonia or cinchonidia, or both.

Medical Action and Uses.—*Quinidia* may be prescribed in the same dose as quinia. Quinoidia is not officinal. Being very slightly soluble, it should be administered in mucilage or syrup. Its lack of bitterness renders it convenient for administration to children, and its imperfect solubility is not disadvantageous when a slow or tonic action is alone required. Its *dose* is the same as that of quinia.

RANUNCULUS, *U. S.*—CROWFOOT.

Buttercups, E.; *Renoncule*, Fr.; *Hahnenfuss*, G.

Ranunculus bulbosus, *Lin.* *Nat. Ord.*—Ranunculaceæ.

Origin.—The bulbous crowfoot grows in grassy fields and along roadsides throughout Europe and has been naturalized in North America. It flowers from April or May till July or August.

Description.—The stem of this species is about twelve or eighteen inches high, and at its base enlarged to a depressed globular tuber which has the appearance of a tunicated bulb from the broad sheathing bases of the leaf-stalks. The radical leaves are, like the entire plant, hairy; long-petiolate, ternate, the lateral divisions sessile, the terminal one stalked, and all of a sub-rhomboid shape, three-cleft, toothed and wedge-shaped at the base. The stem leaves are similar but on shorter petioles. The flowers are about an inch broad, have a reflexed calyx and roundish wedge-shaped, glossy yellow petals, and produce globular heads of obovate akenes having a short curved beak. The plant is inodorous, but has a strongly acrid taste which it loses after drying.

Allied Species.—All species of Ranunculus and some allied genera appear to possess more or less the acridity of the above. The following European and North American species have occasionally been used.

Ran. repens, *Lin.*—It resembles the preceding, but is without the bulbous base, produces long runners, has the divisions of the leaves stalked, a spreading calyx, and the akenes margined and furnished with a rather straight beak.

Ran. acris, *Lin.*—It differs from the creeping crowfoot in being taller and without runners, and in having the divisions of the leaves all sessile.

Ran. sceleratus, *Lin.*—It is very variable in size, smooth, with a hollow stem, roundish reniform three-cleft and lobed or toothed leaves, small pale yellow flowers, and oblong heads of ovate and short pointed akenes.

Constituents.—On distilling fresh crowfoot with water, Braconnot (1818) obtained an acrid distillate having a radish-like odor and separating on standing thin glossy scales; the distillate of *Ran. repens* was not acrid. The acrid principle of *Ran. sceleratus* was found by O. L. Erdmann (1859) to be a golden-yellow volatile oil, which is readily changed into *anemonin* and *anemonic acid.* (See Pulsatilla, page 1150.)

Medical Action and Uses.—Several of the numerous species of Ranunculus possess the same qualities as R. bulbosus. In its fresh state every part of the plant contains an acrid juice, and the bruised leaves, stems, and flowers applied to the skin occasion redness and vesication, and, if the action is prolonged, ulceration and even gangrene. It is stated that in Europe this plant was used by beggars to produce sores for the purpose of exciting pity and procuring alms. They cured their sores by means of mullein leaves (Verbascum thapsus). The bruised fresh plant has been applied as a counter-irritant for the relief of chronic affections of the *larynx* and *bronchia*, but more particularly of chronic *rheumatism* and *sciatica.* It may still be so employed where other irritants are not at hand; it is not used internally.

RESEDA.—Reseda.

Nat. Ord.—Resedaceæ.

Origin and Description.—The well-known *mignonette*, Reseda odorata, *Lin.*, is indigenous to Northern Africa, and everywhere cultivated for its sweet scented flowers, which are employed in perfumery.

Reseda luteola, *Lin.*—Dyer's Weed, Weld, *E.;* Herbe jaune, Gaude, *Fr.;* Wau, Gelbkraut, Harnkraut, *G.*—It grows in open places throughout Europe, and has been naturalized to some extent in the eastern part of the United States. It has a conical root of a radish-like odor and taste, and a furrowed, smooth, erect, and branching stem about three feet high. The leaves are alternate, crowded, oblong-lanceolate, near the base on each side with one tooth, narrowed into a short petiole, or the upper ones sessile, mostly undulate on the margin, light green and shining. The flowers are in dense, finally erect and elongated racemes, and have a four-parted calyx and four pale yellowish petals, of which the lower one is linear and entire, and the others larger and cleft. The capsule is depressed ovate and terminates with four short erect horns. The herb is without odor, and has a persistently bitter taste.

Constituents.—According to A. Vollrath (1871), the root of the mignonette contains *sulphocyanide of allyl* (oil of mustard), and it is probable that the same constituent exists in the root of weld. The herb contains *luteolin*, $C_{12}H_8O_5$, which was discovered by Chevreul (1830). It is obtained by concentrating the tincture, redissolving the crystalline precipitate in 150 parts of alcohol, diluting the solution with 20 parts of water, boiling, filtering, and crystallizing. It is in yellow silky volatile needles, of a faintly bitter and slight astringent taste, sparingly soluble in water, slightly soluble in ether, and soluble in 37 parts of alcohol. Sulphuric acid dissolves it with a deep orange color, acetate of lead precipitates it yellow, and ferric chloride is colored by it green, and afterwards red-brown.

Medical Action and Uses.—Formerly, this plant was considered diaphoretic and alexipharmic; it was employed as an antidote to snake-bites and as a vermifuge. The seeds contain a fatty oil of repulsive taste and smell.

RESINA, *U. S.*, *Br.*—RESIN.

Colophonium, P. G.—*Rosin*, *Colophony*, E.; *Colophane*, Fr.; *Kolophonium*, *Geigenharz*, G.

The residue after the distillation of volatile oil from the turpentine of Pinus palustris and of other species of Pinus.

Preparation.—The manner in which rosin is obtained has been briefly described on page 998. The color depends in a great measure on the degree of heat used in its manufacture. From a communication of I. Zacharias (1877), however, it appears that the amount of resin in turpentine increases with the age of the tree, and that the residuary product of the distillation becomes darker in color, probably in consequence of the greater heat employed in distilling off the oil.

Properties.—Rosin is a very brittle, pulverizable, transparent, or, more frequently, translucent resin, breaking with a glossy and shallow conchoidal fracture, tasteless, and of a faint terebinthinate odor. It varies in color from a pale amber to a dark red-brown, and is distinguished in commerce by the shade of its color, the darkest being called *black rosin*. For pharmaceutical purposes the amber-colored variety is used. *White rosin* is a light-colored variety which is rendered opaque by containing water, on the gradual evaporation of which it becomes translucent. It dissolves readily in alcohol, ether, and in the volatile and fixed oils. It melts at about 135° C. (275° F.), and burns with a dense yellow and sooty flame. When heated to above 200° C. (392° F.) it may be distilled apparently unchanged with a current of superheated steam, but on dry distillation it is decomposed, yielding *colophene* (see page 999), and probably other products, which contain rosin in solution. Mixed with lime and subjected to distillation, volatile oils are obtained, from which, by fractional distillation, Fremy isolated *resinone*, $C_{10}H_{18}O$, which is limpid, readily inflammable, and boils at 78° C. (172.4° F.); and *resineone*, which is thicker, boils at 148° C. (298.4° F.), and seems to have the composition $C_{30}H_{48}O$.

Composition.—According to Maly (1861, 1864), rosin is the anhydrid of *abietic acid*, $C_{44}H_{64}O_5$, and is converted into the acid by agitation with warm diluted alcohol. Flückiger (1867) obtained in this way from 80 to 90 per cent. of the weight of the rosin. This acid is in irregular, glassy, crystalline points or white scales, begins to melt at 129° C. (264.2° F.), fuses completely at 144° C. (291.2° F.) without losing in weight, has an acid reaction, dissolves in alcohol, ether, benzol, wood-spirit, chloroform, and carbon bisulphide, and yields with bases amorphous compounds. The *pinic* and *sylvic acids* of Unverdorben (1825, etc.) and others are regarded by Maly as impure abietic acid, and the *sylvic acid* of Siewert (1859) as a decomposition product of the same acid.

Off. Prep.—Ceratum (Emplastrum) cantharidis, *U. S.*, *Br.;* Cerat. extr. cantharidis, *U. S.;* Cerat. (Unguent.) resinæ, *U. S.*, *Br.;* Cerat. resinæ comp., *U. S.;* Charta epispastica, *U. S.*, *Br.;* Empl. calefaciens, *Br.;* Empl. hydrargyri, *U. S.;* Empl. picis, *Br.;* Empl. resinæ, *U. S.*, *Br.;* Empl. saponis, Unguentum terebinthinæ, *Br.*

Medical Action and Uses.—Resin is not used internally. Sometimes, however, the fumes of boiling resin have been used to impregnate the air breathed by persons suffering from chronic *bronchial catarrh* unattended with fever. Resin is chiefly employed with essential oils to render plasters adhesive and stimulating.

RESINA DRACONIS.—DRAGON'S BLOOD.

Sang-dragon, Fr.; *Drachenblut*, G.

The resin obtained from the fruit of Calamus (Dæmonorops, *Blume*) draco, *Willd.*

Nat. Ord.—Palmæ.

Origin and Production.—This palm has a thin and very long stem, which climbs upon trees by means of strong spines situated on the petioles. Its small, ovate, scaly fruits grow in dense panicles, and are covered with a resin which exudes and hardens upon their surface. By beating and shaking the fruit in a bag the resin breaks off, is mechanically separated from the fruit, softened in the sun or by boiling water, and formed into sticks or cakes. Subsequently the fruit is bruised, boiled with water, and the resin collected in cakes. The palm is indigenous to Borneo and Sumatra, and grows in other parts of the East Indies.

Properties.—Dragon's blood is seen in commerce occasionally in the form of irregular grains, or more frequently in cakes or irregular masses, and in cylindrical sticks which are about twelve inches long and one-half inch or more thick, and are wrapped in palm leaves. It is of a dark red-brown color on the surface, of a brighter red and glossy internally, transparent in very thin splinters, and breaks with a resinous but irregular fracture, caused by the fruit-scales and other impurites which are always present, in largest proportion usually in cake dragon's blood. Alcohol, amylic alcohol, benzol, and chloroform dissolve the resin readily, leaving the impurities behind; ether and oil of turpentine dissolve it less freely, and it is insoluble in petroleum benzin. It is inodorous and tasteless, but when heated has a slight agreeable odor resembling that of benzoin.

Composition.—Dragon's blood contains a little fat, and is free from benzoic and cinnamic acid, as was shown by Hempel (1846). It consists of a peculiar resin, for which Johnston (1839) determined the formula $C_{20}H_{20}O_4$. By dry distillation, Glénard and Boudault (1844) obtained a dark red oil containing *dracyl* = *toluol*, C_7H_8, and *draconyl* = styrol, C_8H_8. Hlasiwetz and Barth (1865) obtained the following decomposition products by fusing the resin with potassa: phloroglucin, a body giving a red reaction with iron salts, and paraoxybenzoic, protocatechuic, and benzoic acids, products which are likewise obtained by treating benzoin in the same manner.

Other Varieties.—On wounding the stem of Dracæna draco, *Lin.*, a liliaceous tree of the Canary Islands, or the stem of Pterocarpus draco, *Lin.*, a papilionaceous tree of the West Indies, exudations are obtained which resemble the dragon's blood described above.

Medical Action and Uses.—Dragon's blood, or sang-dragon, has little or no virtue besides its striking name. A certain degree of astringency probably led to its use in former times in diarrhœa, slight hemorrhages, etc. It is occasionally used as an addition to dentifrices.

RESINA JALAPÆ, *U. S.*—RESIN OF JALAP.

Jalapæ resina, Br.—*Résine de jalap*, Fr.; *Jalapenharz*, G.

Preparation.—Take of Jalap in fine powder sixteen troyounces; Alcohol, Water, each a sufficient quantity. Moisten the jalap with four fluidounces of alcohol, pack it firmly in a cylindrical percolator, and gradually pour upon it twelve fluidounces of alcohol. When the liquid begins to drop from the percolator, close the lower orifice with a cork, and, having closely covered the percolator to prevent evaporation, set it aside in a moderately warm place for four days; then, having removed the cork, gradually pour alcohol upon the surface, and continue the percolation until twenty-four fluidounces have passed, or until the percolate ceases to produce turbidity when dropped into water. Distil off the alcohol, by means of a water-bath, until the tincture is reduced to six fluidounces, and add it, with constant stirring, to seven pints of water. When the precipitate has subsided, decant the supernatant liquid and wash the precipitate twice by decantation with fresh portions of water. Place it upon a strainer, and, having pressed out the liquid, dry the resin with a gentle heat. *U. S.*

Take of Jalap in coarse powder eight ounces; Rectified Spirit a sufficiency; Distilled Water a sufficiency. Digest the jalap with sixteen fluidounces of the spirit, in a covered vessel, at a gentle heat, for twenty-four hours; then transfer to a percolator, and, when the tincture ceases to pass, continue the percolation with successive portions of spirit until it ceases to dissolve anything more. Add to the tincture four fluidounces of the water, and distil off the spirit by a water-bath. Remove the residue while hot to an open dish, and allow it to become cold. Pour off the supernatant fluid from the resin, wash this two or three times with hot water, and dry it on a porcelain plate by the heat of a stove or water-bath. *Br.*

The directions of both Pharmacopœias are plain. Powdered jalap is exhausted with alcohol, the tincture concentrated by distillation, and the residue in the still poured into a large quantity of water, when the resin will be precipitated; or, the residue is mixed with a small quantity of water and the heat continued until all the alcohol has evaporated, when the resulting resin is washed with hot water as long as this becomes colored. By this treatment, water removes the sugar, and some other principles of jalap, which are also soluble in water, and which appear to possess some medicinal activity. (See p. 575.)

The resin may also be obtained by depriving jalap of its principles soluble in hot water, drying and powdering the residue, and exhausting it with alcohol. Good jalap yields about 15 per cent. of resin.

Properties.—Resin of jalap is in yellowish-brown or dark brown masses or fragments, which break with a glossy resinous fracture, and are translucent on the edges. By repeated solution in a little alcohol and precipitation with water, it may be obtained nearly white. It is very brittle and readily reduced to powder varying in color between yellowish and light brown; it has a slight sweetish odor and a somewhat acrid taste, is entirely soluble in alcohol, and insoluble in turpentine. Ether dissolves only a small portion of it, amounting to between 5 and 10 per cent., as ascertained by C. D. Farwell (1878); on the evaporation of the ethereal solution a soft resinous mass is left, which may be dissolved in potassa solution, forming a reddish-brown liquid, and is precipitated again on the addition of an acid. The resin, which is insoluble in ether, is the *convolvulin* of W. Mayer, and is soluble in potassa solution, but not precipitated on the addition of an acid. The chemical nature of this resin and its relation to allied resins have been explained on page 777.

Tests.—Resin of jalap should diminish but little or not at all in weight on being exposed for some time to the heat of a water-bath (absence of water).

On being triturated with water, it should lose nothing in weight, and the liquid should not become colored, showing that it has been well washed with water. To ether and to potassa solution it should have the behavior described above. Adulterations with other resins are proved by the amount soluble in ether, which should not exceed 10 per cent.; or, if they are insoluble in ether, by the precipitate occasioned with acids in the potassa solution. The presence of guaiacum resin is indicated by a green or blue color produced with strong nitric acid or with tincture of chloride of iron. An adulteration with rosin may be detected by its solubility in oil of turpentine, and the presence of aloes manifests itself by its bitter taste and the production of picric acid when treated with nitric acid.

Off. Prep.—Pilula scammonii comp., *Br.*

SAPO JALAPINUS, *P. G.*—Four parts each of resin of jalap and medicinal (white Castile) soap are dissolved in eight parts of alcohol, and the solution evaporated with constant stirring to the consistence of a pill mass, weighing nine parts.

Medical Action and Uses.—This preparation contains all, or nearly all, the purgative elements of jalap, and may be prescribed for the same purposes in doses of from three to six grains, or, combined with other purgatives, in even smaller doses. A valuable formula is the following: ℞. Resinæ jalapæ, gr. xxx; Pulv. lycopodii, gr. x; Saponis medicinal., gr. xc; Amygd. dulc. excort. gr. cxx.—M. S. A. Divide into 120 pills. Two of these pills produce one copious stool, and seven or eight pills as many liquid evacuations.

RESINA PODOPHYLLI, *U. S.*—RESIN OF MAY-APPLE.

Podophylli resina, Br.—*Resin of podophyllum*, E.; *Résine de podophylle*, Fr.; *Podophyllumharz*, G.

Preparation.—Take of May-apple in fine powder sixteen troyounces; Muriatic Acid two fluidrachms; Alcohol, Water, each a sufficient quantity. Moisten the may-apple with four fluidounces of alcohol, pack it firmly in a cylindrical percolator, and gradually pour upon it twelve fluidounces of alcohol. When the liquid begins to drop from the percolator, close the lower orifice with a cork, and, having closely covered the percolator to prevent evaporation, set it aside in a moderately warm place for four days; then, having removed the cork, gradually pour alcohol upon the surface and continue the percolation until twenty-four fluidounces have passed, or until the percolate ceases to produce turbidity when dropped into water. Distil off the alcohol, by means of a water-bath, until the tincture is reduced to six fluidounces, and add it, with constant stirring, to seven pints of water previously mixed with the muriatic acid. When the precipitate has subsided, decant the supernatant liquid and wash the precipitate twice by decantation with fresh portions of water. Place it upon a strainer, and, having pressed out the liquid, dry the resin with a gentle heat. *U. S.*

Take of Podophyllum Root in coarse powder one pound; Rectified Spirit three pints or a sufficiency; Distilled Water a sufficiency; Hydrochloric Acid a sufficiency. Exhaust the podophyllum with the spirit by percolation, place the tincture in a still, and draw off the greater part of the spirit; acidulate the water with one twenty-fourth of its bulk of hydrochloric acid, and slowly pour the liquid which remains after the distillation of the tincture, into three times its volume of the acidulated water, constantly stirring. Allow the mixture to stand for twenty-four hours to deposit the resin. Wash the resin on a filter with distilled water and dry it on a stove. *Br.*

On pouring the concentrated tincture of podophyllum into acidulated water, the extractive matters remain in solution while the resin is precipitated. The addition of hydrochloric acid appears to exert no action on the product, and to be useful merely in hastening the deposition of the resin from the aqueous liquid; its amount as ordered by the second formula is much larger than necessary. The yield is between 4 and 5 per cent. of the weight of podophyllum used; by exhausting the rhizome with alcohol of specific gravity .930, G. H. C. Klie (1877) claimed to have obtained as much as 7¼ per cent.

Properties.—The color of resin of podophyllum, when pure, is grayish-white with a slight tinge of yellow. To obtain it of this shade it is necessary that the resin be precipitated and dried in the cold, or at a temperature not exceeding about 35° C. (95° F.). If a higher heat is used it turns darker, and finally deep brown. From 15 to 20 per cent. of the resin is soluble in ether, and about 80 per cent. is dissolved by boiling water and reprecipitated on cooling; a small portion of the resin, however, remains in solution in the water. Alkaline liquids dissolve the resin readily, yielding a deep yellow, afterwards brown-yellow solution, and deposit nearly the whole of it on being supersaturated with an acid. According to Power, podophyllum resin becomes soft at 120° C. (248° F.), and is completely melted at 124° C. (255° F.). Sulphuric acid colors it intensely yellow, the color changing to purplish and to brown on the addition of a trace of nitric acid. Among the oxidation products by nitric acid are oxalic acid, and an amorphous yellow substance.

In commerce podophyllum resin is sometimes met with of a more or less bright yellow color; it has been obtained by precipitating the concentrated tincture with alum water.

Composition.—F. B. Power (1877) observed that the largest portion of the resin yields yellow and orange-yellow precipitates with acetate and subacetate of lead from an alcoholic solution; and, after removing the lead, an acid resin, which may be called *podophyllinic acid*, is obtained, to which the color reactions described above are due. Its alcoholic solution is colored dull green by ferric chloride, and its aqueous solution reduces cupric oxide in alkaline solution. Fused with potassa it yields *protocatechuic acid*, but no resorcin. As it is only partly soluble in ether, it consists probably of two acids. The *neutral resin*, which is not precipitated by lead, shows none of the above characteristics, but is likewise separable into one portion soluble and one portion insoluble in ether.

The officinal resin contains also a little fatty matter, and yields a small proportion of ash, consisting chiefly of sodium and potassium salts. The mother liquor from which the resin was precipitated gave indications of the presence of protocatechuic acid, which later investigations (1878) proved, however, not to pre-exist in the rhizome.

Medical Action and Uses.—The medicinal properties of this preparation have been sufficiently set forth elsewhere (see Podophyllum). Its action and uses closely resemble those of the resin of jalap. The following formula is convenient for the relief of habitual *constipation:* ℞. Resin. podophyll., Ext. belladonn. āā gr. iv ad gr. vj; Ext. nucis vomicæ alcoholic. gr. viij. M. et in pil. No. xij divid. S. One after dinner.

RESINA SCAMMONII, *U. S.*—RESIN OF SCAMMONY.

Scammoniæ resina, Br.; *Resina scammoniæ*, P. G.—*Résine de scammonée*, Fr.; *Scammoniaharz*, G.

Preparation.—Take of Scammony in fine powder six troyounces; Alcohol, Water, each a sufficient quantity. Digest the scammony with successive portions of boiling alcohol until exhausted. Mix the tinctures, and reduce the mixture to a syrupy consistence by distilling off the alcohol. Then add the residue to a pint of water, separate the precipitate formed, wash it thoroughly with water, and dry it with a gentle heat. *U. S.*

Take of Scammony Root in coarse powder eight ounces; Rectified Spirit a sufficiency; Distilled Water a sufficiency. Digest the scammony root with sixteen fluidounces of the spirit in a covered vessel, at a gentle heat, for twenty-four hours; then transfer to a percolator, and, when the tincture ceases to pass, add more spirit, and let it percolate slowly until the root is exhausted. Add to the tincture four fluidounces of the water, and distil off the spirit by a water-bath. Remove the residue while hot to an open dish, and allow it to become cold. Pour off the supernatant fluid from the resin, wash this several times with hot water, and dry it on a porcelain plate with the heat of a stove or water-bath. *Br.*

Professor Markoe (1877) showed that the alcoholic extract of scammony yields to water only 2 per cent. of soluble matter, which is removed by washing, as directed in the first formula. The yield of resin varies with the quality of scammony employed. The British Pharmacopœia permits the resin to be prepared from scammony or from scammony root by washing the alcoholic extract with hot water; the root yields 5 to 5½ per cent. of resin. The German Pharmacopœia directs its preparation from the root.

Properties.—Scammony resin is of a brownish color, brittle, of a resinous, glossy fracture, and translucent on the edges. It has a slight sweetish odor, which is stronger when prepared from the root. It differs from scammony in not forming an emulsion with water, and in being completely soluble in alcohol and in ether. It dissolves in warm potassa solution, and when this alkaline liquid is supersaturated with an acid, it remains transparent, and does not produce a precipitate. The resin softens at about 120° C. (248° F.), and fuses near 150° C. (302° F.).

Tests.—The behavior to solvents, as described, distinguishes scammony resin from most other resins. If adulterated with guaiacum, its alcoholic solution would render the fresh-cut surface of a potato blue, and it would acquire a green or blue color on the addition of chlorine water or ferric chloride.

Constituents.—Except the coloring principle, scammony resin consists wholly of *scammonin*, which in its pure state is white, inodorous, and tasteless. F. Keller (1857) ascertained it to be the anhydrid of *scammonic acid*, which is soluble in water, and on being boiled with dilute acids, is converted into sugar and *scammonolic acid.* According to Spirgatis (1860), these compounds have the same composition, and are identical with jalapin, jalapic acid, and jalapinolic acid (see page 777).

Off. Prep.—Extr. colocynth. comp., *U. S.*, *Br.;* Mistura scammonii, Pil. scammonii comp., *Br.*

Medical Action and Uses.—The action of the resin of scammony does not differ in kind, but only in degree, from that of scammony itself; but the resin is about twice as strong as scammony. In the dose of about eight grains it occasions colic and watery stools, very much as jalap does; but is more apt than the latter to excite rectal irritation. Being nearly insipid it may conveniently be given to children. It is seldom used alone, but frequently associated with calomel, jalap, &c., in cases of *constipation* and abdominal *dropsy*, and also as a vermifuge for *lumbricoid ascarides.*

It may be prescribed in doses of from five to fifteen grains; and should be made into an emulsion with milk, almonds, mucilage, or other demulcent, and sweetened. The following formula is convenient: ℞. Resin. scammon. gr. viij; rub with Sacch. alb. gr. xlv; mix gradually with Lactem vaccin. f℥iv; Aq. laurocerasi fʒj. M. S. One or two tablespoonfuls every hour.

RHAMNI SUCCUS, *Br.*—BUCKTHORN JUICE.

Suc de nerprun, Fr.; *Kreuzdornbeerensaft*, *G.*

The recently expressed juice of the ripe berries of common buckthorn, Rhamnus catharticus, *Lin.*, s. Cervispina cathartica, *Moench.* Bentley and Trimen, Med. Plants, 64.

Nat. Ord.—Rhamnaceæ.

Origin and Description.—The buckthorn is a branching shrub about nine feet high; it grows in thickets throughout the greater part of Europe and in Siberia, and is naturalized to some extent and cultivated for hedges in North America. It has ovate, minutely serrate, and frequently fasciculate leaves; small, yellowish-green, diœcious flowers in umbellate clusters, and black globular berries of the size of a pea, surrounded at the base by a portion of the persistent calyx, and containing four hard, dark-brown, grooved nutlets. The berries are recognized by European Pharmacopœias as *Fructus rhami catharticæ* s. *Baccæ spinæ cervinæ*, P. G. In their fresh state they contain a greenish or purplish-green sarcocarp, and yield by expression a greenish-colored juice, having an unpleasant odor and a disagreeable, bitter, and rather acrid taste, and changing on keeping to reddish- or purplish-brown.

Composition.—The various analyses of buckthorn berries have furnished the cathartic principle *rhamnocathartin* in the form of an amorphous, translucent, yellowish, brittle mass, which Binswanger (1849) and Winckler did not succeed in crystallizing. This has the taste of the berries, is fusible, dissolves in water and alcohol, is insoluble in ether, is not destroyed during the fermentation of the juice, and yields picric acid when oxidized with nitric acid. The juice contains also a peculiar variety of tannin, sugar, gum, etc.; after expressing the juice, the tissues retain *rhamnin*, which may be extracted with boiling water, crystallizes in yellowish granules or needles, has little taste, dissolves to a limited extent in cold water and alcohol, and is insoluble in ether. This extract has been subsequently examined by several chemists with conflicting results.

Allied Drugs. Rhamnus infectorius, *Lin.*; French berries, *E.*; Graines d'Avignon, *F.*; Gelbbeeren, *G.*—The shrub grows in Southern Europe, and the berries resemble buckthorn berries in size and appearance, but are of a brownish or greenish-brown color, and are usually two- or three-furrowed.

Rhamnus amygdalina, *Desf.*, Rh. saxatilis, *Lin.*, and probably other species growing in Western Asia, Southeastern Europe, and Northern Africa, yield the so-called *Persian berries.* They resemble the preceding, but are of a more greenish and internally yellowish color, and contain pale-brown nutlets. These and French berries contain one or more yellow coloring principles, which have been named *chrysorhamnin* and *rhamnoxanthin* (see p. 468). *Sapgreen* is obtained from buckthorn berries by treating the juice with lime, and evaporating.

Off. Prep.—Syrupus rhamni, *Br.*

Medical Uses.—This preparation is only employed in making the syrup of buckthorn.

RHEUM, *U. S.*—RHUBARB.

Rhei radix, Br.—*Rhubarb root*, E.; *Rhubarbe*, Fr.; *Rhabarber*, G.

The root of Rheum palmatum, and of other species of Rheum, from China, Chinese Tartary, and Thibet. Bentley and Trimen, Med. Plants, 213, 214.

Nat. Ord.—Polygonaceæ.

Origin.—That rhubarb root is obtained from the western and northwestern provinces of China, and from other parts of the highlands of Central Asia, has been known for a long time. The efforts made by the Russian Government, since the first half of the eighteenth century, to obtain the rhubarb plant, have been unsuccessful; at least the plants Rheum palmatum and Rh. undulatum, *Lin.*, raised in Europe from the seeds thus procured, had roots which were not identical with true rhubarb. More recently, however, several species have become known in Europe, which appear to be the source of most, if not all, rhubarb.

RHEUM OFFICINALE, *Baillon.*—In 1867, Dabry, French Consul at Shanghai, procured from Southeastern Thibet a number of fresh root-stocks, which were sent to Paris, where they arrived in a completely decayed condition, a few buds excepted. From these plants were successfully raised, of which one flowered in 1872, and was described by Baillon under the above name. It has a tall stem, from near the thick base of which numerous orbicular-ovate, 5- or 7-lobed leaves grow, attaining sometimes a length of blade equal to four feet. The inflorescence is large, much branched, racemose, with numerous clustered and drooping, small, greenish-white flowers, and with pendulous, triangular, yellow fruits, nearly half an inch long, and with a bright crimson wing on each angle.

RHEUM PALMATUM, *Lin.*—From the observations made by Lieutenant-Colonel Przewalsky during his travels (1872, 1873) in Central Asia, it appears that a variety of this species, which he collected near Lake Kokonor, in Northwestern China, was really the source of the formerly highly esteemed Russian rhubarb. Maximowicz (1874) described this variety as *Tanguticum*, and contended that its cultivation in Europe was unsuccessful on account of the principal roots decaying. The plant grows to the height of eight or ten feet, has large obicular-ovate, deeply five-lobed and cut radical leaves; numerous small pale-pinkish flowers, and drooping, triangular fruits, with a dull-red wing on each angle.

RHEUM HYBRIDUM, *Murray*, is chiefly characterized by the nearly flat and wrinkled leaves, which are heart-shaped at the base, pointed above, and undulately lobed on the margin. A variety of this species, named *Colinianum*, was received by Professor Baillon (1878) from M. Colin, of Verdun, who had procured it from Central Asia; its root has the characters of rhubarb.

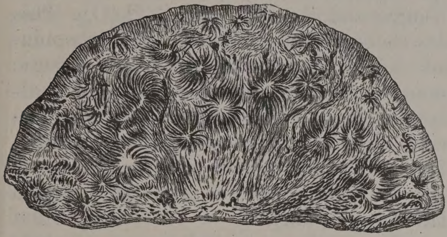
Production.—From the meagre accounts concerning the collection of the root and its preparation for the market, it appears that the root is dug up in autumn, deprived of its corky layer, cut into sections to facilitate the drying, and afterwards exposed to the air, frequently strung on a cord, and, if necessary, dried by the aid of artificial heat.

Rhubarb enters commerce now chiefly from the Chinese port Shanghai, and is hence known as *Chinese rhubarb;* much of it was and is still first shipped to India before it is sent to Europe; the so-called *East India rhubarb* is, therefore, not distinct from the Chinese. Formerly an excellent quality of rhubarb was received through Siberia, under treaty stipulations between the governments of Russia and China. This was almost exclusively received at Kiachta, and there subjected to a very stringent examination, carefully trimmed and dried, and afterwards packed in waterproof chests and sent overland to Moscow and St. Petersburg. This variety was known as *Russian* or *crown rhubarb.* However, since about the year 1850 various causes operated against the rhubarb trade through Siberia; from 1860 very little rhubarb was received at Kiachta, and the office for the inspection of this drug was finally abolished in 1863.

The average consumption of rhubarb in the United States appears to be about 71,000 pounds; during the year 1875–1876, however, 91,591 pounds were imported.

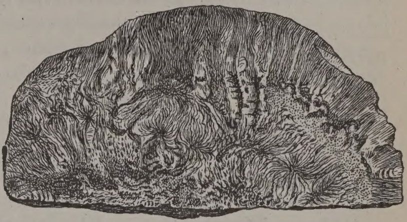
Description.—Rhubarb, as met with in commerce, consists of segments of the root, which are usually assorted into *round* and *flat;* the one kind being either subcylindrical or conical, while the other is irregularly trapezoidal in outline, and flattish, or convex on one side. They are often perforated with a hole, in which remnants of the cord are found by which the root was suspended in drying. The outer surface is always trimmed, but patches of the corky layer, or at least of the inner portion thereof, are usually present to a small extent, and are of a dark blackish-brown color. Otherwise the surface is nearly smooth, or somewhat wrinkled, and, after the removal of the adhering yellowish dust, shows numerous brown-yellow or red-brown short striæ imbedded in a white tissue in which an arrangement into elongated meshes is observable. The transverse surface has a marbled appearance, and consists of white parenchyma traversed by innumerable fine reddish medullary rays; these, in the centre of the pieces, are very irregular, curved, and interrupted, and show a more regular radiating arrangement only towards the circumference near the dark-colored cambium line, and in the inner bark which is generally present in Chinese rhubarb. In Russian rhubarb the cambial zone was entirely trimmed off, leaving only a narrow zone of regularly radiating, nearly parallel medullary rays. Near this zone a dense circle of stellate spots was seen, consisting of small groups of medullary rays, each group radiating from a common centre. These stellate spots are likewise observed in Chinese rhubarb, though not in all pieces, and are in most cases less numerous. Rhubarb is hard, compact, and breaks with an uneven fracture; it has a peculiar aromatic odor, a bitter and somewhat astringent taste, and when masticated is gritty between the teeth, and imparts a yellow color to the saliva. Pieces which are spongy, decayed, worm-eaten, or mouldy should be rejected. Unsightly pieces are sometimes artificially improved in appearance by means of powdered turmeric, in which case the surface turns red-brown with a solution of boracic acid.

Fig. 146.



Russian Rhubarb. Transverse section.

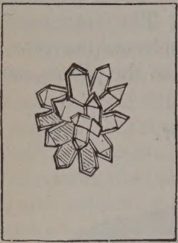
Fig. 147.



Chinese Rhubarb. Transverse section.

Constituents.—Rhubarb has been frequently subjected to analysis, and various more or less active substances were separated from it, and by the different investigators named *rhein*, *rhabarbarin*, *rheumin*, and *rhabarbaric acid.* In 1835, Peretti isolated from rhubarb a crystalline, yellow, sublimable principle, which dissolves in potassa with a red color. This was subsequently proven by Schlossberger and Döpping (1844) to be identical with *chrysophanic aci* (see page 39). After washing the alcoholic extract of rhubarb with water, dissolving the residue in a small quantity of alcohol, and mixing the solution with ether, a precipitate is obtained, consisting of *phæoretin*, *aporetin*, and resinous matter. The liquid yields chrysophanic acid on concentration, while the mother liquor contains *erythroretin*, $C_{38}H_{36}O_{14}$, which is a yellow tasteless powder, readily soluble in alcohol, less freely soluble in ether and glacial acetic acid, and dissolves in alkalies with a purple color. By treating crude chrysophanic acid with cold benzol, *emodin*, $C_{40}H_{30}O_{13}$, is left behind; this crystallizes from hot benzol in orange-colored prisms, which dissolve in alkalies with a deep red color; it was discovered by Warren de la Rue and Müller (1857). The precipitate by ether obtained as above contains aporetin and yields to cold alcohol *phæoretin*, $C_{32}H_{32}O_{14}$, which is yellowish-brown, and soluble in alkalies with a dark red-brown color. *Aporetin* is a blackish resinous mass, sparingly soluble in alcohol, ether, benzol, and chloroform, and yields with alkalies a brown solution.

Fig. 148.

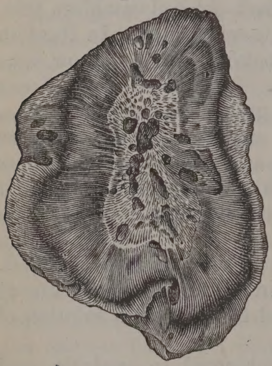


Oxalate of calcium crystals in rhubarb.

Kubly (1867) isolated from rhubarb, besides phæoretin, *chrysophan*, which by alkalies is split into sugar and chrysophanic acid; a colorless, crystallizable, neutral and tasteless body, having the composition $C_{10}H_{12}O_4$; and *rheotannic acid*, $C_{52}H_{52}O_{28}$, which is insoluble in ether, soluble in water and alcohol, precipitates gelatin and albumen, yields with ferric salts a black-green precipitate, and when boiled with dilute acids is resolved into sugar and *rheumic acid*, $C_{40}H_{32}O_{18}$. This acid closely resembles rheotannic acid, but is sparingly soluble in cold water, and yields dark-blue precipitates with ferric salts. Rhubarb contains also sugar, fat, pectinaceous matter, and starch. The grittiness of rhubarb is due to aggregated tufts of microscopic crystals of calcium oxalate, the composition of which was already ascertained by Scheele (1784). The ash left on incineration varies in amount; good rhubarb yields about 12 or 14 per cent., but sometimes as high as 43 per cent. have been obtained (Pharmacographia).

Other Rhubarbs.—Rheum rhaponticum, *Lin.*, is indigenous to Asia Minor, Southern Siberia, and Southeastern Russia. It has a large conical fleshy root, and cordate-ovate rather obtuse leaves, on long fleshy, pleasantly acidulous petioles, the upper part of which has a shallow channel. This species is extensively cultivated as *pie-plant*, for the sake of the leaf-stalks, and the root is occasionally employed in domestic practice. The same species is also cultivated in Moravia and Hungary, and yields the Austrian or Moravian rhubarb. In some parts of Russia, Germany, France, and England Rheum palmatum, *Lin.*, is cultivated; and experiments have also been made with Rh. undulatum, *Lin.*, Rh. compactum, *Lin.*, and Rh. emodi, *Wallich*, s. Rh. australe, *Don.* The various kinds of rhubarb grown in Europe are often very handsome in appearance, though usually of a lighter color than good Chinese rhubarb, and generally of smaller dimensions. The medullary rays usually radiate pretty regularly from the centre, but in interrupted lines, the cambium zone is more distinct, the stellate spots are entirely wanting or present only in small numbers, and the outer surface shows, after trimming, the short striæ of the brownish-red medullary rays, but white meshes are rarely seen.

Fig. 149.



European Rhubarb. Transverse section.

Tests.—It has been stated above that unsightly pieces of rhubarb are occasionally rendered more attractive in appearance by turmeric; the same is the case with *powdered* rhubarb. For the detection of this sophistication, W. L. Howie (1873) recommended the following test: About five grains of rhubarb are placed upon white blotting paper, a few drops of chloroform are percolated through the powder, when the paper surrounding the powder will become very slightly stained from good Chinese rhubarb; while European or dark-colored Chinese rhubarb will produce a deep yellow stain similar to turmeric. A pinch of powdered borax is now placed on the stain, and a single drop of hydrochloric acid placed upon it; if the stain was produced by rhubarb, its color will not be affected, but if the rhubarb contained turmeric, the color will change to a distinct red in a few seconds.

Off. Prep.—Extractum rhei, *U. S.*, *Br.;* Extr. rhei fluid., *U. S.;* Infus. rhei, *U. S.*, *Br.;* Pilulæ rhei, *U S.;* Pil. rhei comp., Pulv. rhei comp., Syrup. rhei, *U. S.*, *Br.;* Syrup. rhei arom., *U. S.;* Tinct. rhei, *U. S.*, *Br.;* Tinct. rhei et sennæ, *U. S.;* Vinum rhei, *U. S.*, *Br.*

Medical History.—The names Rhabarbarum and Rheum are derived from that of the river Rhâ (Volga) which empties into the Caspian Sea, because from that direction rhubarb was anciently, as at present, brought to the countries bordering on the Levant. Two names were used to designate it, Rhaponticum, and Rha-barbarum, of which the former revealed its source near the Pontic or Euxine Sea, and the other that it was brought from the barbarous regions of the North. Rhapontic rhubarb is said, however, to have been astringent and not purgative. Certain it is that the earliest account of the cathartic rhubarb comes to us through the Arabian writers, who insist upon its combined tonic and purgative qualities, and its astringency when roasted. Rhubarb was, however, well known in China, from time immemorial, as a purgative.

Physiological Action.—Rhubarb acts as a purgative on horses and dogs as well as on man, and in all cases its coloring and purgative principles are absorbed into the blood, since it tinges the urine and milk, and renders the latter purgative. It also sometimes stains the perspiration yellow. The color which it gives the feces probably led to its being regarded as a cholagogue. Its purgative and astringent properties have been ascribed to cathartinic (?) and rheo-tannic acids respectively. After large doses a moderate purgative action is followed by quiescence of the bowels; but a very small quantity taken daily in mass and allowed to dissolve in the mouth will maintain them in a free condition for some time, and that without at all impairing the digestion. The purgative action of rhubarb has been manifested when it was applied to ulcers, or moistened and rubbed upon the skin.

Medical Uses.—The gentle action of rhubarb renders it one of the best remedies for *hemorrhoids* connected with constipation. Its tonic or astringent influence superadded to its laxative operation constitutes it one of the best remedies for *diarrhœa* due to cold or to the presence of irritating ingesta in the bowels; and for this purpose roasted rhubarb is thought to be peculiarly efficient. It is best prepared by roasting fragments of it like coffee. The diarrhœa to which children are liable in summer is often cured by this medicine, especially when associated with magnesia. At one time rhubarb was believed to be a valuable remedy for *dysentery*, but in this disease, which presents so many types and varieties, it is difficult to determine in what particular form of it the medicine is most efficient. We believe that it is so in the first stages of simple dysentery, when associated with mild salines; in the decline of the bilious form with a tendency to protracted diarrhœa; and as an occasional purgative in chronic dysentery prolonged by scybala in the bowels.

Externally, powdered rhubarb has been recommended as a stimulant and astringent application to old, indolent, and irritable *ulcers*. Opium, calomel, and other substances may be mixed with it.

The *dose* of rhubarb as a purgative is about twenty grains; as a gentle aperient and tonic, five grains. Associated with calomel its action is prompt and efficient. With magnesia it is very appropriate when the secretions of the stomach and bowels are unduly acid. The simple rhubarb pill, which contains soap, is very eligible as a mild laxative for habitual or occasional use. The numerous officinal preparations of this drug are commented upon in their proper places.

RHODODENDRON.—ROSEBAY.

Rosage, Fr.; *Alpenrose*, G.

Nat. Ord.—Ericaceæ.

Description.—This genus is composed of evergreen shrubs and low trees, inhabiting mountainous localities of the northern hemisphere. They have leathery, entire, somewhat revolute and petiolate leaves, often crowded near the end of the branches, and showy flowers in compact terminal clusters or corymbs, with the corolla five-lobed, funnel-form, and somewhat campanulate or with a wheel-shaped border. The leaves of the following species have been used.

RHOD. CHRYSANTHUM, *Lin.*—It is indigenous to Siberia, and has yellow flowers. The leaves are about 2 inches long, oblong or obovate-oblong, rather obtuse, reticulate, smooth, pale rust-colored beneath. When fresh they have a slight rhubarb-like odor, which is nearly lost in drying; their taste is astringent, unpleasantly bitter, and somewhat pungent.

RHOD. MAXIMUM, *Lin.*—It grows in North America, and has rose-colored or whitish flowers. Its leaves are about 7 inches long, elliptic-oblong or obovate-oblong, acute, smooth, dark green, shining, paler beneath. Their taste is astringent and somewhat pungent.

RHOD. FERRUGINEUM, *Lin.*—It is found in Europe and Asia, and has purple glandular-dotted flowers. The leaves are about 1½ inch long, lanceolate or lance-oblong, rust-colored and scaly beneath, and have an astringent and bitter taste.

Constituents.—These leaves contain tannin. Their bitter and other principles have not been investigated.

Medical Action and Uses.—The Siberian or snow-rose is said to be a very active medicine. It is related that a goat after eating its leaves became excited, then tottered and fell upon its knees, and did not recover for two hours. In man small doses appear to increase the secretions, and especially to act as a diaphoretic. Larger doses render the mouth and throat dry and constringe them, promote the alvine and cutaneous secretions, and excite a sense of formication and prickling in the skin, which also exhales an aromatic smell. In still larger doses it causes giddiness, confusion of the senses and ideas, dimness of vision, constriction of the throat, dyspnœa, hebetude, paralysis of sensibility and motility and even convulsions. Sometimes it acts principally as an evacuant upon the stomach and bowels, in other cases excites profuse diuresis or sweating, itching or eruptions of the skin, pain and twitching of the limbs, etc. It is said to reduce the pulse and render it intermittent.

Rosebay has been almost exclusively employed in the treatment of *rheumatism* and *gout*, a hot infusion being used at the commencement of the attack, when acute; but in the chronic forms of these diseases a moderate but steady action of the medicine is maintained for weeks and even months, the evidence of its utility being furnished by painful sensations in the affected parts. It has also been used in *sciatica*, in chronic *diseases of the skin*, and chronic *diarrhœa* and *dysentery*. It is given in powder in doses of ten grains several times a day; or in a decoction made with from two to four drachms of the leaves in ten fluidounces of water.

RHŒADOS PETALA, *Br.*—RED-POPPY PETALS.

Flores rhœados, P. G.—*Corn poppy, Corn rose*, E.; *Coquelicot, Pavot rouge*, Fr.; *Klatschrosen*, G.

The fresh petals of Papaver rhœas, *Lin.* Bentley and Trimen, Med. Plants, 19.

Nat. Ord.—Papaveraceæ.

Origin.—The red poppy is an herbaceous annual, growing in fields among cereals throughout the greater part of Europe, in Northern Africa, and in Asia eastward to India. It is about two feet high, is covered with spreading hairs, has deeply pinnatifid leaves, with the segments lanceolate and cut-toothed; it has showy red flowers, and produces short, smooth, obovate capsules, which are truncate above, and contain numerous minute blackish seeds.

Description.—The petals are roundish in outline, two inches and more in width, one pair always broader than the other pair, deep scarlet-red, after drying of a dull purple, very thin, with a short claw and a black spot near the base. Their odor in the fresh state is heavy and somewhat narcotic, and is dissipated in drying; their taste is mucilaginous and slightly bitter.

PAPAVER DUBIUM, *Lin.*, which is sometimes met with spontaneously in the United States, is appressed-hairy, and has a club-shaped capsule and roundish-oblong, red petals, which agree in sensible properties with the preceding, but are generally smaller.

Constituents.—Red-poppy petals have been frequently examined, and it has been asserted by some that they contain small quantities of morphia, paramorphia, and narcotina, which alkaloids, however, could not be detected by other investigators. According to Hesse (1865) they contain *rhœadina* (see p. 1013). Leo Meier (1846) found in the petals gum, starch, albumen, fat, and wax, and two deliquescent coloring principles: *rhœadic acid*, which is dark-red, soluble in alcohol and water, but insoluble in ether, and yields brown compounds with alkalies; and *papaveric acid*, which is bright-red, soluble in dilute alcohol and water, and forms violet compounds with the alkalies.

Off. Prep.—Syrupus rhœados, *Br.*

Medical Action and Uses.—The dried petals of the red or corn poppy are used in the preparation of syrup of red poppy.

RHUS GLABRUM, *U. S.*—SUMACH.

Smooth sumach, Pennsylvania or upland sumach, E.; *Sumac*, Fr.; *Sumach*, G.

The fruit of Rhus glabrum, *Lin.* *Nat. Ord.*—Terebinthaceæ.

Origin.—The smooth sumach is a shrub or suffruticose plant, growing in rocky and barren soil in North America. It attains a height of about 12 feet. The stem has a large pith and a thin circular layer of white wood, which is covered with a thin brown-gray *bark*, having small scattered warts on the outer surface, the inner tangential layers of a green and the inner surface of a brown color. The *leaves* are imparipinnate, with from 21 to 31 lance-oblong, pointed, and serrate, on the under side whitish leaflets. The small greenish *flowers* grow in dense ovoid terminal panicles, and appear in June; the fruit ripens in September.

Description.—The fruit is drupaceous, subglobular, less than one-eighth of an inch in diameter; is densely covered with bright purplish-red hairs, and incloses a roundish oblong smooth putamen. It is inodorous, and has a strong and pleasant acidulous taste. The leaves and bark, which have also been employed medicinally, have an astringent and bitter taste.

Allied Species. Rhus copallina, *Lin.*, *Dwarf sumach.*—It is from 3 to 7 feet high, and has downy branches, and the petioles wing-margined between the lanceolate entire leaflets.

Rhus typhina, *Lin.*, *Staghorn sumach.*—It is 20 to 30 feet high, velvety, hairy, and has leaves with from 17 to 31 oblong-lanceolate, pointed, and sharply serrate or cut-toothed leaflets.

Rhus coriaria, *Lin.*, *European sumach.*—It is 8 to 12 feet high, and grows near the Mediterranean; the leaves have 11 to 15 elliptic, coarsely serrate, woolly leaflets. All the above species have red, hairy, acidulous fruits and astringent leaves, and with the exception of the last, are indigenous to North America.

Constituents.—Trommsdorff (1834) found in the fruit of the European sumach tannin, coloring matter, malate of potassium, and much malate of calcium. Similar results were obtained by W. B. Rogers (1835) with the fruit of Rhus glabra and copallina. The seeds contain fixed oil. The astringent taste of European sumach leaves was ascertained by Chevreul to be due to tannic and gallic acids, and Stenhouse (1862) corroborated this result by converting the tannin into gallic acid. He attributes the variation in the amount of tannin to the fact that the European sumach leaves are collected also from Rhus cotinus, *Lin.* Bowman (1869) estimated the tannin in *Rhus glabra* by means of gelatin, and found in the bark 8.75 and 14.55 per cent., and in the fruit 1.9 per cent.

Medical Action and Uses.—Sumac berries, containing both an acid and an astringent principle, may be used in infusion as a gargle in *catarrhal* and other mild forms of *pharyngitis*, for which it forms a very agreeable and efficient remedy. Even in the decline of graver forms of this affection, it is deserving of attention. The same is true of its use in *aphthæ*, and other forms of sore mouth, including that produced by mercury. An infusion or decoction of the leaves or of the inner bark of the root is simply astringent, but may be applied to the same purposes.

ROBINIA.—Locust Tree.

False acacia, E.; *Robinier*, Fr.; *Falsche Acacie*, G.

Robinia pseudo-acacia, *Lin.* *Nat. Ord.*—Leguminosæ, Papilionaceæ.

Description.—The common locust tree is indigenous to the southern part of the United States, but is commonly cultivated and naturalized further north and in Europe. It is thorny when young, attains a height of 60 or 80 feet, but is smaller in northern localities, and has a durable white wood and a brownish or gray, smooth, and internally yellowish bark. Its leaves are imparipinnate, the leaflets in from 8 to 12 pairs, oval, obtuse, and smooth, and the fragrant whitish flowers in long slender racemes. The legume is about 3 inches long, linear, flat, margined on the inner side, and contains about 6 blackish-brown small seeds. The root and inner bark have a sweetish taste.

Constituents.—The root was examined by H. Reinsch (1845), who found it to contain much albumen, tannin, sugar, starch, and other common vegetable principles. His *robinic acid* is believed by Hlasiwetz (1852) to be *asparagin*, of which he obtained 2½ ounces from 30 pounds of the root. According to Zwenger and Dronke (1861) the flowers contain a yellow glucoside, *robinin*, which, on being boiled with acids, is resolved into sugar and *quercetin*, and which is also contained in the bark and wood.

Medical Action and Uses.—The bark of the root is said to be tonic, and in large doses purgative and emetic, and a syrup prepared from the flowers is related to have produced acro-narcotic effects in children. No definite information concerning its medicinal virtues is accessible.

ROSÆ CANINÆ FRUCTUS, *Br.*—HIPS.

Cynosbata, Fructus cynosbati.—Fruit of the Dog rose, E.; *Gratte-cul, Cynorrhodon*, Fr.; *Hagebutten, Hainbutten*, G.

The ripe fruit of the Dog rose, Rosa canina, *Lin.*, and other indigenous allied species.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—The *dog rose* is a spiny European shrub, from four to eight feet high, and resembles the roses indigenous to this country, but differs from them in the shape of the calyx, and in the absence of glandular hairs on the peduncle and calyx.

Description.—Hips are not the fruit, but the enlarged calyx tubes of the rose. They are about an inch in length, ovate, contracted above, of a bright red color, shining, internally stiff-haired, and inclose a number of ovate, hairy, brownish, bony akenes. Hips are at first tough, and crowned with the five-cleft deciduous calyx lobes; later in autumn they are naked above, softer, and more fleshy. They are inodorous, and have a sweet acidulous and somewhat astringent taste. For medicinal use the hard akenes are removed, and the fleshy calyx tube alone employed. The corresponding part of Rosa carolina, *Lin.*, and R. lucida, *Ehrhart*, are depressed globular, the former somewhat hairy, and have properties similar to those of the first.

Constituents.—Scheele already noticed malic and citric acid in the pulp. Biltz (1824) obtained 7.78 per cent. of malic, and 2.95 per cent. of citric acid; also 30.6 per cent. of sugar, 25 per cent. of gum, and small quantities of tannin, resin, wax, malates, citrates, and other salts.

Off. Prep.—Confectio rosæ caninæ, *Br.*

Medical Action and Uses.—Hips are described as slightly refrigerant and astringent; but they are used in medicine only to prepare the confection of hips.

ROSA CENTIFOLIA, *U. S.*—PALE ROSE.

Rosæ centifoliæ petala, Br.; *Flores rosæ*, P. G.; *Flores rosarum incarnatarum.—Cabbage rose petals, Hundred-leaved rose*, E.; *Rose à cent feuilles, Rose pâle*, Fr.; *Centifolienrose, Rosenblätter*, G.

The petals of Rosa centifolia, *Lin.* *Nat. Ord.*—Rosaceæ, Roseæ.

Origin.—This well known shrub is probably indigenous to Western Asia, and is cultivated in many varieties in all countries. Its branches are covered with numerous nearly straight spines; the petioles and peduncles are nearly unarmed, but more or less clothed with glandular bristles, and the leaves have five or sometimes seven ovate or elliptic-oval serrate glandular, and beneath soft-hairy leaflets. The flowers are collected and deprived of the calyx and ovaries, the petals alone being employed.

Description.—The petals are roundish-obovate, retuse at the apex or almost obcordate, of a pink color, a delicious rose-odor, and of a sweetish, somewhat bitter and slightly astringent taste. In drying they become brownish and less fragrant.

Constituents.—The odor of rose petals is due to a minute quantity of volatile oil (see page 992). Enz (1867) determined the other constituents to be tannin, giving a green reaction with ferric salts; fat, resin, sugar, a bitter principle, malates, tannates, and phosphates, and a coloring matter, which is easily altered, and, from the investigations of Fremy, Cloez, Filhol, and others, seems to be identical with that of the red rose and of many other red-colored flowers.

Pharmaceutical Uses.—Rose petals are employed chiefly in the distillation of rose-water, and are for this purpose often preserved by being packed into suitable vessels with one-half or their own weight of common salt. It is stated that in some laboratories the entire rose flowers are used in the distillation of rose-water, and furnish a good product. The dried petals are used in preparing Syrupus sarsaparillæ comp., *U. S.*

Medical Action and Uses.—Pale rose-leaves are seldom used medicinally except in the form of the officinal rose-water. The nervous symptoms and occasionally the coryza, ascribed to the fresh flowers, are apt to be produced by other odorous flowers.

ROSA GALLICA, *U. S.*—RED ROSE.

Rosæ gallicæ petala, Br.; *Flores rosarum rubrarum.—Red-rose petals*, E.; *Rose rouge*, *Rose de Provins*, Fr.; *Essigrosenblätter*, G.

The petals of Rosa gallica, *Lin.* Bentley and Trimen, Med. Plants, 104.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—The red rose is a bushy shrub, two or three feet high, which grows wild in Southern Europe and the Levant, and is cultivated in gardens in numerous varieties. It is armed with bristly prickles and with a few curved spines, and has slightly heart-shaped and thicker leaflets than the preceding species. The flowers are collected while still in bud, and the petals cut off near the base and rapidly dried.

Description.—As seen in commerce, red rose is in small cones consisting of the densely imbricated numerous petals, which, when unfolded, are roundish, retuse at the apex, and at the base narrowed into a short yellow claw, the greater portion of which has been trimmed off; the centre of the cone is hollow, or it contains some of the stamens. The color is deep purplish-red, velvety in aspect; the odor is roseate, and the taste bitterish, slightly acid, and astringent. Red rose should be preserved in a dry place, and excluded from the light.

Constituents.—The chemical constituents of red rose are very similar if not identical with those of pale rose, but the astringent principle is more predominating. Filhol (1863) denied the existence of tannin in red-rose petals; by extracting them with ether, two fats and *quercitrin* were obtained, to which the dark green reaction with ferric salts is due; alcohol afterwards took up a little gallic acid, and nearly 20 per cent. (?) of invert-sugar. Rochleder (1867), however, ascribed the reaction with iron to *quercetic* and a little gallic acid. The coloring principle of roses acquires a bright red color on the addition of an acid, and is changed to blue by alkalies.

Off. Prep.—Confectio rosæ (rosæ gall.), Infus. rosæ comp. (rosæ acidum), *U. S.*, *Br.*; Mel rosæ, Pil. aloes et mastiches, *U. S.*; Syr. rosæ gallicæ, *U. S.*, *Br.*

Medical Action and Uses.—Red rose leaves were anciently used in medicine as cooling and astringent, for the relief of uterine and other *hemorrhages*, and as an application to *aphthæ* and other *ulcers* affecting the mouth, ears, anus, etc., and the fresh bruised leaves were applied to inflammations of the *eyes*, etc. Rose leaves enter into several officinal preparations, which are used chiefly as excipients.

ROSMARINUS, *U. S.*—ROSEMARY.

Folia rosmarini s. roris marini, P. G.; *Folia anthos.*—*Feuilles de romarin*, Fr.; *Rosmarinblätter*, G.

The leaves of Rosmarinus officinalis, *Lin.* Bentley and Trimen, Med. Plants, 207.

Nat. Ord.—Labiatæ, Monardeæ.

Origin.—Rosemary is a native of the basin of the Mediterranean, and is often cultivated in gardens. It is shrubby, three or four feet high, much branched, evergreen, and has few flowered axillary clusters of rather large pale-blue flowers.

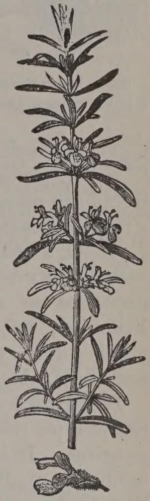
Description.—Rosemary leaves are about one inch long, leathery, linear, entire, sessile, obtuse at both ends, dark-green above, densely woolly and dotted with oil glands beneath, and revolute on the margin. In drying, the margin becomes more strongly revolute, the leaf narrower and rigid, and the midrib prominent on the lower side. Rosemary has a peculiar aromatic, somewhat camphoraceous odor and a pungently aromatic taste.

Constituents.—The principal constituent is the volatile oil (see page 992). A little tannin, resin, and bitter principle appear likewise to be present.

Pharmaceutical Uses.—The leaves are employed in the preparation of fumigating powders, and the distillation of the volatile oil.

Medical Action and Uses.—By the ancients rosemary was esteemed for its emmenagogue, galactagogue, and diuretic virtues, and more recently it was regarded as diaphoretic and carminative, and as useful in various functional *nervous disorders*. In Europe it is sometimes still used for similar purposes. The volatile oil, which is officinal, is a powerful stimulant. An infusion, prepared with from 60 to 120 grains of the leaves, in a pint of water, may be prescribed in tablespoonful doses. Fomentations made with the plant steeped in hot water or alcohol are used for the relief of local pains.

Fig. 150.



Rosmarinus officinalis, *Lin.* Branch and flower.

ROTTLERA, *U. S.*—KAMEELA.

Kamala, Br., P. G., *Glandulæ rottleræ.*—*Kamala*, E., Fr., G.

The powder and hairs obtained from the capsules of Rottlera tinctoria, *Roxb.*, s. Mallotus (Echinus, *Baillon*) philippinensis, *Müll.*, s. Croton philippense, *Lam.* Bentley and Trimen, Med. Plants, 236.

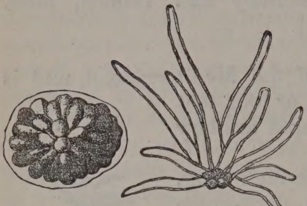
Nat. Ord.—Euphorbiaceæ.

Origin.—The kamala grows wild in Australia, Eastern China, India, Southern Arabia, and Abyssinia, and in most of the islands lying between these countries from the Philippines westward. It is a large shrub or small tree, with petiolate, ovate, acute, and entire leaves, and produces globular tricoccous three-seeded capsules, from which the glands are obtained by rubbing and sifting in baskets.

Description.—Kamala is a fine granular mobile powder, of a brick-red color, somewhat resinous appearance, inodorous, and nearly tasteless. It is with difficulty mixed with water, imparts to boiling water only a yellow tinge, but a deep-red color to alkaline solutions, alcohol, ether, chloroform, and benzol.

When thrown into a flame it burns similar to, but less rapidly than, lycopodium, and when heated in a crucible, it leaves a small amount of ash, which weighs from pure kamala 1.37 per cent. (Pharmacographia.) Examined under the microscope, the glands are seen to be depressed-globular, and to consist of a thin transparent membrane, inclosing a yellowish mass, in which are imbedded many club-shaped vesicles radiating from a common centre, and containing a red substance; this structure becomes more apparent after treating the glands with potassa, and pressing them between glass. The glands are always mixed with colorless stellate simple hairs.

Fig. 151.



Rottlera tinctoria. Gland and stellate hairs magnified 190 diameters.

Constituents.—Leube (1860) analyzed a sample of kamala, which yielded nearly 29 per cent. of ash, 47.6 resin, and 19.7 other soluble matters consisting of citric, oxalic, and tannic acids, gum, etc. Cold alcohol dissolved a resin, $C_{15}H_{18}O_4$, fusible at 80° C. (176° F.), and left a more sparingly soluble resin, $C_8H_{12}O_5$, fusible at 191° C. (376° F.). Both resins are brittle, red-yellow, soluble in alkalies with a red color, not altered by dilute acids, and when treated with nitric acid yield oxalic acid. Leube could not obtain Anderson's rottlerin, $C_{22}H_{20}O_6$ (1855), which crystallized from the concentrated ethereal tincture in yellow silky needles. Groves (1872) ascertained that it is easily modified by exposure to air, and is consequently obtained only from the recent drug. Flückiger subsequently observed that, on being fused with potassa, rottlerin yields *paraoxybenzoic acid.* Anderson's *resinous coloring matter* had the composition $C_{20}H_{30}O_7$.

Medical Action and Uses.—Kamala has long been employed as a remedy for *tænia* in Hindostan. It does not give rise to much nausea, colic, or purging. It is said that British soldiers in India often apply for a dose of the medicine, "after which they invariably part with the worm in the course of a few hours, and then go on with their military duty as if nothing had happened." In general the parasite appears to have been discharged dead. The medicine is reported to be equally efficient in removing *lumbricoid worms* and rectal *ascarides.*

The *dose* of powdered kamala is from one to two drachms. To prevent its griping it may be associated with a little hyoscyamus. A saturated tincture has been found efficient in the dose of from one to three fluidrachms diluted with cinnamon water; or the extract procured by evaporating the tincture may be employed. The dose of either preparation should be repeated several times at intervals of about three hours.

RUBIA, *U. S.*—Madder.

Dyers' madder, E.; *Garance*, Fr.; *Krapp*, *Färberröthe*, G.

The root of Rubia tinctorum, *Lin.* *Nat. Ord.*—Rubiaceæ.

Origin.—This plant is an herbaceous perennial, indigenous to the Levant and Southern Europe, and is cultivated in several European countries. It is two or three feet or more high, has elliptic-lanceolate, rough, prickly leaves in whorls of four or six, greenish-yellow flowers, and smooth, black, baccate fruits.

Description.—The rhizome is creeping, and has numerous long, light blood-red, cylindrical roots, of the thickness of a quill. These are, after drying, deeply wrinkled, have an easily separable gray-red corky layer, a thin dark brown-red inner bark, and a spongy red wood, which in the fresh state is yellowish, and contains irregular medullary rays. The rhizome is sometimes present; it resembles the root, and is chiefly distinguished by a central pith. The root breaks with a short and smooth fracture, has a feeble odor, and a sweetish, bitterish, somewhat acrid and astringent taste. Madder is usually found in the shops in the form of a coarse powder.

Constituents.—Madder has been very frequently subjected to chemical investigation, and a large number of principles have been isolated, which are most likely oxidation- and decomposition-products of a yellow coloring matter found by Decaisne in the fresh root. Many of these are glucosides, and yield *alizarin* besides other principles, under the influence of dilute acids. *Rubian* $C_{28}H_{34}O_{15}$ is an amorphous dark yellow bitter mass. *Rubianic acid* $C_{20}H_{22}O_{11}$ crystallizes in lemon-yellow, silky, bitterish needles. *Rubihydran* and *rubidehydran* are gum-like masses. These principles were isolated by Schunck (1847–1856). Rochleder's *ruberythrinic acid* $C_{16}H_{18}O_9$ (1855, etc.) crystallizes in silky yellow prisms. The most important constituent is *alizarin* $C_{14}H_8O_4$, which crystallizes in orange-red sublimable needles, is soluble in boiling water, alcohol, and ether, and yields purple or red-colored compounds with bases. Other compounds obtained from madder are *rubitannic acid*, *rubichloric acid*, *purpurin*, *rubiretin*, verantin, etc. It contains also pectin, sugar, citric acid, etc.

Medical Action and Uses.—Madder is an obsolete medicine, but was formerly in high repute as an *emmenagogue*. It was administered in *doses* of half a drachm, gradually increased to a drachm, four times a day.

RUBUS, *U. S.*—BLACKBERRY.

Écorce de ronce noir, Fr.; *Brombeerrinde*, G.

The bark of the root of Rubus canadensis, *Lin.*, and of Rubus villosus, *Ait.* Bentley and Trimen, Med. Plants, 100.

Nat. Ord.—Rosaceæ, Dryadeæ.

Origin.—Both species are common shrubby North American plants. R. canadensis is the *dewberry*, and has a trailing slightly prickly stem, and nearly smooth ovate-lanceolate, sharply serrate leaflets. R. villosus is the common *American blackberry*, has an upright or reclining stem armed with stout recurved prickles, and is glandular and hairy on the branchlets and the lower surface of the leaflets, and ripens its fruit later than the first species.

Description.—The roots of both species are considerably branched, vary in size from the thickness of a goosequill or less to the diameter of an inch or more, and contain a large whitish tough ligneous meditullium. The bark is quite thin; blackish, or in the dewberry blackish-gray externally, internally dark brown; tough, breaks with some difficulty, shows a tangential arrangement of the tissue; is nearly inodorous, and has a strongly astringent and somewhat bitter taste. The thinnest roots are frequently not deprived of the inert wood.

Constituents.—Blackberry bark contains tannin; its other constituents have not been investigated.

Other Products of Rubus.—The bark and leaves of most species of this genus have an astringent and somewhat bitter taste, and the fruits are acidulous and of a more or less pleasant flavor, and contain malic and citric acid, sugar, pectin, albumen, etc. The *blackberries* have a juicy receptacle, united with the numerous small drupes; in the *raspberries* the receptacle remains dry, and separates from the collective mass of drupes. The European raspberry, Rubus idæus, *Lin.*, has a red, soft-hairy fruit of a very agreeable flavor. Very similar is R. strigosus, *Mich.*, which is indigenous to North America. R. occidentalis, *Lin.*, likewise a North American species, has purplish-black fruits.

Off. Prep.—Extractum rubi fluid., Syrupus rubi, *U. S.*

Medical Action and Uses.—Blackberry root and dewberry root possess astringent and probably tonic virtues, and are much used in *summer complaint* and *infantile diarrhœa.* They are best administered in a decoction made with water or with milk, an ounce in a pint and a half of liquid being boiled down to a pint.

RUMEX, *U. S.*—YELLOW DOCK.

Radix rumicis s. lapathi.—*Racine de patience frisée,* Fr.; *Grindwurzel,* G.

The root of Rumex crispus, *Lin.* *Nat. Ord.*—Polygonaceæ.

Origin.—The *curled dock* is a European perennial, and has been extensively naturalized in North America and in other countries. It grows in waste places and in cultivated ground, and is distinguished from allied species by the wavy curled margins of its lanceolate leaves, and by the roundish-cordate, slightly denticulate, and grain-bearing valves of the fruit. The root is collected in autumn.

Description.—The root is eight to twelve inches long, one-quarter to three-quarters inch or more thick, many headed, annulate above, somewhat branched and sparsely beset with fibres; after drying, deeply wrinkled longitudinally, externally of a grayish-brown color, inodorous, and of a bitter and astringent taste. The root breaks with a short irregular fracture, and upon transverse section shows a rather thick bark, nearly one-sixth the diameter of the root; a dark-colored cambium line and a fleshy meditullium, containing porous wood wedges, separated by narrow medullary rays. The color of the inner tissue is white or whitish, with yellowish or brownish-red striæ. The roots of Rumex obtusifolius, *Lin.*, and R. sanguineus, *Lin.*, both indigenous to Europe and naturalized in North America, are indiscriminately collected with the preceding, and resemble it.

Constituents.—The chemical composition of yellow dock is nearly identical with that of rhubarb, except in the relative proportion of the constituents, the astringency predominating. The *rumicin* and *lapathin* of earlier investigators were proven by Tann (1858) to be identical with chrysophanic acid.

Medical Action and Uses.—Yellow dock is astringent, slightly tonic, and also laxative, and has been compared to rhubarb, and also to sarsaparilla, for its operation. It has been chiefly used in chronic *cutaneous diseases,* particularly of a scrofulous origin. Some species of rumex have been famous for the cure of *intermittent fevers,* for which purpose they were given in hot decoction to the production of sweating. Others have been regarded as eminently depurative, and used in chronic *hepatic congestion* and *dyspepsia* with lateritious urinary deposits and a tendency to *gout.* Externally it has been applied to the treatment of various *skin diseases, glandular swellings,* and *scabies.* For the last an ointment is employed, made by boiling dock root in vinegar until the fibre is softened; the latter is then reduced to a pulp and mixed with sulphur and lard. It is pretty certain that the sulphur is the efficient ingredient of this ointment. The root, softened by boiling, may be used as a stimulant and resolvent cataplasm. The decoction is made by boiling two ounces of the fresh root, or one ounce of the dry root, bruised, in a pint of water. Of this two fluidounces may be taken at a dose.

RUTA, *U. S.*—RUE.

Folia (Herba) rutæ, P. G.—*Rue, Rue des jardins,* Fr.; *Raute, Gartenraute,* G.

The leaves of Ruta graveolens, *Lin.* Bentley and Trimen, Med. Plants, 44. *Nat. Ord.*—Rutaceæ.

Description.—Rue is an herbaceous or suffruticose perennial, two or three feet high, which grows wild throughout Southern Europe, and is frequently cultivated in gardens. The leaves are alternate, on long petioles, thrice or twice pinnate, or the upper ones pinnatifid, the lower ones three to four inches long, triangular-ovate in outline, subcoriaceous, grayish-green, finely pellucid-punctate and smooth; the final divisions obovate-oblong or spatulate, sparingly crenate, obtuse or rounded above, the terminal division larger and spatulate wedge-shaped. The plant has yellowish flowers in terminal corymbs, and four- or five-lobed capsules containing numerous ovoid-angular blackish seeds. The leaves have a peculiar, strongly balsamic odor, and possess an aromatic, bitter, and acrid taste.

Constituents.—The most important constituent of rue is its volatile oil (see page 903). Maehl found free malic acid. Weiss (1842) isolated the yellow coloring matter, *rutin*, and obtained it in needle-shaped crystals. Bornträger (1844) ascertained it to possess acid properties, and named it *rutinic acid.* Hlasiwetz (1855) observed that it splits into sugar and quercetin, and regarded it as identical with *quercitrin;* but Zwenger and Dronke found the unfermentable *rutinsugar* to differ from isodulcite, and to have the composition $C_{12}H_{18}O_9$. In preparing rutin, it is with difficulty purified from resinous matter and a compound resembling coumarin.

Physiological Action.—Rue is an active irritant, as numerous cases of poisoning by it attest. In one example, a man who had been gathering rue suffered from an inflammation of the skin of the forearms with abundant vesicles, which healed very slowly. Three cases are reported by one physician, in which rue was used to produce abortion. In the first a decoction of the sliced root, in the second a decoction of the leaves, and in the third the expressed juice of the leaves, was taken. In one of the cases the effects were violent gastric pain, vomiting, or efforts to vomit with the rejection of a little blood. In all there was great prostration, confusion of mind, cloudy vision, feebleness and slowness of pulse, coldness of the extremities, and twitching of the limbs. All of the patients, who were in the fourth or fifth month of pregnancy, aborted and recovered. In another case a woman had several times caused herself to abort by using an infusion of rue. The symptoms produced were pain in the back, bearing down, frequent micturition, continuing for several days and often attended with headache, when a "show" took place, followed by pains and abortion, about ten days from the beginning of the administration. Three doses of the oil of rue taken within an hour by a healthy adult produced uneasiness in the stomach, oppression and confusion of the brain, aching in the loins, an urgent desire to urinate, a strong smell of rue in the urine, flushes of heat, unsteadiness of gait, a tendency to sleep, and increased frequency and diminished tension of the pulse. On the other hand, when an infusion of the dried leaves was employed, the pulse fell from 80 to 69 in three hours.

Medical Uses.—Rue was held in high esteem from the time of Hippocrates. It was employed to cure amenorrhœa, promote the lochia, and cause abortion. It was believed that in women it stimulated sexual desire, but that in men it diminished the seminal secretion and the tendency to venery; that it was carminative and tonic, and useful internally and externally to relieve colic; that it destroyed intestinal worms, and cured intermittent fever. It was thought, in due proportion, to strengthen, but in excess to weaken, the sight; and was prescribed as an antidote to poisoning by aconite, mushrooms, etc. Externally, it was known to cause a pustular eruption upon the hands of persons employed to gather it, and was used to destroy fleas.

Rue is a powerful antispasmodic, and was formerly administered in enemata for preventing or shortening *hysterical* attacks. Its stimulant action upon the uterus is shown in the unimpregnated as well as the pregnant state of the organ, but especially in the cure of *amenorrhœa* due to non-inflammatory causes. In cases arising from congestion of the uterus, rue has sometimes occasioned profuse hemorrhage and severe pain. It should, therefore, be cautiously used in *dysmenorrhœa.* The essential oil is the most convenient form for its administration. In Chili it is said to be applied to the umbilicus and to the soles of the feet to produce an emmenagogue effect. Rue has been used instead of savin in uterine *hemorrhage* after abortion, and when it depends upon general debility. A decoction of the fresh leaves of rue has been employed as an injection to destroy *ascarides* of the rectum, and, internally, to remove *lumbricoid worms.* Externally, compresses saturated with a strong decoction of the plant, dried and applied to the chest, have been used with advantage in *chronic bronchitis.* A similar decoction has been found very efficient in destroying body *lice*, in various *scaly eruptions*, and in *glandular* engorgements.

The decoction and infusion of rue should be made from the fresh plant; but as this is not always to be procured, the oil, which is officinal, may be substituted for it. Where fresh rue can be obtained, an infusion may be prepared with about a drachm of the leaves to a pint of water.

SABADILLA, *U. S.*, *Br.*—CEVADILLA.

Fructus (*Semen*) *sabadillæ*, P. G.—*Cévadille*, Fr.; *Sabadillsamen*, *Läusekörner*, G.

The seed of Veratrum sabadilla, *Schlecht.*, s. Asagræa (Helonias, *Don*) officinalis, *Lindl.;* Sabadilla officinarum, *Brandt;* Schœnocaulon officinale, *Gray.* Bentley and Trimen, Med. Plants, 287.

Nat. Ord.—Melanthaceæ.

Origin.—The cevadilla is a bulbous plant with linear grass-like radical leaves, and a slender scape, bearing a narrow spike-like raceme, about 12 or 18 inches long, of greenish-yellow flowers of which the lower ones only are fertile. It is indigenous to the eastern section of Mexico, also to Guatemala and Venezuela. The plant growing in the latter country differs in some respects from the Mexican cevadilla, but no difference is observed in the seeds. The seeds alone are usually exported from Venezuela, and the ripe capsules from Mexico.

Description.—The fruit consists of three slightly-spreading, brownish, papery follicles which are about half an inch long, and are either empty or contain from two to six seeds each. These are from one-sixth to one-fourth of an inch long, narrow oblong or lance-linear, one side usually flattened and angular, the lower end rounded and the apex attenuate and rather beaked; the testa is rugosely wrinkled, somewhat shining, of a brownish-black color and incloses a whitish oily albumen and at the base a small linear embryo. The seeds are inodorous, and have a bitter and persistently acrid taste; the powder is sternutatory.

Constituents.—Pelletier and Caventou's analysis (1820) proved the presence of fat, wax, mucilage, and *veratria*, combined with an acid which was at first supposed to be gallic acid, but was shown by Pfaff to be a different compound; the fat is a mixture of liquid and solid fat, and contains a volatile fatty acid, *sabadillic* or *cevadic acid*, which has an odor similar to that of butyric acid, melts at 20° C. (68° F.), and at a higher heat sublimes in white pearly needles. *Veratria* was discovered by Meissner (1819), and though frequently examined by chemists, was known only in an amorphous condition, until Merck (1855) succeeded in preparing it in large colorless rhombic prisms, which on exposure become white, opaque and friable, and lose their shape in boiling water without melting or dissolving. The crystals are obtained by dissolving medicinal veratria in alcohol, adding water until a permanent precipitate begins to appear, and evaporating spontaneously; the residue will consist of crystals imbedded in a brown amorphous resin-like mass, which is removed by cold alcohol, after which the crystals may be purified by recrystallizing from strong alcohol. Weigelin (1871) ascertained that veratria exists in two distinct modifications, one of which is soluble in water, and by heating the solution is converted into the insoluble variety which has a resinous appearance. According to him, its composition is $C_{52}H_{86}N_2O_{15}$; Merck's formula was $C_{32}H_{52}N_2O_8$.

On treating medicinal veratria with ether, a residue is left, from which Couërbe (1834) isolated a second crystallizable alkaloid, *sabadillia*, for which Weigelin gives the formala $C_{41}H_{66}N_2O_{13}$. It is not sternutatory, and dissolves more or less freely in water, benzol, petroleum benzin, amylic alcohol, and chloroform; neutralizes the acids completely; but yields amorphous gum-like salts with sulphuric and hydrochloric acid, which are not precipitated by alkalies or their carbonates, and yield but slight precipitates with phospho-tungstic acid and potassio-cadmium iodide.

That portion of medicinal veratria which is soluble in ether yields to hot water, in which veratria is insoluble, a third alkaloid, which Weigelin named *sabatrina* and found to have the composition $C_{51}H_{86}N_2O_{17}$. It is likewise soluble in benzol, petroleum benzin, amylic alcohol, and chloroform, is amorphous, and yields amorphous salts, which are precipitated by hot potassium hydrate and carbonate if not added in excess.

The most recent investigation on the sabadilla alkaloids was made by C. R. A. Wright and A. P. Luff (1878), who were unable to find sabadillia. They regard sabatrina as an alteration product. They retain the name *veratria* for the amorphous alkaloid of medicinal veratria, and deny the existence of isomeric modifications; they give it the formula $C_{37}H_{53}NO_{11}$, and state that on saponification it splits up into veratric acid and a new base *verina* $C_{28}H_{45}NO_8$. Merck's crystallizable base is named by them *cevadina*, and is stated to have the composition $C_{32}H_{49}NO_9$, and, on saponification, to be resolved into a new base *cevina* $C_{27}H_{43}NO_8$, and the cevadic acid of Pelletier and Caventou, which is regarded as methyl-crotonic acid $C_5H_8O_2$.

Veratric acid, $C_9H_{10}O_4$, was discovered by Merck (1839); it crystallizes in needles or prisms which are soluble in alcohol and hot water, but insoluble in ether; is fusible and sublimable, and yields with the alkalies crystallizable salts which are soluble in alcohol and water.

Cevadilla yields about one-third per cent. of veratria and about one-sixtieth per cent. of veratric acid. The composition of the capsular integuments has not been ascertained. The seeds are used in pharmacy only for preparing veratria.

Medical Action and Uses.—The medicinal virtues of cevadilla are due to the veratria it contains, and will be found more particularly described in connection with that alkaloid. The seeds are poisonous to dogs and cats, causing vomiting and convulsions. Two children drank of a decoction of cevadilla(?), and presented the following symptoms: vomiting, insensibility, pallor, a small sharp pulse, heat of head and cool extremities, and spasms of the face and limbs; deglutition was impossible, the pupils were dilated and the eyes projecting and oscillating. Both patients recovered.

It was formerly employed to destroy body *lice* and other *vermin;* but sometimes, when applied to the sore head, it occasioned alarming symptoms. The tincture has been found a very efficient remedy for *scabies.* The powder has been used for the same purpose, mixed with oil and brandy and applied after the patient had taken a prolonged warm bath. Cevadilla has also been prescribed as a *vermifuge*, for tænia and rectal ascarides, and for various nervous affections; but it is seldom given internally.

SABBATIA, *U. S.*—SABBATIA.

American centaury, E.; *Centaurée américaine*, Fr.; *Sabbatie*, G.

The herb of Sabbatia (Chironia, *Lin.*) angularis, *Pursh.*

Nat. Ord.—Gentianaceæ.

Description.—The American centaury is a smooth, biennial herb, growing in dry fields and on hill-sides throughout the Middle and Southern United States. Its stem is about two feet high, quadrangular, winged, and much branched above; the leaves are about an inch long, oblong-ovate, five-nerved, entire, acute, and at the base clasping; the flowers are in terminal corymbose panicles; have a five or six-parted calyx, with lance-linear lobes; a wheel-shaped pale or purplish-red corolla, about an inch and a half wide; five or six finally recurved stamens; and produce an oblong-ovate, mucronate, many-seeded capsule. It blooms in July, and should then be collected. The herb is without odor, but has a persistent and purely bitter taste.

Allied Herbs.—Several other species of Sabbatia, having white, rose-colored, or purplish flowers, are indigenous to the United States, particularly in the Southern States, and appear to possess similar properties.

ERYTHRÆA (GENTIANA, *Lin.*) CENTAURIUM, *Pers.;* Herba centaurii, *P. G.;* European centaury, *E.;* Centaurée, *Fr.;* Tausendguldenkraut, *G.*—This species closely resembles the above, but has oval or obovate-oblong, obtuse, three or five-nerved nearly sessile leaves, and the parts of the flowers in fives. It is only ten or twelve inches high, and grows spontaneously in a few places in this country.

Constituents.—The plants contain the principles commonly found in herbs, but appear to be free from tannin, or nearly so; their bitter principles have not been obtained in a pure state. Méhu (1868) isolated *erythrocentaurin*, $C_{27}H_{24}O_8$, by agitating the syrupy alcoholic extract of European centaury with ether; it crystallizes readily, is inodorous, tasteless, neutral, dissolves in 1600 parts of cold water, 48 parts of alcohol, 13 of chloroform, and 245 parts of ether; light colors it red, but on recrystallization it is again obtained colorless. The yield is only $\frac{1}{30}$ per cent. Méhu obtained (1870) the same principle also from Erythræa chilensis, *Persoon*, and J. F. Huneker (1871) from American centaury.

Medical Action and Uses.—American centaury is a simple bitter, without special virtues. Its cold infusion is useful in debilitated states of the stomach, and its hot infusion as a diaphoretic in muscular *rheumatism*, *sorethroat*, and febrile attacks generally. The infusion may be made with an ounce of the plant to a pint of boiling water, and given hot in the *dose* of from four to six fluidounces, or cold in the *dose* of two fluidounces.

SABINA, *U. S.*—SAVINE.

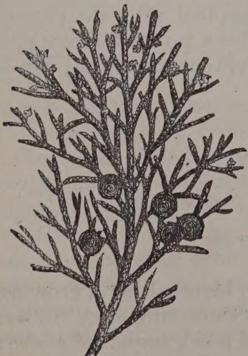
Sabinæ cacumina, Br.; *Summitates (Herba) sabinæ*, P. G.—*Savin tops*, E.; *Sabine*, Fr.; *Sadebaumspitzen*, *Sevenkraut*, G.

The tops of Juniperus sabina, *Lin.*, s. Sabina officinalis, *Garcke.* Bentley and Trimen, Med. Plants, 254.

Nat. Ord.—Coniferæ.

Origin.—Savin is a small evergreen, procumbent or erect shrub, which grows on rocky banks from Maine to Wisconsin, near the great Lakes, and further northward. It is distributed throughout a great portion of Europe and eastward to the Caspian Sea and Southern Siberia. Besides in size it is distinguished from red cedar (see page 781), which it closely resembles, by the larger fruit, which is nodding on the recurved peduncle-like branchlet. The young branchlets are collected for medicinal use.

Fig. 152.



Branch of savin.

Description.—As met with in commerce, savin is in small and thin subquadrangular pieces, consisting of tender twigs, which are densely covered with minute, scale-like, imbricate leaves, arranged alternately in opposite pairs. The leaves are rhomboid-lanceolate, rather obtuse, and closely appressed, and on the back have a shallow groove, containing a gland, which is mostly oblong in shape. Older leaves are more pointed and more or less spreading. Savin has a persistent, somewhat terebinthinate odor, which is stronger after bruising the branchlets; the taste is nauseous, resinous, and bitter.

Constituents.—Gardes (1837) found savin to contain tannin, resin, volatile oil (page 994), extractive, chlorophyll, etc.

Off. Prep.—Ceratum (Unguentum) sabinæ, *U. S.*, *Br.;* Extract. sabinæ fluid., *U. S.;* Tinctura sabinæ, *Br.*

Medical History.—In ancient times the virtues of savin were clearly recognized. Its stimulant action caused it to be employed for the treatment of ulcers and carbuncles, and as a remedy for alopecia; it was also used with honey for the removal of freckles; and it was well known that, internally, it was apt to cause bloody urine, and, when taken by pregnant females, miscarriage.

Physiological Action.—Given to dogs in powder it occasions severe pain, vomiting, bloody stools and urine, paralysis, spasms, and death; after which, evidences are found of gastro-intestinal inflammation, and the brain is congested. The oil of savin produces similar but more intense effects (see Ol. sabinæ). On man the action of savin itself is chiefly illustrated by cases in which it was taken for the purpose of producing abortion. Thus, an infusion caused incessant vomiting, abortion, excruciating pain, rupture of the gall-bladder, and death. Many cases are recorded of the fatal consequences of its use in large doses.

Medical Uses.—Savine has been used with unquestionable advantage in cases of *amenorrhœa* and *dysmenorrhœa*, depending upon a want of vigor in the uterine apparatus; and also for the cure of *menorrhagia*, depending upon a like condition. Several trustworthy physicians declare that, in such cases of uterine hemorrhage, one grain of powdered savine, repeated three times a day, and continued for weeks together, will overcome the tendency to the uterine loss. Under like conditions, *sterility* and *chlorosis* have been cured by this medicine. It had once a repute, not entirely undeserved, for its virtues in *chronic gout* and *rheumatism*, for which it was employed in infusion or in decoction, both internally and in a lotion for the affected joints. Savine has no doubt been found efficient as a *vermifuge*, but other anthelmintics are to be preferred as being less dangerous. In pregnancy, and whenever there is a tendency to congestion of any important organ, savine is contraindicated. Savine, in cerate, is used to excite or to prolong the secretion produced by blisters. In powder slightly moistened it is one of the most efficient remedies for *venereal warts*. It may be applied alone, or mixed with burnt alum or with subacetate of copper. It is also used, either in powder or in solution, to wither polypi, and may be applied with advantage to *condylomata*, and, as in ancient times, to stimulate indolent and unhealthy *ulcers*.

Fresh is much more active than dried savine. It may be administered in powder, in the *dose* of five or six grains repeated several times a day. It is most conveniently given in syrup or honey.

SACCHARUM, *U. S.*—SUGAR.

Saccharum purificatum, Br.—*Refined sugar*, *Cane-sugar*, E.; *Sucre*, *Sucre de canne*, Fr.; *Zucker*, *Rohrzucker*, G.

The refined sugar of Saccharum officinarum, *Lin.* Bentley and Trimen, Med. Plants, 298.

Nat. Ord.—Graminaceæ.

Origin.—The sugar-cane appears to have been indigenous to India and other parts of Southern and Eastern Asia, and has been cultivated from time immemorial. At present it is not known in the wild state; but it is raised in most tropical and subtropical countries, and in many of them for the production of sugar. It is a perennial, and produces a stem which is from eight to twelve feet high, one to two inches thick, cylindrical, jointed, and, with the exception of the flowering tops, which are hollow, filled with a juicy pith. The leaves are four to five feet long, two inches wide, and linear; and the flowering panicles large, pyramidal, and with spreading branches. Several varieties are known, differing chiefly in the color and hairiness of the stem. Saccharum chinense, *Roxb.*, having a slender, erect panicle, is probably a distinct species, and the one principally cultivated in China.

Cane-sugar is present in a large number of grasses, particularly in those having a rather thick stem, such as Sorghum saccharatum, *Pers.*, s. Holcus saccharatus, *Lin.*, Zea mays, *Lin.*, and others. It is also present in the juice of different species of maple, birch, palm, and other trees; and in many fleshy roots, prominent among which is a cultivated variety of Beta vulgaris, *Lin.*, or *sugar-beet*, which is largely employed in Europe in preparing sugar.

Preparation.—Recently collected sugar-cane yields by crushing and expressing about 80 per cent. of juice, which contains from 78 to 84 per cent. of water, 16 to 21 per cent. of sugar, 0.3 to 0.4 per cent. of mucilaginous, resinous, fatty, and albuminous matters, and nearly the same amount of salts. The juice is a grayish, turbid, sweet liquid, which is clarified by heating, a little lime being at the same time added for the purpose of neutralizing free acid; it is then concentrated by rapid evaporation in open pans, transferred to coolers where it is frequently stirred, and afterwards into casks perforated at the bottom and arranged in such a manner that the liquid portion may drain off and be collected in suitable tanks. The granular solid product thus obtained constitutes the *raw* or *muscovado sugar* of commerce; the liquid portion is known as *treacle* or *molasses*. Raw sugar is refined by dissolving it in water, the solution is heated with blood, the impurities are skimmed off, and the liquid is filtered through recently burned granular animal charcoal. The clear and colorless filtrate is concentrated in a vacuum pan, and, when of sufficient density, run off into conical moulds, the narrow orifice of which is closed by a plug. It solidifies as a dense crystalline mass, which is drained by the removal of the plug, and freed from the remaining colored mother-liquor by percolating through it a concentrated solution of pure sugar, after which it is dried and sent into commerce as *refined* or *loaf sugar*. By concentrating the mother-liquors they are made to yield more sugar of an inferior grade until finally a thick syrupy liquid is obtained, which refuses to crystallize, and is known as *sugar-house molasses*, and in England as treacle.

The method of obtaining sugar from the sugar-beet is very similar to that described, but is attended with greater difficulties, owing to the presence of larger quantities of proteids and other foreign constituents. Sugar-beets contain about 12 per cent., and yield about 9 per cent., of cane-sugar.

Properties.—Refined sugar is seen in commerce broken into small pieces or lumps, which have a granular crystalline texture and a pure white color. Somewhat inferior kinds of sugar having a yellowish tint are often artificially improved in appearance by adding, while crystallizing, a minute quantity of blue pigment, like ultramarine, with the view of neutralizing the objectionable tint and making the sugar appear whiter; such sugar will yield a yellowish solution with water, and, on standing, will gradually separate the pigment. Perfectly white sugar, known in commerce as *double refined*, is the only kind that should be used in pharmaceutical preparations. Sugar may be obtained in large transparent rhombic prisms, known as *rock-candy*, *saccharum candidum*, which does not differ from lump sugar except that this is in crystalline masses from disturbed crystallization. Sugar has the specific gravity 1.60, is permanent in the air, has a very sweet taste, and dissolves at ordinary temperatures in one-half its weight of water, yielding a dense, sweet, and colorless liquid known as syrup. At the boiling point, sugar dissolves in water almost in all proportions. It requires about 80 parts of boiling absolute alcohol for solution, and is almost completely deposited again on cooling. Of hot alcohol, specific gravity .830, about four parts are necessary for dissolving one part of sugar, most of which crystallizes on cooling. It is more freely soluble in weak alcohol, but is insoluble in ether and in chloroform. It combines with chloride of sodium, yielding deliquescent crystals which contain 14.9 per cent. of that salt. Definite compounds have likewise been obtained with several other salts and with alkalies and alkaline earths (see page 828). When triturated in the dark it becomes luminous. Its solution deviates polarized light to the right, a behavior which is of great practical importance for the estimation of sugar in aqueous liquids, and for distinguishing different kinds of sugar which have a different rotary power.

When sugar is heated to 160° C. (320° F.) it melts without losing in weight, and congeals on cooling to a transparent amorphous yellowish mass known as *barley sugar*, *saccharum hordeatum*, which becomes gradually opaque on the surface from the formation of minute crystals. If sugar is kept in the melted state for a short time, it is converted into *invert sugar*, which is a deliquescent mixture of *glucose* and *levulosan;* $2C_{12}H_{22}O_{11}$ yields $C_{12}H_{24}O_{12} + C_{12}H_{20}O_{10}$; the latter is not fermentable until after it has been boiled with water or dilute acids. When heated to between 180° and 200° C. (356° and 392° F.), sugar turns brown, evolves a peculiar odor, and is converted into *caramel*, $C_{12}H_{18}O_9$, parting at the same time with $2H_2O$; the pure product of this composition, *caramelan*, was obtained colorless by Gélis (1862). Caramel may be prepared in the same manner from inferior qualities of sugar, from molasses, and from glucose, and the conversion is hastened in the presence of small quantities of alkalies; the addition of a little carbonate of ammonium, which is again volatilized by the heat, is of service for the reason stated. Subjected to dry distillation, sugar yields aldehyd, aceton, acetic acid, tarry products, and carbonic acid, carbonic oxide, and marsh-gas. According to Lassaigne, iodine heated with solution of sugar is converted into hydriodic acid. Under the influence of ferments, cane sugar is first converted into glucose or an allied sugar before it undergoes alcoholic fermentation.

Other Sugars.—Carbohydrates having a sweet taste are frequently met with in plants and among the products of decomposition of those organic compounds forming the large class of *glucosides*. The sugar yielded by the latter is frequently, though not always, identical with the sugar met with in grapes and other fruits, and is nearly allied to, if not identical with, the sugar produced from starch. This is now very largely made for uses in the arts by boiling 100 parts of starch, 400 parts of water, and 5 or 6 parts of sulphuric acid for about thirty-six hours, or until starch can no longer be detected in the liquid; the free acid is then neutralized with chalk, the filtrate clarified and decolorized, if necessary, by treating it with clay and animal charcoal; and, finally, concentrated, preferably in a vacuum pan. The *grape-sugar* or *glucose* of commerce is prepared in this manner. It is usually in a white or whitish, irregularly granular powder or mass; from alcohol it may be obtained in compact, nodular groups of needles. It rotates polarized light to the right, though less than cane sugar, reduces the so-called noble metals, and acquires a dark color when heated with solutions of alkalies. It is less sweet than cane sugar, is directly fermentable, undergoes by heat alterations analogous to those of grape sugar, is insoluble in ether, dissolves in about 50 parts of alcohol, and requires little more than one part of cold water for solution; but after it has been rendered amorphous by heat, it dissolves in water in nearly all proportions.

Fruit Sugar frequently accompanies grape sugar in fruits, and has the same composition, but is a colorless, uncrystallizable syrup, has nearly the same sweetness as cane sugar, and turns the plane of polarized light to the left.

Composition.—Cane sugar or *saccharose* has the formula $C_{12}H_{22}O_{11}$, molecular weight 342, and yields, with nitric acid, when moderately heated, saccharic, racemic, and tartaric acids. Grape sugar, or *glucose*, when crystallized, has the formula $C_{12}H_{24}O_{12}.2H_2O$, molecular weight 396, and is oxidized by nitric acid to saccharic, tartaric, and oxalic acids. Fruit sugar, or *levulose*, has the composition $C_{12}H_{24}O_{12}$, molecular weight 360, and is by nitric acid converted into saccharic, racemic, and oxalic acids. *Chylariose* is the same sugar in honey.

Tests.—The purity of cane sugar is ascertained by the physical properties described above, and by its complete solubility in water and alcohol. The absence of glucose, or of a similar sugar, is ascertained by some of the reactions given below.

Moore's Test.—A solution of cane sugar, heated with three or four per cent. of potassa for a minute or two, remains colorless; glucose and milk sugar are colored brown.

Trommer's Test.—A solution of cane sugar, mixed with a little sulphate of copper and an excess of potassa or soda, retains its blue color on boiling, but turns bright red in the presence of glucose or milk sugar, red cuprous oxide being deposited. Glucose, and most allied sugars, effect the same reduction, though more slowly, in the cold.

Fehling's Test is a modification of the preceding, and may be used for the quantitative determination of glucose. The test liquid is prepared by dissolving 34.64 grams crystallized sulphate of copper in water, adding 200 grams of Rochelle salt, and 600 or 700 grams of soda solution, spec. grav. 1.12, and diluting the whole to one liter. Ten cubic centimeters of this solution are reduced by 0.05 gram of grape sugar.

Pettenkofer's Test.—Bile in the presence of sugar (of other carbohydrates and of proteids) acquires a blood-red color with concentrated sulphuric acid.

Boettger's Test.—A little subnitrate of bismuth, boiled with solution of glucose, rendered alkaline by sodium carbonate, acquires a gray or black color; pure cane sugar produces no alteration.

O. Schmidt's Test.—Acetate of lead, added to a saccharine liquid, is precipitated white by excess of ammonia; on heating the mixture it remains unchanged if cane sugar is present, but turns orange-red with glucose.

Many other tests have been proposed; the above are quite available, and give good results. Tannin and similar compounds which are likely to interfere are previously removed either by solvents or precipitants. By boiling with dilute acids, cane sugar is converted into glucose.

Off. Prep.—Sugar is a constituent of confections, syrups, and troches; also of Ferri carbonas sacch.; Liqu. calcis sacch., *Br.;* Mistura ferri carbon. (comp.), *U. S.*, *Br.;* Pil. ferri carb., *U. S.;* Pil. ferri iodidi, *U. S.*, *Br.;* Pulv. amygdalæ comp.; Pulv. cretæ comp.; Pulv. glycyrrhizæ comp.; Pulv. tragacanthæ comp., *Br.*

History.—Cane sugar has been manufactured in Asia from the most remote antiquity. "Thou hast bought me no sweet cane with money" (Isaiah xliii. 24), in the eighth century before Christ, seems to be an allusion to the sugar cane. In the fourth century before our era, Theophrastus wrote of a sort of "honey" procured from canes or seeds. In the first century several writers allude to it, and describe its origin as oriental; but for more than a thousand years it remained unknown in Europe, when it was introduced by the Arabians, along with the arts and sciences of which they were the surviving depositaries. From the Mediterranean countries it was transplanted to the new world, which was destined to return the gift with interest; but it is only within the last two or three hundred years that its use became general as an article of food.

The medicinal virtues of sugar were alleged by the ancients to be that it is laxative and cleansing to inflamed and ulcerated surfaces, and less apt than honey to excite thirst. When, in course of time, it came into general use, it was accused of impairing the digestion, producing biliousness, promoting the generation of intestinal worms, and causing caries of the teeth, opinions every one of which is popular at the present day. Sugar is generally regarded as nutritious food, contributing directly to the growth of the tissues, and especially to the formation of fat. But a more thorough experimental investigation of the subject has shown that sugar cannot be regarded as nutritious. On the contrary, an excessive consumption of it leads to wasting of the tissues and a scorbutic condition. Its real value as an article of food appears to be that it diminishes tissue waste; that in so far, therefore, it resembles alcohol in its mode of action.

Medical Uses.—Sugar is of comparatively little value for its independent effects, but few substances are more useful as an associate of other medicines, whether to preserve them from oxidation and decomposition, to conceal or improve their taste, or to give them special pharmaceutical forms.

In solution sugar is almost exclusively lenitive, but in powder it is stimulant. It is universally employed to diminish dryness of the mouth and fauces, to allay irritation, and to mitigate *cough* and *hoarseness*. Sugared water is said to have a diuretic effect. It certainly, when moderately used, promotes digestion, and allays nervous excitement. It enters into all the drinks, mucilaginous, farinaceous, and gelatinous, employed in febrile diseases. Finely powdered sugar will sometimes relieve the *hiccup* which in nursing infants is apt to arise from over-feeding. Loaf-sugar, eaten freely, is said to arrest the development of *alcoholic intoxication*, perhaps by retarding gastric absorption. A strong solution of sugar injected into the rectum has been used successfully to destroy *ascarides* of that part. In powder it is very efficient as a remedy for *aphthæ* of the mouth, in repressing the exuberant granulations of *ulcers;* in removing opacities of the *cornea;* and in curing granular *eyelids*. In *chronic laryngitis*, when inhaled by a sudden aspiration from a tube extending to the root of the tongue, it may be used with advantage alone, or mixed with other powders. In the same manner it may be employed as a snuff in chronic *ozæna*. The fumes from burnt sugar destroy *offensive effluvia*, and are conveniently disengaged by sprinkling sugar upon burning coals or on a hot shovel. The culinary and medicinal uses of beet sugar are the same as those of cane sugar, but in sweetness it is inferior.

SACCHARUM LACTIS, *U. S.*, *Br.*—SUGAR OF MILK.

Lactin, *Milk sugar*, E.; *Sucre de lait*, Fr.; *Milchzucker*, G.

A crystalline substance obtained from whey.

Preparation.—Milk sugar is one of the constituents of the milk of mammals, and appears to be present in larger proportion in the milk of herbivorous animals than in that of the carnivoræ. To obtain it the butter and casein are first removed, and the whey (see p. 789) is concentrated, and the liquid permitted to crystallize in large tanks, the crystallization being facilitated by the introduction of thin sticks or cords. It is chiefly prepared in Switzerland.

Properties.—Sugar of milk is usually met with in commerce in cylindrical pieces, composed of numerous crystals aggregated around an axis of stick or cord. It crystallizes in hard, white or translucent four-sided prisms; has a sandy and slightly sweet taste, dissolves in 6 parts of cold and 2½ parts of boiling water, and is insoluble in alcohol and ether. Its aqueous solution rotates the plane of polarized light to the right, and reduces alkaline solutions of copper, but in a less degree than glucose. It does not readily undergo vinous fermentation until after it has been boiled with diluted sulphuric acid, which converts it into *lactose*, $C_{12}H_{24}O_{12}$, and glucose. In the presence of casein it is converted into *lactic acid*, alcohol being formed at the same time, but in small quantity only if the free acid is neutralized as fast as it is produced. Heat converts it first into caramel, and afterwards into products similar to those obtained on the dry distillation of sugar. By boiling with dilute nitric acid it is converted into mucic, saccharic, tartaric, racemic, and finally into oxalic acid. Its hardness renders it serviceable for reducing other substances to a fine powder.

Composition.—In the crystallized state its formula is $C_{12}H_{24}O_{12}$, molecular weight 360; heated to 140° C. (284° F.) it is $C_{12}H_{22}O_{11}$.

Off. Prep.—Pulvis elaterii comp., *U. S.*

Medical Action and Uses.—Sugar of milk is far less sweet than cane or beet sugar, and is thought to be less apt to ferment in the stomach and bowels. It is chiefly used as a vehicle for small doses of pulverulent medicines.

SAGO, *U. S.*—SAGO.

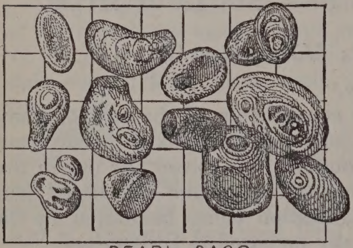
Sagou, Fr.; *Sago*, G.

The prepared fecula of the pith of Metroxylon sagus, *König* (s. Sagus Rumphii, *Willd.*), Metrox. lævis, *Kön.* (s. Sagus lævis, *Rumph.*), Sagus farinifera, *Lamarck*, Arenga saccharifera, *Labill.* (s. Saguerus Rumphii, *Roxb.*), and of other palms. Bentley and Trimen, Med. Plants, 277.

Nat. Ord.—Palmæ.

Origin and Preparation.—The sago palms inhabit the East India islands, and are cultivated there and in Further India. They are mostly trees of medium height, but with a thick stem, containing a large amount of parenchyma tissue, the cells of which are filled with starch. When of sufficient size, the tree is cut down, split lengthwise, and the pith removed, powdered, and washed with water to obtain the starch free from woody tissue and other impurities. This *sago meal* is then made with water into a kind of paste, which is granulated by passing it through a sieve, the globular pieces dropping into a shallow pot suspended over a fire, where they are dried with constant stirring. While flowering, the Arenga furnishes a juice rich in sugar.

Fig. 153.



Description.—Sago is occasionally seen in the form of whitish glistening powder or irregular grains, varying somewhat in tint, and being distinguished as *white* and *brown sago*. More frequently it is seen as *pearl sago*, in the form of globular grains, pearl-like in appearance, with a smooth surface, and occasionally two or three grains adhering together. From the heat employed in its preparation, it is somewhat diaphanous, and when examined under the microscope, some of the starch granules are seen to be distended and partly ruptured. Sago starch consists of irregularly ovate, oval, or elliptical grains, often with a roughish surface; the hilum is located near one end, and is naturally small and circular, but in sago is often slit in one or more directions from the effect of heat. The end opposite the hilum is always more or less truncate or flat and muller-shaped. *Factitious sago*, which is made in Europe of potato starch, is best recognized by means of the microscope. (See page 883.)

Composition.—Sago has the same composition as other starches, $C_6H_{10}O_5$, and yields the same products of decomposition.

Medical Action and Uses.—Sago is demulcent and nutritious, and forms an excellent food for the sick, when the digestive organs are feeble, or fever contraindicates the use of a stimulant diet. It is more generally acceptable to the palate than arrowroot or tapioca, and is more digestible than rice.

SALEP.—Salep.

Tubera (Radix) salep, P. G.—*Salep*, Fr., G.

The tubers of different species of Orchis. *Nat. Ord.*—Orchidaceæ.

Origin and Preparation.—The plants belonging to the genus Orchis are small herbs, usually with a stem between six and eighteen inches high, with showy, mostly pink, red, or purple-colored ringent flowers, having the lip turned downward, and bearing a nectariferous spur underneath; and with parallel-veined sheathing leaves, those of the stem often reduced to bracts. The subterraneous portion usually consists of two fleshy more or less ovate or palmately lobed tubers, the smaller of which originates from the axil of a radical leaf, and produces the flowering stem during the following year. These tubers furnish the salep. They are collected, scalded in water, and rapidly dried, and thereby lose their white opaque appearance, as well as their unpleasant odor and bitter taste. Salep was formerly procured in Persia and other Oriental countries, but at the present time it is prepared in various parts of Southern and Central Europe.

Description.—Oriental salep is an inch and over long, European salep is always smaller. Salep is ovate or oblong in shape, somewhat flattened or wrinkled, of a pale brownish-yellow color, somewhat translucent, of a horny texture, hard, inodorous, and of an insipid, very mucilaginous taste. It is generally kept in the form of powder, which has a yellowish color. The tubers of Orchis mascula, *Lin.*, O. morio, *Lin.*, O. militaris, *Lin.*, O. palustris, *Jacq.*, O. ustulata, *Lin.*, O. galeata, *Lam.*, and of other species are undivided, while those of O. latifolia, *Lin.*, O. maculata, *Lin.*, O. sambucina, *Lin.*, and others are palmately divided; the latter kind were formerly known in European pharmacy as *radix palmæ Christi*.

Constituents.—Raspail found the old tuber collected in autumn to be free from starch, while the young tuber contained then large quantities of it. Dragendorff (1865) obtained from 100 parts of salep: *starch* 27.3, *mucilaginous constituents* 48.1, *sugar* 1.2, *proteids* 4.9, and cellulose 2.4 parts; the mucilage is not extracted by cold water. Salep yields 2.1 per cent. of ash.

Adulterations and Substitutions.—The scalded tuber of colchicum resembles salep in appearance, but has a more globular shape, a broad groove on one side, and a sweetish, afterwards bitter and acrid taste. An adulteration of powdered salep with starch is best detected by the microscope, which reveals the shape of the foreign starch granules; owing to the manner of its preparation, salep has its starch converted into a pasty mass. One part of powdered salep should yield, with 50 parts of boiling water, a jelly-like mass after cooling, and with 100 parts a thick turbid mucilage.

Mucilago Salep, *P. G.*, is prepared by shaking in a vial one part of powdered salep with 10 parts of cold water until it is uniformly diffused, when 90 parts of boiling water are added, and the whole well agitated.

Medical Action and Uses.—Salep was, even in ancient times, regarded as very nutritious, and as a demulcent it was used in medicine. It tends to confine rather than relax the bowels, and hence is a very useful article of diet for infants and children affected with *diarrhœa* or *summer complaint*, and for adults suffering from tuberculous and other forms of chronic diarrhœa. The mucilage is prepared by first macerating powdered salep in cold water, and gradually adding boiling water with stirring, in the proportion of five grains of salep to the ounce. Instead of water, milk or some animal broth may be used. Salep jelly may be made as follows: Rub sixty grains of salep with water in a mortar until it has swollen to four times its original bulk, then add gradually, and with constant stirring, sixteen ounces of boiling water, and boil down to eight ounces.

SALIX, *U. S.*—WILLOW.

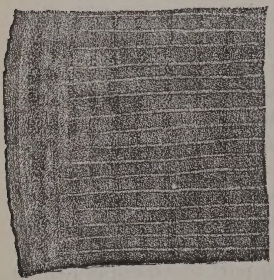
Willow bark, E.; *Écorce de saule*, Fr.; *Weidenrinde*, G.

The bark of Salix alba, *Lin.* Bentley and Trimen, Med. Plants, 234.
Nat. Ord.—Salicaceæ.

Origin.—The willows form a large genus, which is mostly confined to the northern temperate zone, and with some species extends into the arctic regions. They are either trees or shrubs, with flexible branches, and have alternate, short petioled, and mostly more or less lanceolate, entire or finely serrate leaves, with small or conspicuous stipules. The flowers are diœcious, in cylindrical catkins, each bract being one-flowered and without other floral envelopes. The fruit is a one-celled and two-valved capsule, and contains numerous minute seeds, which are furnished with a silky down. Most of the species are exceedingly variable in some of their characters, and all grow in moist localities, along streams, etc. The species recognized by the Pharmacopœia is common in Europe, and is frequently cultivated, and has been to some extent naturalized, in North America. It grows to the height of sixty or eighty feet, and belongs to the group of *crack willows*, which are characterized by having their branchlets brittle at the base. Salix fragilis, *Lin.*, resembles this species. Salix purpurea, *Lin.*, is mostly shrubby, with olive-green, brownish, or purplish bark, and has the branches not brittle at the base. The bark is collected from the branches in spring, when it is easily removed from the wood.

Description.—Willow bark is met with in fragments or in quills. It varies in thickness between one-thirtieth and one-tenth inch, is externally smooth or little wrinkled, varies in color between gray, brownish, and brown-yellow, is shining, when young has a somewhat metallic lustre, and is furnished with some roundish, small, suberous warts. The inner surface is smooth, pale-brownish or cinnamon-colored. The bark may be readily torn in a longitudinal direction, but breaks transversely with some difficulty. Under the thin corky layer it has a green color, and the inner bast layer is striate by very fine medullary rays, and is arranged in tangential rows, and may be separated in thin shreds. The dry bark is nearly inodorous, and has a bitter and astringent taste.

Fig. 154.



Willow bark. Transverse section magnified 15 diameters.

Constituents.—The bark of a large number of willows has been examined by different chemists, with the result that *salicin* has been obtained from all. The same principle has also been obtained from the leaves and flowers of willows, and the bark and leaves of different species of *Populus*. The other constituents of willow bark are wax, fat, gum, and tannin, yielding a green reaction with ferric salts. The crack willows appear to contain more tannin, and the purple willows more salicin.

Salicin, $C_{13}H_{18}O_7$, was discovered by Leroux (1830), but was for a number of years regarded as an alkaloid or as a vegetable salt. It is prepared by boiling willow bark with water, digesting the decoction with levigated litharge until colorless, filtering and evaporating to crystallization. It forms white shining scales or needles, of a persistently bitter taste, and is very freely soluble in hot water and in alcohol, but is insoluble in ether. It has a neutral reaction to test-paper, is permanent in the air, melts at 198° C. (389.4° F.) without sustaining loss in weight, and at a higher heat is decomposed, yielding, among other products, *salicylous acid*. Sulphuric acid imparts a blood-red color to salicin, and yields various products of decomposition. Salicin is a glucoside, which, on being digested with emulsin or saliva, or heated to 80° C. (128° F.) with dilute sulphuric acid, assimilates one molecule of water and is split into glucose and *saligenin*, $C_7H_8O_2$, which crystallizes in pearly tables, is easily soluble in hot water, alcohol, and ether, melts at 82° C. (179.6° F.), and sublimes at 100° C. (212° F.). Saligenin is characterized by yielding in solution a deep blue color with ferric chloride, and when boiled with dilute acids, by being converted into a resinous body, *saliretin*, $C_{14}H_{14}O_3$, while oxidizing agents convert it into salicylous and salicylic acids. Cold nitric acid of specific gravity 1.16 oxidizes salicin with the production of *helicin*, $C_{13}H_{16}O_7$, which crystallizes in white needles, and is by ferments and dilute acids resolved into sugar and salicylic aldehyd. If nitric acid of specific gravity 1.09 is employed, salicin yields *helicoidin*, $C_{26}H_{34}O_{14}$, which may be regarded as a compound of salicin and helicin. These interesting reactions have been chiefly investigated by Piria (1837, etc.).

The bark and leaves of different species of *Populus* contain *populin* or *benzoyl salicin*, $C_{20}H_{22}O_8$, which crystallizes in white needles of a sweet and somewhat acrid taste, and yields, under the influence of dilute acids, benzoic acid and decomposition products of salicin.

Physiological Action.—Willow bark was anciently employed in medicine as an astringent. Its active principle, salicin, does not, like quinia, exert any marked influence in preventing or retarding putrefaction or fermentation. Injected under the skin of rabbits to the extent of thirty grains, it caused no toxical phenomena. Although it is related that some very sensitive persons, after repeated doses of three or four grains, complained of dimness of sight and flashes before the eyes, yet in others, when several ounces were taken in the course of three weeks, no disorders were occasioned except ocular scintillations and ringing in the ears. In one instance about two hundred and fifty grains were administered within two days without any sensible effects.

Medical Uses.—Like simple bitters, willow bark appears to increase the appetite and improve the digestion; but if its use is long continued, it confines the bowels. It has been used in cases of *dyspepsia* and of general *debility*, and to lessen excessive discharges from mucous membranes. It has had some repute as a *vermifuge*, and its powder has been applied as a dressing for unhealthy and gangrenous *ulcers*. Before being introduced into medicine willow bark had been a popular domestic febrifuge. It was first recommended for the treatment of *intermittent fever*, by Stone of London, in 1763, and was reported to be efficient by many others, down to the discovery of salicin, in 1825, after which the latter was alleged by a great many observers to be a valuable substitute for quinia. But these reports were counterbalanced by others, which appeared to show that salicin was quite powerless in periodical fevers. In neither case was the natural tendency to cure of these affections sufficiently considered. In the absence of quinia salicin might be employed in mild cases of intermittent fever.

Powdered willow bark may be given in *doses* of from twenty to sixty grains three times a day, as a tonic; as an antiperiodic at least an ounce must be taken during an intermission. A decoction or infusion may be made with an ounce of the bruised bark to a pint of water. The dose of salicin as an antiperiodic is usually stated as five grains; but from the preceding account such doses must manifestly be inoperative. Not less than twenty grains repeated three or four times during an intermission should be regarded as sufficient.

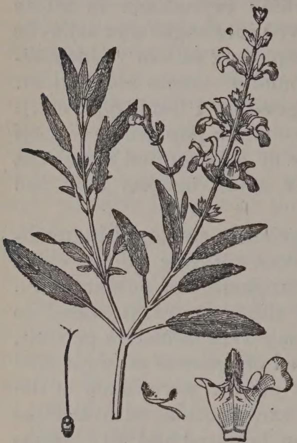
SALVIA, *U. S.*—SAGE.

Folia (Herba) salviæ, P. G.—*Sauge officinale*, Fr.; *Salbeiblätter*, G.

The leaves of Salvia officinalis, *Lin.* *Nat. Ord.*—Labiatæ, Monardeæ.

Origin and Description.—Sage is a suffruticose perennial, indigenous to Southern Europe, and extensively cultivated in France and Germany, and in gardens in the United States. The stem is one or two feet high, woody at the base, much branched, quadrangular, and whitish pubescent above. The leaves are opposite, petiolate, two or three inches long, ovate- or lance-oblong, finely crenulate on the margin, wrinkled, grayish-green, and beneath soft hairy. The lower leaves are sometimes auriculate at the base, the upper ones smaller and nearly sessile. The flowers are in small cymes in the axils of the upper leaves or bracts, have a tubular, bell-shaped, bilabiate, brownish, pubescent calyx, with mucronate divisions, and a violet-blue, bilabiate corolla, with a short tube, a depressed, helmet-shaped upper lip, a three-lobed, spreading lower lip, and two stamens. All parts of the plant are more or less glandular, and have a peculiar, strong, aromatic odor, and a warm, bitterish, and somewhat astringent taste.

Fig. 155.



Salvia officinalis, *Lin.*

Constituents.—The most important constituent is volatile oil, of which the fresh herb yields one-sixth to one-fourth per cent., and, when recently dried, about three times this quantity. *Oil of sage* is of a greenish or yellowish color, has the density 0.86 to 0.93, commences to boil at 130° C. (266° F.), and is very freely soluble in 80 per cent. alcohol. P. Muir (1876) found the portion boiling between 156° and 158° C. (312.8° and 316.4° F.) to be a terpene $C_{10}H_{16}$, which yielded cymene under the influence of sulphuric acid, and terephtalic acid when treated with sulphuric acid and acid chromate of potassium. The portion having the boiling point 10° C. (18° F.) higher yielded identical products, and in the neighborhood of 200° C. (392° F.) an oxygenated portion was obtained, which Muir designated *salviol.* A stearopten was obtained, which melts at 187° C. (368.6° F.), and closely resembles ordinary camphor. The other constituents are of no medicinal importance, and are those commonly found in plants; Hirsch did not succeed in obtaining tannin.

Off. Prep.—Infusum salviæ, *U. S.*

Allied Species.—Most species of Salvia are aromatic and bitter. Salvia pratensis, *Lin.*, and S. sclarea, *Lin.*, are used in Southern Europe; S. lyrata, *Lin.*, is common in North America, but only slightly aromatic.

Medical Action and Uses.—Sage is an ancient medicine. From the time of Hippocrates, when it was reputed to be desiccant and astringent, it was used in chronic pulmonary complaints and uterine derangements, and as a dressing for wounds and sores. Later on it was regarded as emmenagogue, and used to arrest hæmoptysis, and as a gargle for sore throat.

Sage is stimulant, tonic, and astringent. Pidoux states that, having caught cold during the month of July, an infusion of half an ounce of sage caused him to sweat copiously for several hours. Such effects are likely to be produced by a hot infusion of any stimulant. It is certain that a cold infusion of sage has in all ages been employed to moderate excessive sweats depending upon debility alone. A vinous infusion is to be preferred for this purpose. It is less serviceable in the colliquative *sweats* of phthisis, accompanied by hectic fever; yet even in them it adds to the power of aromatic sulphuric acid when used as a vehicle for the latter. A strong infusion of sage has been employed successfully to hasten the drying up of the *milk* at weaning time. Sage tea, or an infusion of sage in red wine, is a popular and efficient remedy for aphthous and other *ulcers* of the mouth, and for all forms of *sore throat;* it is best used as a wash or gargle when sweetened with honey. Its power is increased by the addition of vinegar, alum, or chlorate of potassium (see Infusum salviæ). Externally, similar applications are of great use in healing *ulcers* and the raw surfaces occurring in *intertrigo*, etc. The aromatic wine of the French Codex, and which is so largely used for such purposes, contains sage. Sage is much used as a seasoning for gross and fat meats, such as pork and goose. It is seldom prescribed internally, unless in an infusion, which is officinal.

SAMBUCUS, *U. S.*—ELDER.

Sambuci flores, Br.—*Elder-flowers*, E.; *Fleurs de sureau*, Fr.; *Fliederblumen*, *Hollunderblüthen*, G.

The flowers of Sambucus canadensis, *Lin.* Bentley and Trimen, Med. Plants, 138.

Nat. Ord.—Caprifoliaceæ.

Origin.—The American elder is suffruticose, attaining a height of eight or ten feet, and grows in moist thickets and on the banks of streams throughout a great portion of North America. It has opposite, mostly smooth *leaves*, with from seven to eleven short-stalked, oblong, pointed, serrate leaflets, the lower pair of which is frequently three-parted; and juicy, purplish-black, drupaceous *fruits*, containing three one-seeded hard nutlets, and having an acidulous and sweetish taste. The bark, leaves, flowers, and fruit are sometimes medicinally employed, but only the flowers are recognized as officinal.

Description.—The flowers are in large, level-topped cymes, which terminate the small branches, and are five-branched below and forked above. The marginal flowers are occasionally radiate; all have a superior calyx, with five minute teeth, a wheel-shaped, cream-colored or whitish corolla, with a short tube, and a spreading, five-lobed limb, and five stamens which are inserted between the obtuse corolla lobes. The flowers appear in June, and have in their fresh state a peculiar, rather disagreeable odor, which becomes more pleasant and sweetish on drying. They are collected when in full bloom, and rapidly dried to prevent them from turning black; the corollas fall off very readily, and are separated from the stalks by shaking. Well dried elder flowers are of a pale brownish-yellow color, and have a sweetish, somewhat aromatic, and mucilaginous taste. The constituents of this drug appear to be closely allied to those of the European elder.

SAMBUCUS NIGRA, *Lin.*, extends throughout the greater portion of Europe, Southern Siberia, and Northern Africa. It is a shrub or small tree, has the leaflets ovate-oblong and acute, and the flowers in smaller compound cymes than the preceding; otherwise the two species resemble each other very closely.

Constituents.—European elder flowers contain as their most important principle a volatile oil which, according to the investigations of Eliason, Pagenstecher, and others, is yellowish and limpid, but mostly of a butyraceous consistence, of a strong odor, and of a warm, bitterish, afterward cooling taste. The recently dried flowers yield only one-third to one-half per cent. of it, if the distilled water is extracted with ether. The remaining constituents of the flowers are acrid resin, a little tannin, mucilage, albumen, and other common vegetable principles; among the salts are malates of potassium and calcium. Scheele found in the berries mucilage, sugar, and malic acid; and Kraemer (1846) obtained from the bark *viburnic acid*, which is identical with *valerianic acid*. The constituents of American elder are probably very similar.

Allied Species.—SAMBUCUS EBULUS, *Lin.* All parts of this European species have a strong, disagreeable odor, and a bitterish, somewhat acrid taste. At present the four-seeded fruit, which resembles elder-berries, but has a more disagreeable taste, is occasionally employed. The plant is known as dwarf-elder, *E.*; yèble or hièble, *Fr.*; and Attich, *G.*

Off. Prep.—Aqua sambuci, *Br.*

Medical Action and Uses.—Elder-berries (S. nigra) are cooling, aperient, and diuretic, and when their juice is fermented it forms a wine which is much used in England as a domestic cordial. The flowers of S. europœa are said to be poisonous to peacocks, and the berries to hens.

The ancients considered elder-bark and leaves as purgative and diuretic, and several centuries ago the leaves, bark, and seeds were much used in dropsy, and the flowers for fomentations, as they continue to be at the present time. From the flowers a water is distilled which is employed as a perfume, and an ointment is prepared with them for the treatment of *burns* and *excoriations*. The young leaf-buds are said to be a drastic cathartic, but the fresh inner bark is more efficacious. The juice of the root of S. nigra has been found to act as a hydragogue cathartic in the dose of one or two ounces, taken fasting. This dose excites copious salivation, followed by vomiting without excessive straining; later, watery stools occur, and continue for eight or ten hours. In this country similar effects have followed the use of the native elder bark (S. canadensis) infused in hard cider. The expressed juice of the root may be given in the *dose* of two fluidounces every two hours, until its specific operation begins. A decoction is made by boiling an ounce of the inner bark in two pints of water until reduced to a pint; of this four fluidounces may be given at a dose.

SANGUINARIA, *U. S.*—Bloodroot.

Puccoon, Tetterwort, Indian paint, E.; *Sanguinaire*, Fr.; *Blutwurzel*, G.

The rhizome of Sanguinaria canadensis, *Lin.* Bentley and Trimen, Med. Plants, 20.

Nat. Ord.—Papaveraceæ.

Origin.—Bloodroot is a native of Canada and the United States, where it grows in open woods on a rich soil. In early spring the rhizome sends up one or two leaves and a slender scape about four or six inches high, bearing a single large white flower. The leaves do not attain their full size until after the petals have been shed in April or May, and are then about three inches long and four or five inches wide, heart-shaped at the base, reniform in outline, palmately seven- or nine-veined, and divided into the same number of obtuse lobes; the upper surface is of a light green, the lower surface glaucous, whitish, and the veins often reddish. The calyx consists of two fugacious sepals, and the corolla of about eight oblong and obtuse petals; the stamens are in several rows, and the fruit, which ripens in June, is an oblong two-valved capsule, tapering at each end, and containing numerous roundish seeds with a strongly crested raphe. All parts of the plant contain a bright orange-red juice, but only the rhizome is employed.

Description.—The rhizome is two to four inches long and about one-half inch thick, horizontal, slightly branched, cylindrical, and faintly annulate by leaf-scars. In the fresh state it is fleshy, and emits, when wounded, a dark-red juice; after drying it is reddish-brown externally, longitudinally wrinkled, and breaks with a short fracture of a slight waxy appearance. Transverse section shows a thin bark, which is in width about one-twelfth the diameter of the rhizome, a very fine cambium line, and a white mealy inner portion, in which the fibro-vascular bundles are not readily seen, and which contains a large number of small red resin-cells; the interior tissue is not unfrequently of a nearly uniform brownish-red color, due probably to the manner in which the drug was dried. The thin rootlets are mainly on the lower side, and in commercial bloodroot are mostly broken off, short remnants or scars only remaining. Bloodroot yields a pale grayish-red powder, and has a slight heavy odor and a persistently bitter and acrid taste.

Constituents.—Dr. Dana (1828) obtained from bloodroot the alkaloid *sanguinarina*, which Probst considered identical with the alkaloid chelerythrina discovered by him (1838) in celandine (see page 385). The identity of the two was conclusively proven by Shiel (1855). Riegel (1845), and afterwards Gibb (1860), isolated a second alkaloid, which they named *porphyroxin*, from its supposed identity with a constituent of opium formerly known by that name (see page 1013). It was obtained by exhausting the rhizome with dilute acetic acid, precipitating the sanguinarina with ammonia, neutralizing the filtrate with acetic acid, and precipitating with tannin; on decomposing the precipitate with either lime or potassa, and exhausting with ether, white tasteless crystals are stated to be obtained, which yield with acids bitter and neutral salts. In 1856, E. S. Wayne announced the discovery of a third alkaloid, named *puccina* by Gibb. It was said to remain dissolved in ether after precipitating the ethereal solution of crude sanguinarina with sulphuric acid. L. C. Hopp (1875) proved it to be sanguinarina held in solution as sulphate by a trace of resin; he also found *sanguinarinic acid* of Newbold (1866) to be a mixture of impure citric and malic acids.

Sanguinarina, $C_{19}H_{17}NO_4$, is obtained from the syrupy alcoholic extract of sanguinaria, by digesting it with dilute hydrochloric acid, filtering from the resin, precipitating by ammonia, dissolving the crude alkaloid in ether, and passing hydrochloric acid gas into the solution, when hydrochlorate of sanguinarina is precipitated. The pure alkaloid is in white verrucose or needle-shaped crystals, which are sternutatory, freely soluble in ether and alcohol, and yield with acids bright red salts, having a bitter and persistently acrid taste, like the alcoholic solution of the alkaloid.

The red color of bloodroot is not solely due to salts of sanguinarina; in preparing the alkaloid, much resinous matter is left, having a dark-red color.

Off. Prep.—Acetum sanguinariæ, Tinctura sanguinariæ, *U. S.*

Physiological Action.—In non-nauseating doses it increases the appetite and improves digestion; in larger doses it nauseates and slows the pulse; and in excessive quantities it sometimes excites vomiting, but more usually a sense of burning in the stomach, faintness, vertigo, impaired vision, general insensibility, coldness, extreme reduction of the force and frequency of the pulse, with irregularity and palpitation of the heart, great prostration of muscular strength, and sometimes a convulsive rigidity of the limbs. Fatal poisoning has resulted from an over-dose of this medicine. The foregoing effects have been essentially reproduced in experiments upon animals by Dr. Robert Meade Smith (Inaugural Thesis, University of Pennsylvania, 1876), who concludes that sanguinarina, with which he experimented, affects, and directly depresses, the functions of the spinal cord, of the cardiac nerves, and of the heart itself. In man, sanguinarina, in doses of from one-sixth to one-fourth of a grain continued for several days, occasions nausea and sometimes vomiting, and a manifest reduction of the pulse-rate. One grain, in solution, repeated at intervals of ten minutes, may excite vomiting after the third dose.

Medical Uses.—The physiological action of sanguinaria bears no relation to its medicinal uses. In all cases in which the former is developed, the depressing operation of the medicine is distressing and unsafe. Its only value is demonstrated, if at all, by its long-continued use in moderate doses, so as to produce its so-called deobstruent, or alterative, effects. These are supposed to be exhibited when it is used in the treatment of *atonic dyspepsia* with "torpor of the liver;" but in such cases the cure is probably due, in a greater degree, to the simultaneous regulation of the diet, etc., and abstinence from active medication. Possibly in protracted muscular rheumatism the medicine may deserve a trial. It has been used in *bronchitis*, *croup*, and *asthma*.

Powdered dry bloodroot has been employed as a *sternutatory* and as a stimulant to indolent and unhealthy *ulcers*. The latter effect probably led to its being used by quacks in the treatment of *cancer*. The fresh juice of the root is said to cure *warts*, and an infusion or decoction of the root has been applied to chronic *scaly* and *pustular eruptions*.

The *dose* of sanguinaria as an emetic is from ten to sixty grains. An infusion made with an ounce of the bruised root in half a pint of boiling water may be given in tablespoonful doses at short intervals. The tincture, which is officinal, represents the medicine fully.

SANGUIS.—Blood.

Sang, Fr.; *Blut*, G.

Description and Composition.—Blood is an animal fluid which passes to all organs through the circulation. In the inferior animals it is of a white color, while in the vertebrated animals it is red; and the red color is brighter in blood taken from the arteries than in that contained in the veins. Blood is not a simple solution of different compounds, but it is a kind of emulsion containing chiefly blood-corpuscles in suspension. According to Lehmann, 1000 parts of corpuscles contain 688 water, 16.75 hæmatin, 282.22 globulin, 2.31 fat, 2.60 extractive matter, and 8.12 mineral constituents, among which potassium salts predominate. 1000 parts of the liquid portion of blood contain 902.90 parts of water, 4.05 fibrin, 78.84 albumen, 1.72 fat, 3.92 extractive matter, and 8.55 mineral constituents, among which chloride of sodium predominates. The saline constituents both of the corpuscles and liquid are, besides iron, phosphates of calcium and magnesium, and chlorides, phosphates, and sulphates of potassium and sodium. The composition of blood varies, however, in different animals, and in the same animal if taken from different vessels. When left to itself, blood coagulates, forming a *clot*, *cruor*, which separates from the liquid portion called *serum*. The clot consists of the fibrin, which has become insoluble, and of the corpuscles, while the serum is chiefly a solution of albumen and salts. According to Boussingault, the red color of the blood of the higher animals is not due to iron, since the white blood of molluscs contains about the same amount of iron, varying in different animals between about 0.04 and 0.06 part in one thousand.

Bullock's blood has been used in the fresh state, and according to W. C. Bakes (1872) also evaporated to an extract and powdered under the name of *pulvis sanguinis*.

Medical Action and Uses.—We shall not in this place discuss the nutritive qualities of blood, but only recall the fact that, in spite of the wise Mosaic law against eating blood, it is more or less used as food in several countries. We remember to have observed many years ago in the Roman market cakes of coagulated blood sold openly as food, and which disagreeably recalled the basins of human blood we had then but recently seen shed in hospital practice.

In 1876, Mr. Vacher, an English health officer, having learned that the serum of the blood of sheep and oxen was regarded by the journeymen in certain slaughter houses as "a remedy of great value for the treatment of scrofulous children, and as little less than a specific in cases of seat- and tapeworms," undertook some experiments with it which confirmed him in his impression of its efficacy. When employed in the Birkenhead Borough Hospital, it was found "most successful in cases of thread-worms, and less so in ascaris lumbricoides, while it failed almost entirely in tænia." It would seem unnecessary to introduce a new remedy for these entozoa when so many efficient anthelmintics are already available, especially when the proposed medicine is difficult to obtain in a fresh and sound condition, and is of doubtful value. It has been proposed to render this substance more permanently available by drying it, but there is as yet no evidence of its virtues in that condition.

There is, moreover, in our opinion, a serious objection to converting food into medicine, which is at present so much practised, in the case of "charcoal biscuit," "beef biscuit," wines and elixirs of "beef and iron," etc. These preparations are far more apt to inspire an aversion to wholesome food than to quicken the appetite or improve the digestion. We submit that in the treatment of disease the laboratory and the kitchen should not be associated in the same prescription.

SANICULA.—Sanicle.

Sanicle, Fr.; *Sanikel*, G.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Description.—The genus *Sanicula* is composed of perennial herbs, with palmately divided and coarsely serrate radical leaves and irregular or compound umbels, having polygamous, rather capitate flowers, and few-leaved involucres and involucels. The fruit is nearly globular, and has the mericarps closely united, without prominent ribs, covered with hooked prickles, and containing five oil-tubes. The following species have been employed:—

Sanicula europæa, *Lin.*—It is a common European plant. The root is several headed, branched, and dark brown. The radical leaves are palmately five-parted, and the obovate wedge-shaped segments again three-lobed. The stem-leaves are few in number and small. The perfect flowers are sessile, and the staminate flowers on very short stalks.

San. marilandica, *Lin.*, has the radical and stem-leaves five- or seven-parted, and the divisions rather narrow; the staminate flowers are numerous and on slender pedicels, and the perfect flowers have elongated and recurved styles.

San. canadensis, *Lin.*, resembles the European species, but has three-parted stem-leaves, and is distinguished from the second species by the nearly sessile staminate flowers, the shorter styles, and the smaller number of fruits in each umbellet.

The roots and leaves of these plants are nearly inodorous, and have a somewhat bitter and slightly acrid taste. The American species are in some localities known as *black snakeroot* and *pool root*.

Constituents.—These plants have not been analyzed.

Medical Action and Uses.—Nothing appears to have been recently added to the often-repeated statements that the aborigines of this country used sanicle in syphilis and diseases of the lungs, and that some physicians affirmed its virtues in chorea and intermittent fever.

SANTALUM, *U. S.*—Red Saunders.

Pterocarpi lignum, Br.; *Lignum santalinum rubrum.*—*Red sandal-wood*, E.; *Santal rouge*, Fr.; *Rothes Santelholz*, G.

The wood of Pterocarpus santalinus, *Lin.* Bentley and Trimen, Med. Plants, 82.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This species is a small or medium-sized tree, with a trunk of a foot or more in diameter. The leaves are pinnately trifoliate, with orbicular ovate emarginate leaflets. The flowers are small, yellow, and in lax racemes. The pod is roundish, sickle-shaped, winged, and contains one or two seeds. It grows wild only in the Madras Presidency, but is cultivated in Southern India.

Description.—Red sandal-wood is met with in commerce in hard and heavy billets, which are deprived of the light-colored sap-wood, are externally of a dark brown or reddish-brown color, and split irregularly and coarsely splintery in a longitudinal direction. If cut transversely, it is of a somewhat variegated appearance, the circles being alternately rather broad and dark brown-red, and narrow and lighter colored. The medullary rays appear as delicate red radiating lines. In the shops the wood is usually found in chips or in a coarse and irregular powder, of a brown-red color, nearly inodorous, and having a scarcely perceptible astringent taste. A red resinous mass exudes from the wood on heating it. Red saunders is distinguished from other red-colored woods by the characters given, and by means of water, which is not colored by it.

Constituents.—The coloring principle of red saunders is *santalic acid* or *santalin*, $C_{15}H_{14}O_5$, which may be obtained, according to Leo Meier (1849), by precipitating the tincture with acetate of lead, washing the precipitate with hot alcohol, and decomposing it with sulphuretted hydrogen in the presence of alcohol. Santalic acid forms microscopic needles of a beautiful red color, is inodorous and tasteless, melts at 104° C. (219.2° F.), is insoluble in water, but dissolves in concentrated sulphuric acid with a deep red, in alkalies with a violet, in alcohol with a blood red, and in ether with a yellow color; it is soluble in the volatile oils of cinnamon, cloves, bergamot, and bitter almond, but is insoluble in most other volatile and in fixed oils. L. Meier obtained several other compounds, which appear to be decomposition products. Red saunders is free from gallic acid, but appears to contain a minute quantity of tannic acid, which has not been further examined.

Off. Prep.—Spiritus (Tinctura) lavandulæ comp., *U. S.*, *Br.*

Medical Uses.—Red saunders has no medicinal virtues; and is used only as a coloring agent.

SANTALUM ALBUM.—SANDAL-WOOD.

Lignum santali album s. citrinum.—*Yellow* (*White*) *sanders-wood*, E.; *Santal citrin*, Fr.; *Gelbes* (*Weisses*) *Santelholz*, G.

The wood of Santalum album, *Lin.* Bentley and Trimen, Med. Plants, 252.

Nat. Ord.—Santalaceæ.

Origin.—The white sandal is a small tree, indigenous to Southern India and some of the East Indian islands, and cultivated in other parts of tropical Asia. Santalum yasi, *Seemann*, of the Fiji Islands, yields likewise sandal-wood. The leaves of white sandal are opposite, and vary in shape between oval and lanceolate, and are smooth, and glaucous beneath. The flowers are small, numerous, in paniculate cymes, very variable in color, and without odor. In India the trees are felled or dug up when the trunk is about a foot in diameter, the branches are cut off, and the trunk is left on the ground until the sap-wood has been mostly eaten away by ants, when it is trimmed, the heart-wood alone being used.

Description.—Sandal-wood is in billets, varying in thickness from about three to eight or nine inches, and in color from whitish to brownish-yellow, the deeper colored being more highly valued than the paler varieties. The wood is hard and heavy; when cut transversely, it has a somewhat waxy lustre and irregular concentric zones, alternately lighter and darker in color, sometimes rather indistinct, with very fine vessels and delicate medullary rays. When rubbed or rasped, it has an agreeable aromatic, somewhat roseate odor; its taste is aromatic, bitterish, and slightly acrid.

Constituents.—The most important principle of sandal-wood is the volatile oil, which is stated to be obtainable in the proportion varying between one and four per cent. *Oil of sandal-wood* is a yellowish liquid, having the odor of the wood in a high degree. Its density is about 0.96, and it commences to boil near 215° C. (419° F.). It is readily soluble in eighty per cent. alcohol, but it appears from Dragendorff's observations (1876) that old oil is less soluble than that which has been recently distilled. Sandal-wood contains also a resinous principle, and a tannin which is colored green by ferric salts.

Medical Action and Uses.—About 1865 oil of sandal-wood was introduced as a substitute for copaiba in the treatment of *gonorrhœa*. In some cases it was found to produce nausea or disturbance of the stomach, and the odor it communicated to the urine was described as sickening. Its smell upon the hands and breath was also said to be extremely persistent. But the more frequent statement was that it had a far more agreeable smell than copaiba, and was generally preferred to it. In some cases it agreed with patients who could not tolerate copaiba. The general result, however, appears to be that it possesses no decided superiority over that medicine.

Oil of sandal-wood may be given in doses of from ten to twenty drops three times a day, according to the degree of inflammation present. It has been administered in capsules, or in mixtures such as the following: ℞. Oil of sandal-wood, f℥j; Dilute alcohol, f℥ij; Oil of cinnamon, ♏xxv.—M. S.—One or two teaspoonfuls two or three times a day.

SANTONICA, *U. S.*, *Br.*—SANTONICA.

Flores cinæ, P. G.; *Semen cinæ, s. contra, s. sanctum, s. santonici.*—*Levant wormseed*, E.; *Barbotine, Semencine*, Fr.; *Wurmsamen, Zittwersamen*, G.

The unexpanded flowers of Artemisia cina, *Berg.* See Bentley and Trimen, Med. Plants, 157.

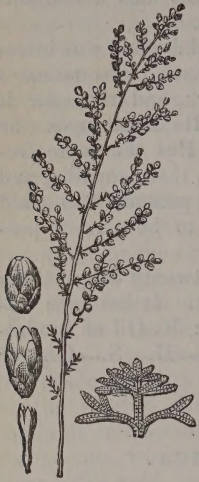
Nat. Ord.—Compositæ, Senecionideæ.

Origin.—Levant wormseed is obtained from Asia, and appears to be mainly if not exclusively collected in the northern part of Turkestan, and to be sent to the great fair at Nishnei-Novgorod, and thence to St. Petersburgh and Western Europe. Berg characterized the plant botanically under the name given above from the commercial drug, and Willkomm (1872) described under the same name a plant brought from Turkestan; but the flower-heads of this plant do not entirely resemble the wormseed of trade in that they have fewer scales (Pharmacographia). Flückiger and Hanbury consider the drug to be obtained from Artemisia maritima, var. Stechmanniana, *Besser*, and this plant to be identical with A. Lercheana, *Karel. et Kiril.*, A. maritima, var. pauciflora, *Ledebour*, and A. pauciflora, *Weber*. The typical form of A. maritima, *Lin.*, grows in salt marshes in Western Europe, and extends under various forms eastward to Western Asia.

Description.—Levant wormseed consists of unexpanded flower-heads, which are about one-twelfth of an inch long and one-thirtieth of an inch wide, oblong-ovoid in shape, obtuse at both ends, smooth, somewhat shining, and of a grayish-green color changing to brownish-green on exposure to light. The involucre is densely imbricate, and consists of twelve to eighteen keeled scales, of which the lower ones are smallest and ovate in shape, and the oblong upper ones have a scarious margin, and are dotted with numerous minute yellowish glands. The florets are four or five in number, but undeveloped and minute. The drug has a strong peculiar odor, and a bitter, camphoraceous, and disagreeable taste, and frequently contains fragments of the thin peduncles and of linear leaves.

Other Varieties.—The unexpanded flower-heads of a species of Artemisia, supposed by some to be derived from A. ramosa, *Smith*, have sometimes entered commerce from Northwestern Africa, and are known as *Barbary wormseed.* This consists of roundish-ovate flower-heads, having a grayish-brown color, covered with a whitish down, and mixed with numerous fragments of peduncles and of leaves; the outer scales are roundish, and the inner ones ovate. Another variety has occasionally been observed in Europe and described as *Indian wormseed.* It is only about one-half the size of the officinal drug, and is hairy and of a more yellowish color. We have repeatedly observed American wormseed to be sold in place of santonica, to which it bears no resemblance (see page 386).

Fig. 156.



Santonica. Branch, leaf, flower-head, and floret.

Constituents.—Levant wormseed has been frequently examined, and found to contain as active principles about 1½ or 2 per cent. of a crystalline body, *santonin* (see below), and 1 per cent. of volatile oil; also resin and various other less important constituents. *Oil of Levant wormseed* is pale yellow, limpid, has the density 0.92, commences to boil at about 170° C. (338° F.), is readily soluble in ether and alcohol, and according to Völkel is a mixture of various oxygenated compounds, of which Hirzel distinguished *cinæbene*, *cinæbene camphor*, and others.

Pharmaceutical Uses.—Levant wormseed is the source of santonin, and is employed in making

EXTRACTUM CINÆ, *P. G.*—This is prepared by exhausting the powdered drug with a mixture of equal parts of ether and alcohol, and evaporating the tincture to the consistence of a soft extract, which is of a dark-brown color.

Action and Medical Uses.—This medicine was introduced into Europe by the Crusaders, and has ever since been employed as an anthelmintic. Since the discovery and isolation of santonin, the proximate principle upon which the "seeds" depend for their virtues, they are less used than formerly. They were then held to be stomachic in small doses; general stimulants of the circulatory and nervous systems in larger doses; and in still larger quantities were found to produce gastric oppression, nausea, vomiting, and diarrhœa. Rarely they gave rise to symptoms of cerebral congestion.

Santonica is used almost exclusively as a vermicide for lumbricoid *worms* and *ascarides* of the rectum, but occasionally for *tapeworm* also. For the last it is of little efficacy; for the other parasites it is one of the best remedies. It is administered in coarse powder with honey, molasses, or some analogous liquid, to which jalap may be added for its purgative effect. The *dose* is from ten to sixty grains three times a day.

SANTONINUM, *U. S.*, *Br.*—SANTONIN.

Santonine, Fr.; *Santonin*, G.

Formula $C_{15}H_{18}O_3$. Molecular weight 246.

Preparation.—Take of Santonica in moderately coarse powder forty-eight troyounces; Lime recently slaked and in fine powder eighteen troyounces; Animal Charcoal in fine powder, Diluted Alcohol, Acetic Acid, Alcohol, each a sufficient quantity. Digest the santonica and lime with twelve pints of diluted alcohol for twenty-four hours, and express. Repeat the digestion and expression twice with the residue, using the same quantity of diluted alcohol. Mix the tinctures, and reduce the mixture to eight pints by distilling off the alcohol. Then, having filtered, and evaporated to one-half, gradually add acetic acid until in slight excess, stirring during the addition, and set the whole aside for forty-eight hours. Place the resulting crystalline mass upon a funnel loosely stopped, wash it with water, and dry it. Next, boil the dry residue with ten times its weight of alcohol, and, having digested the tincture for several hours with animal charcoal, filter it while hot, and add enough hot alcohol, through the filter, to wash the charcoal thoroughly; then set it aside in a dark place to crystallize. Lastly, dry the crystals on bibulous paper in the dark, and keep them in a well-stopped bottle, protected from the light. *U. S.*

Take of Santonica bruised one pound; Slaked Lime seven ounces; Hydrochloric Acid a sufficiency; Solution of Ammonia half a fluidounce; Rectified Spirit fourteen fluidounces; Purified Animal Charcoal sixty grains; Distilled Water a sufficiency. Boil the santonica with a gallon of the water and five ounces of the lime in a copper or tinned iron vessel for an hour, strain through a stout cloth, and express strongly. Mix the residue with half a gallon of the water and the rest of the lime, boil for half an hour, strain, and express as before. Mix the strained liquors, let them settle, decant the fluid from the deposit, and evaporate to the bulk of two pints and a half. To the liquor, while hot, add, with diligent stirring, the hydrochloric acid until the fluid has become slightly and permanently acid, and set it aside for five days that the precipitate may subside. Remove by skimming any oily matter which floats on the surface, and carefully decant the greater part of the fluid from the precipitate. Collect this on a paper filter, wash it first with cold distilled water till the washings pass colorless and nearly free from acid reaction; then, with the solution of ammonia previously diluted with five fluidounces of the water; and, lastly, with cold distilled water till the washings pass colorless. Press the filter containing the precipitate between folds of filtering paper, and dry it with a gentle heat. Scrape the dry precipitate from the filter, and mix it with the animal charcoal. Pour on them nine ounces of the rectified spirit, digest for half an hour, and boil for ten minutes. Filter while hot, wash the charcoal with an ounce of boiling spirit, and set the filtrate aside for two days in a cool, dark place to crystallize. Separate the mother liquor from the crystals, and concentrate to obtain a further product. Collect the crystals, let them drain, redissolve them in four ounces of boiling spirit, and let the solution crystallize as before. Lastly, dry the crystals on filtering paper in the dark, and preserve them in a bottle protected from light. *Br.*

The process given by the U. S. Pharmacopœia is that of Trommsdorff (1834), while the British Pharmacopœia recommends a process which has been elaborated by the researches of Calloud, Cerutti, Mialhe, and others. In both processes the santonin is extracted with lime, with which it forms a compound soluble in water and alcohol; and on concentrating the liquors an aqueous solution of calcium-santonin remains, contaminated with coloring and extractive matter and with resin held in solution by lime. The calcium compounds are decomposed by either acetic or hydrochloric acid, which form freely soluble calcium salts, and liberate the santonin, together with resin and other compounds. The impure santonin thus obtained may be freed from some of its impurities by washing it with dilute ammonia, or, without being thus treated, may be purified by recrystallization from hot alcohol, a little charcoal being used to remove coloring matter; the resin will remain dissolved in the alcohol. The yield is 1½ to nearly 2 per cent. In 1876, 427 pounds of santonin were imported into the United States; in the following year only 63 pounds.

Properties. — Santonin crystallizes in flat, rhombic prisms, which are colorless, of a pearly lustre, and of a slightly bitter taste. When heated to about 170° C. (338° F.) it melts to a colorless liquid, which, on being slowly cooled, becomes again crystalline; but, when rapidly cooled, usually remains amorphous and gum-like until after it has been moistened with alcohol, ether, or acetic acid, or has been heated again to a little over 40° C. (104° F.). It is nearly insoluble in cold water, and requires 250 parts of boiling water for solution. Trommsdorff found santonin to be dissolved at 17.5° C. (63.5° F.) in

43 parts, and at 80° C. (176° F.) in 2.7 parts of alcohol, spec. grav. .848, while at the same temperatures 280 and 10 parts of an alcohol having the density .928 were necessary. Santonin dissolves in 72 parts of cold and 42 parts of boiling ether, and in 4.35 parts of chloroform; it is likewise soluble in strong acetic acid, in volatile oils, and in warm olive oil. Santonin should be kept excluded from the light, or in yellow bottles. In the sunlight it acquires a yellow color, and, according to Sestini (1864, 1865), is converted into *photo-santonic acid*, $C_{23}H_{34}O_6$, which is more freely soluble in simple solvents, has a bitter taste, and, when pure, is colorless and inodorous; the coloring matter produced at the same time is of a resinous nature. Santonin is transiently colored red by hot alkalies and alkaline earths, and forms with them soluble salts, the solution of which yields insoluble precipitates with the salts of most heavy metals. According to Hesse (1874), these compounds are true salts, and, on liberating from them the *santonic acid*, it may be obtained from the hot aqueous solution in white rhombic crystals, which do not turn yellow in the light, are sparingly soluble in cold water, and have the composition $C_{15}H_{20}O_4$. The officinal santonin is, therefore, *santonic anhydrid.*

Impurities.—Santonin has been sometimes adulterated with *boracic acid*, which imparts to the flame of alcohol a green color, and, on being heated upon platinum foil, is left behind as a glass-like mass, the solution of which turns turmeric paper brown. *Strychnia* has been mistaken for santonin; it is readily detected by the bluish-purple color produced by sulphuric acid and a little potassium bichromate. *Picric acid*, which has been mistaken for santonin colored yellow by light, is very bitter, and may be recognized by the behavior described on page 70.

Off. Prep.—Trochisci santonini, *U. S.*

Physiological Action. *On Animals.*—Given to rabbits in thirty-grain doses, the animals appear to be much depressed, they pass purplish or yellow urine freely, and gradually die of exhaustion. In larger doses it occasions trembling of the limbs, insensibility, rigidity, and opisthotonos alternating with convulsions, salivation, and dilatation of the pupils. It is thought by some experimenters that death by santonin is due to spasm of the respiratory muscles. Manometric observations appear to show that it is not caused by failure of the heart. After death the heart, lungs, brain, and spinal marrow are found engorged with blood.

On Man.—The most remarkable effect of medicinal doses of this substance is that the whole field of vision appears yellow or yellowish-green; if the dose is large, it may be purplish, or even red. This effect seems to be due to changed conditions of the retina or of the brain, and not, as was formerly supposed, to a staining of the humors of the eye. When given in large doses, as five grains or more, santonin imparts to the urine a deep saffron color, and stains the linen as bilious urine does. At the same time it operates strongly as a diuretic. When the urine grows alkaline by putrefaction, or is made so by the addition of an alkali, the saffron tint is replaced by a violet or purplish color. In doses of three grains, santonin may occasion nausea and vomiting, with abdominal pain, thirst, giddiness, and diarrhœa. Decidedly poisonous effects sometimes arise from doses which are quite insignificant in comparison with those which some experimenters have taken without serious inconvenience. For example, a child six months old was rendered amaurotic for two months by a dose of five grains of santonin. In another case two grains, given to a child two years old, occasioned convulsions, injection and heat of the face and head, twitching of the eyeballs, dilatation of the pupils, foaming at the mouth, clenching of the teeth, stertorous breathing, and jerking of the arms. On the morrow the recovery was complete. In a third case, a healthy child of two years swallowed two santonin troches at six o'clock in the morning. No result appeared until four in the afternoon, when suddenly the muscles of the left side of the face began to twitch, and the pupils to dilate. Then clonic convulsions affected the left side, beginning at the fingers, and these were followed by muscular rigidity of the same side. After a quarter of an hour the spasms subsided, but in the course of an hour were renewed, the voice meanwhile becoming quite extinct. The spasms were at intervals repeated for several days, during which the respiratory act grew very feeble, and artificial respiration was resorted to. (Becker.) In other cases it is not the nervous, but the digestive, apparatus that is chiefly affected, and violent vomiting and purging, followed by collapse, produce an attack like one of cholera morbus. In all cases the urine has the characteristic color. Although recovery generally takes place after such grave symptoms, they occasionally terminate in death. These illustrations suffice to prove the necessity of caution in the administration of santonin.

Medical Uses.—The chief practical value of santonin consists in its power of destroying *lumbricoid worms*, and in a less degree rectal *ascarides.* A single dose of about two grains has sufficed to kill and cause the expulsion of one hundred and sixty-six of the former species. It should be prescribed in doses not larger at first than one grain for adults, and one-quarter of a grain for children, and ought to be taken at night, both because its action upon the parasites is less interfered with by food at that time, and because the yellow vision which it may occasion will not then be a source of so much annoyance. The following day a dose of castor oil should be given. As santonin in substance is almost devoid of taste and smell, it may be given with powdered sugar, or in a little jelly. Pastilles or troches of santonin, made with chocolate, are much used, and are very efficient. Santonin has also been employed with alleged advantage in the treatment of *whooping-cough*, as a diuretic in cases of *renal colic*, and for subacute and chronic inflammations of the *choroid* and *retina*, especially those which have an atrophic character. But in none of these affections has its utility been demonstrated. Internal and external stimulants, heat, cold, and artificial respiration, have all been employed in poisoning by santonin, but of these the last is the only one of positive value. Inhalations of ether should be used to control the spasms.

Santonate of soda has been given as a substitute for santonin. It has the advantage of greater solubility—if that indeed be an advantage, for not only is its taste thereby rendered more distinct and disagreeable, but it is more readily absorbed from the stomach, and therefore is less apt to come into contact with the intestinal parasites which it is given to destroy. In experiments upon animals it produces poisonous effects more speedily than the proportion of santonin contained in it would do. Nevertheless, santonate of soda has been used with success as an anthelmintic. It may be prescribed for adults in doses of eight or ten grains twice a day, and for children in doses of from two to five grains, mixed with sugar. After the second day a laxative, such as confection of senna, or jalap and cream of tartar, should be administered to remove the worms. Enemata of water containing this salt may be used for rectal ascarides.

SAORIA.—SAORIA.

The fruit of Mæsa lanceolata, *Forsk.*, s. M. picta, *Hochstetter.*

Nat. Ord.—Myrsinaceæ.

Origin and Description.—The saoria is a shrub, growing throughout Abyssinia at the height of about 7000 feet. The fruit, which is the part employed, is drupaceous, globular-ovate, united with and about two-thirds of its length covered by the calyx, about one-eighth or one-sixth of an inch in diameter, often crowned by the short style and capitate stigma; yellowish- or brownish-green, and containing numerous small turbinate, angular seeds, which are flattened above, and imbedded in a resinous mass adhering to the central placenta. Saoria has a bitterish, pungent, and acrid taste.

Constituents.—According to the analysis of Apoiger (1857), saoria contains a little volatile oil, various organic acids, tannin, reacting green with iron salts, an acrid principle, fixed oil, pectin, and other common vegetable principles. The ash of the dried fruit amounted to 7.76 per cent., and contained 0.30 per cent. of boracic acid.

Allied Drug.—MYRSINE AFRICANA, *Schimper*, belonging to the same natural order, grows throughout the greater portion of Africa. The fruit, *tatzé* or *satzé*, has been used like the preceding, from which it differs in being more globular, not united with the calyx, of a reddish-brown color, and in containing only one nearly globular seed which is grooved at the base. The taste of the fruit is more disagreeable than that of saoria.

Medical Action and Uses.—Saoria gives a violet tint to the urine, and occasions some nausea and liquid stools. According to some authorities it is a more certain remedy for *tænia* than the indigenous tænifuges of France; but others regard its action as uncertain. It may be given in powder, mixed with porridge, in the *dose* of an ounce or an ounce and a half.

Tatzé has a persistently acrid and disagreeable taste, and is apt to produce vomiting and purging. Dr. Strohl found it partially successful in six cases of *tænia*. He administered from four to six drachms of the powder in a liquid vehicle.

SAPO.—SOAP.

Savon, Fr.; *Seife*, G.

Preparation.—Soaps may be obtained by combining fatty acids (see page 949) with alkalies; but they are generally prepared by boiling fats with a solution of caustic soda or potassa, when the fatty acids unite with the alkali, the soap remaining dissolved in the water, together with the glycerin which is liberated from the fat. The lye used in this operation is employed in a rather diluted state, and an excess of it is mostly used, since the saponification is thereby much facilitated, and the free alkali may be readily removed from the soap. The boiling is continued until the mixture becomes transparent and rather tenacious. The soap is separated from the lye by adding common salt to the liquid, soap being insoluble in the solutions of most salts of potassium and sodium. If potassa has been used for saponification, the sodium chloride serves also the purpose of converting the potassa soap into soda soap. When the soap has separated from the liquor, and sufficiently solidified, it is transferred into wooden frames until it is stiff enough to be cut into bars, which are exposed to the air in a warm place until they become hard and dry.

Properties and Composition.—Soaps are salts of the fatty acids. Commonly the term soap is restricted to such of these salts as contain potassa or soda as the base and are soluble in water. The compounds with earthy and metallic bases are chemically analogous to these *soluble soaps*, but being insoluble in water, are often distinguished as *insoluble soaps*. Of this latter kind two are recognized by the Pharmacopœias, namely, lead plaster (p. 525), and liniment of lime (p. 810). The consistence of soap depends, in part, on the nature of the fat, and in part on the alkali. Drying oils yield softer soaps than non-drying oils; and of the latter those containing much olein furnish soaps which are less hard, but more freely soluble in water and alcohol than those rich in palmitic or stearic acid. Soda soaps are invariably harder than potassa soaps, which are mostly deliquescent, and, therefore, remain soft. Soaps have mostly a white color when pure; the color and the marbled appearance of many soaps are due either to accidental impurities or to coloring matter contained in the oil; or they are produced by the intentional addition of coloring matters or of metallic salts, like sulphate of iron, in which case the result is due to the presence of an iron soap.

The well-known detergent properties of soap depend upon its decomposition by a large quantity of water into acid and basic salts, of which the latter act as solvents of fats and other matters; in this respect their action is similar to, but milder than that of caustic alkali. So-called *hard water* is unsuited for washing on account of calcium or magnesium salts, which are contained in solution, and which form insoluble soaps by double decomposition.

Examination and Valuation.—Soaps frequently contain a large amount of water, in some kinds 40 or even 50 per cent. From 12 to 15 per cent. of water are usually regarded as admissible for good commercial Castile soap. The water is determined from a weighed quantity of the soap reduced to thin shavings, which are exsiccated at a temperature between 100° and 110° C. (212° and 230° F.). By incinerating another portion of soap, the soda may be determined from the residue, and should be about 10 or 11 per cent. for the exsiccated soap. By decomposing a solution of soap with hydrochloric acid, and collecting the fatty acid, its weight may be ascertained, and should be near 90 per cent. of the dried soap. Adulterations with chalk, clay, and similar compounds are ascertained by their insolubility in hot water or alcohol. Common soaps are sometimes mixed with resin soap, an alkaline solution of rosin being incorporated. There is usually no difficulty in recognizing the presence of rosin, but we know of no method for accurately determining its amount. Free alkali cannot be recognized by litmus paper, since soap solutions possess an alkaline reaction; but if powdered soap is mixed with calomel, and the mixture is moistened with distilled water, it will acquire a gray or blackish color in proportion to the amount of free alkali present. Unsaponified fat remains insoluble and floats upon the solution of the soap made with distilled water.

Medicinal Soaps.—Sapo, *U. S.;* Sapo durus, *Br.*; Sapo oleaceus, *P. G.;* Sapo hispanicus s. venetus; Soap, Hard soap, Castile soap, *E.;* Savon blanc de Marseille, Savon d'Espagne, *Fr.;* Oelseife, Spanische Seife, *G.*—It is prepared from olive oil and soda, and should be white or grayish-white, free from rancid odor, hard, and should not become moist on exposure; it should be completely soluble in alcohol and in water, should not impart an oily stain to paper, and on incineration should yield an ash which is not deliquescent. *Mottled Castile soap* is a similar soap, which is more or less colored by the addition of an iron salt; internally it is white, mottled with black, changing to red-brown on exposure. The German Pharmacopœia directs also *Sapo medicatus;* it is prepared by boiling 60 parts of solution of soda, specific gravity 1.33, with 100 parts of olive oil, dissolving the soap in 300 parts of distilled water, separating it by adding a concentrated solution of 25 parts of table salt, redissolving the washed soap in 60 parts of hot water, and cutting it when cold into pieces which are to be dried and powdered. *Sapo medicinalis*, F. P., is a soda soap made with expressed oil of almond.

Sapo animalis, *Br.;* Sapo domesticus, *P. G.;* Curd soap, *E.;* Savon animal, *Fr.;* Hausseife, *G.*—It is made with soda and a purified animal fat consisting principally of stearin. It resembles the preceding, but when it is dissolved in 8 parts of boiling alcohol, the solution, after cooling, forms a translucent jelly-like mass, which constitutes the basis of the liniment known as opodeldoc (see page 814).

Sapo mollis, *P. G.;* Sapo viridis, *P. G.;* Soft soap, *E.;* Savon vert (noir), *Fr.;* Grüne (Schwarze) Seife, *G.*—It is made with potassa and olive oil, or more frequently with whale oil, cod oil, hempseed oil, and others. It is yellowish-green or dark colored, soft and rather gelatinous, inodorous (*Br.*), but as met with in commerce usually of a nauseous smell. When incinerated it leaves an ash which is very deliquescent.

Off. Prep.—1. *Of hard soap*: Empl. cerati saponis, Empl. resinæ, *Br.;* Empl. saponis, Extr. colocynthidis comp., *U.S.*, *Br.;* Linim. potassii iodidi cum sapone, *Br.;* Linim. saponis, Pil. aloes, Pil. aloes et assafœtidæ, *U. S.*, *Br.;* Pil. assafœtidæ, *U. S.;* Pil. cambogiæ comp., *Br.;* Pil. opii, Pil. rhei, *U. S.;* Pil. rhei comp., *Br.;* Pil. saponis comp., Pil. scillæ comp., *U. S.*, *Br.*

2. *Of curd soap:* Pil. scammonii comp., Suppos. acidi carbolici cum sapone, Suppos. acidi tannici c. sapone, Suppos. Morphiæ c. sapone; it may also be substituted for the hard soap in preparing Linim. potass. iodidi c. sapone, *Br.*

3. *Of soft soap:* Linimentum terebinthinæ, *Br.*

History.—Pliny, after speaking of several ammoniacal preparations as resolvents of scrofulous tumors, says: "Soap, invented by the Gauls to make the hair yellow, may also be employed. It is prepared with tallow and ashes, the best with goats' fat and beech ashes. It is of two kinds, the solid and the liquid. Both are employed by the Germans, but by the men more than by the women." In Arabian medicine soap was used: To hasten the suppuration of boils, and, especially when mixed with honey, as a stimulant for ulcers; as a suppository to promote defecation; for washing leprous skins, and, with salt in a warm bath, to cure prurigo and ulcerated scabies; with oil to heal the salt rheum (eczema) of children's heads; with warm water to cleanse the scalp of dandriff, and destroy nits and lice; and with "Sandix" and slaked lime to dye the hair (Ebn Baithar).

Medical Action and Uses.—Soap acts upon quadrupeds (horses and dogs) internally, very much as it does upon man, *i.e.*, as mildly laxative, and as weakly antacid from its alkaline constituent. But it is hardly ever used alone for these purposes, but rather to dissolve resinous medicines along with which it is given, and thereby to quicken and strengthen their action. Pereira states that he knew an idiot who had frequently eaten large lumps of soap without any ill effects, and that he had heard of a pound of it being swallowed for a wager.

Besides the use of soap as a *laxative*, it has been given internally as a solvent for uric acid. Along with calcined egg-shells (lime) and aromatic bitters it formed a once famous cure for *gravel;* probably in this case it acted by giving up its acid to the lime and liberating the soda, which then tended to neutralize the free uric acid in the system. Soap is one of the best antidotes for *acid poisons*, because it is always to be promptly obtained, and because it does not itself act as an irritant. It should be given freely in the form of soapsuds. As a local remedy for external injuries by acids or by phosphorus, soapsuds are efficient if promptly used.

As an external remedy soap acts by modifying the condition of the skin; it combines with the fat of the excretions, and removes them when they have grown acid or fetid, and, with them, the dirt accumulated from without; it softens the epidermis and removes its outer layers, and thus exposes the integument to the vivifying influence of the air; by all of which agencies a healthier condition of it is secured. If the soap be too strongly alkaline, or too little diluted with water, or applied with too active friction, it may induce painful irritation of the skin. This is particularly the case when there is added to the soap proper, some article intended to exert a specific action, as sulphur, tar, etc. But in general the curative agent is used separately after the skin has been brought to a proper condition by warm water and soap. These remarks are particularly applicable to the treatment of *scabies*, *prurigo*, *psoriasis*, and *eczema.* For this purpose soft soap is greatly to be preferred. In Germany, where the treatment of itch with soft soap originated, it is now nearly abandoned not only on account of the offensive smell and irritant properties of this preparation, but because the speedier and more agreeable cure by balsam of Peru and storax has superseded it. The stimulant action of soft soap is also resorted to in the treatment of *ichthyosis* and of *lupus.* A soft soap made with olive oil and pure solution of potassa is devoid of the offensive smell of ordinary soft soap, and is to be preferred when patients are delicate or fastidious, as in the case of ladies and children. The ancient treatment of *boils* by soap continues to be used. In general, yellow soap, mixed with sugar and spread on leather or muslin, is applied to the part. So far from irritating it and causing greater pain, this remedy, when promptly resorted to, lessens the pain materially and hastens suppuration.

SAPONARIA.—SOAPROOT.

Radix saponariæ, P. G.—*Soapwort*, E.; *Saponaire, Savonnière*, Fr.; *Seifenwurzel*, G.

The root of Saponaria officinalis, *Lin.* *Nat. Ord.*—Caryophyllaceæ.

Origin.—Soapwort is a perennial herb growing throughout the greater part of Europe on the banks of streams and roadsides. It is sometimes met with in cultivation in gardens, and has been naturalized in North America. The stem is about two feet high; the leaves are opposite, mostly sessile, ovate, oblong or nearly lanceolate, three-nerved, entire, and nearly smooth. The large, pale rose-colored flowers are in corymbed clusters, have a cylindrical five-toothed calyx, and five petals with a two-cleft appendage at the top of the long claw. The herb flowers from June to August.

Description.—The root is collected in the spring or autumn without the creeping runners, is ten to fifteen inches long, cylindrical, about one-eighth or one-quarter inch thick, gradually tapering below, somewhat branched, longitudinally wrinkled, and of a red-brown color externally. It breaks with a short fracture, and is internally white, with a rather thick bark, and a soft yellowish and in the centre whitish wood, which has no medullary rays, and is surrounded by a fine dark-colored cambium line. The root is inodorous, and has a sweetish and bitter afterwards persistently acrid taste.

Constituents.—Soaproot contains *saponin* (see p. 1167), and is free from starch. Bucholz (1811) found also resin, mucilage, and other common principles. Osborne (1827) obtained from the root collected before flowering, white, fusible, very bitter needles, soluble in water, alcohol, and ether; but the nature of these has not been ascertained.

Allied Root.—LEVANT SOAPROOT is obtained from Gypsophila struthium, *Lin.*, a caryophyllaceous perennial of Northern Africa and Southern Europe. It is eight to sixteen inches long, one to four inches thick, transversely and longitudinally wrinkled, brownish-yellow externally; internally white, with a rather hard wood and numerous medullary rays. In sensible properties and in composition it resembles the preceding.

Medical Action and Uses.—Saponaria has long enjoyed the reputation of being diaphoretic and diuretic, and alterative in that it cured chronic diseases of the skin and bronchia, rheumatism, gout, syphilis, and periodical fevers, or the visceral engorgements following them. It has been compared with sarsaparilla and with senega. It is administered in a decoction made with an ounce of the root to a pint of water. That this plant possesses active powers is evident from the large proportion it contains of saponin, whose peculiar virtues are treated of elsewhere. (See Senega.)

SARCOCOLLA.—SARCOCOLLA.

Sarcocolle, Fr.; *Fleischleimgummi, Fischleimgummi*, G.

An exudation of Penæa sarcocolla, *Lin.*, and P. mucronata, *Lin.* *Nat. Ord.*—Penæaceæ.

Origin and Description.—The plants named above are small branching shrubs, with small, opposite, entire, coriaceous leaves, and clusters of yellow flowers, surrounded by a purplish-red leafy involucre. The shrubs are indigenous to Central and Southern Africa, and exude a juice which, after hardening, constitutes sarcocolla. This is in small, roundish, somewhat spongy, and friable grains, which are sometimes agglutinated to larger masses, often mixed with fine hairs, and have a yellowish, reddish, or brownish color. Sarcocolla is inodorous, has an insipid, sweetish, afterwards somewhat acrid and bitter taste, resembling that of liquorice root; is soluble in water, almost completely soluble in alcohol, except the impurities, and when heated burns and gives off the odor of burning sugar.

Constituents.—On treating sarcocolla with ether, Pelletier (1834) separated a resin; the undissolved residue yielded to alcohol *sarcocollin*, and left gummy matter behind. Sarcocollin is uncrystallizable, soluble in alcohol and water, possesses a bitter-sweet taste, and when oxidized with nitric acid yields oxalic acid. Its composition is stated to be $C_{13}H_{23}O_6$.

Medical Action and Uses.—The name of this substance, which means a healer of the flesh, it has borne since an early period in the history of medicine. It was held in great repute for agglutinating wounds and curing defluxions of the eyes, and was also applied to joints affected with chronic inflammation. It was reputed to be a depilatory; was used with honey to check otorrhœa; and applied with nitre as a discutient of scrofulous glands.

SARRACENIA.—PITCHER-PLANT.

Sarracenie, Fr., G.

Nat. Ord.—Sarraceniaceæ.

Description.—The following North American species have been employed:—

SAR. PURPUREA, *Lin.;* Side-saddle plant, Huntsman's cup, Water cup, *E.*—It grows in boggy places from Canada southward. The *rhizome* is oblique, conical, about an inch or more long, of a reddish-brown color externally, and brownish-white internally, has numerous, thin, nearly simple, toughish rootlets attached, breaks with a short fracture and does not acquire a blue color with solution of iodine. It is inodorous, and has a bitter and somewhat astringent taste. The *leaves* are radical, six or eight inches long, pitcher-shaped, most inflated near the middle, curved, broadly winged, with an erect, roundish, heart-shaped hood, and have a bitterish taste. The *flower* is nodding, globose, and deep purple, and has fiddle-shaped petals.

SAR. FLAVA, *Lin.;* Trumpet-leaf, *E.*—The *rhizome* is similar to the preceding, but larger. The *leaves* are about two feet long, tubular, gradually enlarged to the open throat, and have a very narrow wing and a roundish mucronate hood, which is narrowed towards the base. The flower is yellow. The plant grows in the Southern United States.

SAR. VARIOLARIS, *Mich.*, grows from South Carolina to Florida, and has elongated leaves mottled with white on the back, with a linear wing, and with the lamina inflected over the throat of the tube. The flower is yellow.

Constituents.—Sarracenia purpurea was analyzed by Björklund and Dragendorff (1863), who found, besides the usual constituents of herbs, *acrylic acid*, which is volatile, and about one-sixth per cent. of a *volatile base*, having an odor resembling that of conia. Stan. Martin (1866) announced the presence of a bitter alkaloid, *sarracenina*, the sulphate of which is crystallizable; and E. Schmidt (1872) isolated a yellow coloring matter, *sarracenic acid*, which yields with alumina a yellow lake.

Medical Action and Uses.—S. flava and S. variolaris possess stimulant and tonic virtues, for which they enjoy a high reputation in South Carolina, where they are used in the treatment of *dyspepsia* and its associated ailments.

A hasty and immature observation at one time ascribed to S. purpurea the virtues of a specific remedy for smallpox, a notion which it is almost superfluous to say was not confirmed by experience, but which, like other errors, it required some time and labor to destroy.

SARSAPARILLA, *U. S.*—SARSAPARILLA.

Sarsæ radix, Br.; *Radix sarsaparillæ*, P. G.—*Salsepareille*, Fr.; *Sassaparilla*, G.

The root of Smilax officinalis, *Humboldt and Bonpland*, and of other species of Smilax.

Nat. Ord.—Smilaceæ.

Origin.—Sarsaparilla is obtained from different species of Smilax growing in swampy forests of Mexico and as far south as the northern portion of Brazil. These are woody climbers, and often attain a great height. Smilax sarsaparilla, *Lin.*, is indigenous to the United States, and grows chiefly in the Southern States; it is in part at least Smilax glauca, *Walter*, but does not afford any sarsaparilla; its subterraneous portion is a long, cylindrical, creeping rhizome with prominent nodes, and bears no resemblance to the commercial drug. The only sarsaparilla-yielding species which are tolerably well known are the following:—

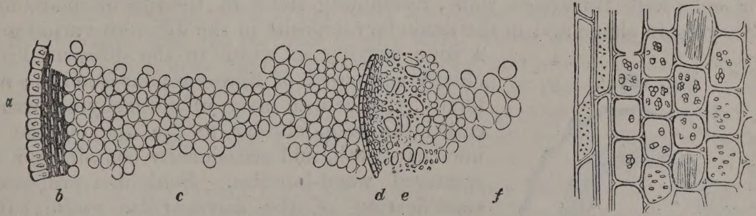
SMILAX OFFICINALIS, *Humb. and Bonpl.*—It is indigenous to New Granada and other parts of Northern South America, and has a quadrangular stem, and large cordately-ovate or oblong, five- or seven-nerved leaves; it furnishes Jamaica sarsaparilla.

SMILAX MEDICA, *Schlechtendal.*—It has a zigzag stem, and much smaller leaves, which are frequently auriculate, with broad and obtuse basal lobes. It is indigenous to Mexico, and affords the Mexican sarsaparilla.

SMILAX SYPHILITICA, *Humb. and Bonpl.*, S. scabriuscula, *Humb. and Bonpl.*, S. cordato-ovata, *Rich.*, S. papyracea, *Poir.*, S. purhampuy, *Ruiz*, and others, seem to be imperfectly known, or, at all events, it is uncertain whether they are sources of some variety of the drug.

Collection.—No satisfactory account has been given of the manner in which the different varieties are collected and prepared for the market. According to Rich. Spruce, in the valley of the Amazon the roots are about nine feet long, spread horizontally, and are collected after several stems have been produced, younger plants having so few roots as not to be worth grubbing up. The earth is scraped away from the roots by hand, aided by a pointed stick, and the roots of other plants interfering are cut through with a knife. When at length laid bare, the sarsaparilla roots are cut off near the crown, a few slender ones being allowed to remain to aid the plant in renewing its growth, and the stems are

Fig. 157.



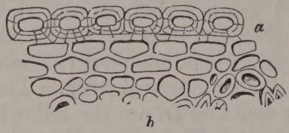
Transverse and longitudinal section of Sarsaparilla. *a.* Epidermis. *b.* Subcuticular tissue. *c.* Parenchyma. *d.* Nucleus sheath. *e.* Woody zone. *f.* Central parenchyma.

cut down to near the ground. The yield of a plant of four years' growth is about sixteen pounds, and of older plants from two to four times that quantity. (Pharmacographia.)

During the year 1875–1876, 883,590 pounds, and in the following year 500,636 pounds of sarsaparilla were imported into the United States.

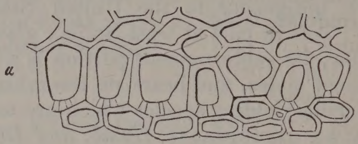
Description.—As met with in commerce, sarsaparilla consists either of the horizontal roots alone, or in part also of the short knotty rhizome, to which, in some sorts, portions of the overground stems are sometimes attached. The roots are long, cylindrical, tapering towards both extremities, and beset with thin branching fibres called the *beard*, or nearly free from it. They are more or less deeply furrowed in a longitudinal direction, and have mostly a gray or blackish-gray color externally from adhering earth, and after this has been washed off are of a bright brownish- or reddish-yellow color, and particularly in the folds are often clothed with short simple hairs. When cut transversely several distinct zones are observed, which, under the microscope, are seen to consist (see Fig. 157)—*a*, of the epidermis, the cells of which are sometimes prolonged into hairs; *b*, of a subcuticular layer composed of several rows of cells with their walls thickened from secondary deposits; *c*, a layer of parenchyma, called the *bark*, and containing starch or an amorphous mass, and some cells filled with bundles of needle-shaped crystals consisting of oxalate of calcium; *d*, a single row of cells with thickened walls, resembling those of the subcuticular tissue, and varying in shape and in the secondary deposits in the different varieties; *e*, a zone varying in width in the different kinds, chiefly composed of fibro-vascular bundles; and, finally, *f*, a central layer of parenchyma, usually called the *pith*, similar to the one outside the nucleus sheath, and occasionally containing a few scattered wood-bundles. Schleiden proposed a classification of the sarsaparillas mainly from the character of the nucleus sheath, and more recently a similar view was taken by Ferd. Otten (1876).

Fig. 158.



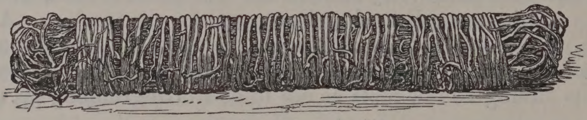
Honduras Sarsaparilla. *a*. Nucleus sheath. *b*. Woody zone.

Fig. 159.



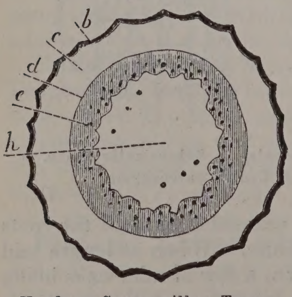
Mexican Sarsaparilla. *a*. Nucleus sheath.

Fig. 160.



Honduras Sarsaparilla.

Fig. 161.

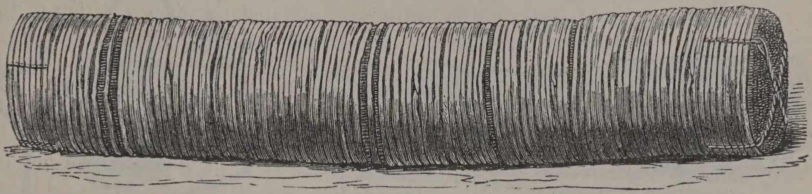


Honduras Sarsaparilla. Transverse section.

Sarsaparilla is nearly inodorous, except in infusion and decoction; it has at first a slight taste, but leaves an acrid impression in the fauces, by the intensity of which the quality of the root may be approximately judged.

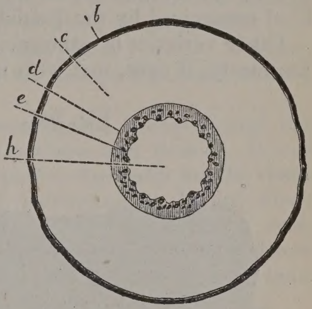
Commercial Varieties.—The sarsaparillas may be conveniently distinguished as *mealy* and *non-mealy*, the former being amylaceous in the interior, and usually marked externally by rather uniform and shallow wrinkles, while the non-mealy varieties are not farinaceous when broken transversely, contain but little granular starch, and are usually characterized by deep longitudinal and irregular folds. The sarsaparillas from Honduras and Mexico, which are mostly met with in the United States, are representatives of the two classes.

Fig. 162.



Rio Negro or Para Sarsaparilla.

Fig. 163.



Rio Negro Sarsaparilla. Transverse section.

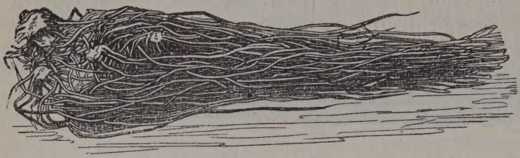
Mealy Sarsaparillas. HONDURAS SARSAPARILLA.—This is exported from Belize and other ports on the Bay of Honduras, and comes in bundles two or three feet long, consisting of the folded roots, in the interior containing some hard woody rhizomes, and often short fragments of the stem, and tied with roots of the same kind. The roots have some fibres attached, and have the cortical layer somewhat thicker than the woody zone, and of about the same width, or thinner than the pith.

RIO NEGRO SARSAPARILLA, also called *Para*, *Brazilian*, and *Lisbon Sarsaparilla.*—This is exported from Para, and comes in long cylindrical rolls, tied together by a smooth stem, and with both ends cut off evenly. It is free from rhizomes and stems, and contains but few root-fibres, but the interior of the bundle is frequently packed with roots of inferior quality. The bark and pith are nearly of the same width, but the ligneous zone is only one-third or one-fourth that thickness.

Non-mealy Sarsaparillas. MEXICAN SARSAPARILLA, also called *Vera Cruz* and *Tampico Sarsaparilla.*—The roots are folded back, so as to cover the knotty rhizomes, and the portions of the stem, which are often six inches in length. The roots have but few rootlets attached, and are deeply and irregularly wrinkled. The pith is of about the same width as the woody zone; but the bark is twice this thickness, at least in the projecting ridges. It is obtained from Smilax medica, *Schl.*, and is the kind recognized by the German Pharmacopœia.

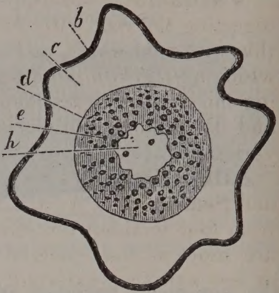
JAMAICA SARSAPARILLA.—This is also known as *bearded sarsaparilla*, from the numerous root fibres attached to it. It comes in bundles similar to, but usually shorter than those of Honduras sarsaparilla, and less neatly tied. The layers of pith and bark are nearly of the same width, but the woody zone is narrower, varying between one-half and one-third the width of the former. It varies in mealiness, often in different parts of the same root, and is also distinguished from the other varieties by its reddish-brown color. It does not grow wild in Jamaica, but is stated to be obtained from the Isthmus of Panama; and a similar drug, agreeing in all essential qualities with this, is sometimes exported from Venezuela, and known as *Caracas sarsaparilla.* It is supposed to be derived from Smilax officinalis, *H. and B.*, which is cultivated in Jamaica, but there furnishes a more mealy root. Jamaica sarsaparilla is the only kind recognized by the British Pharmacopœia.

Fig. 164.



Mexican Sarsaparilla.

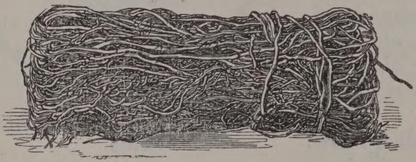
Fig. 165.



Mexican Sarsaparilla. Transverse section.

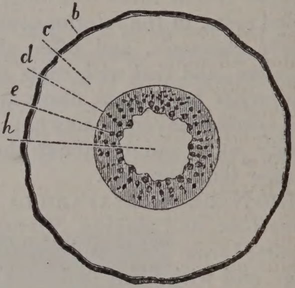
Other varieties of sarsaparilla have been described by European writers, but are rarely, if ever, met with in commerce in this country.

Fig. 166.



Jamaica Sarsaparilla.

Fig. 167.



Caracas Sarsaparilla Transverse section.

Constituents.—Sarsaparilla was analyzed by Pallotta (1824), Folchi, Thubeuf (1831), Batka (1834), Poggiale (1835), and others, and the acrid principle has at different times received the designations *smilacin, pariglin, parillin, salseparin,* etc. Pallotta precipitated the decoction with milk of lime, decomposed the precipitate with carbonic acid, and, after drying, exhausted it with alcohol. Thubeuf exhausted the root with boiling alcohol, concentrated the tincture, treated the residue with charcoal, and recrystallized from hot alcohol; ten pounds of the root yielded three ounces of smilacin. In its purest state parillin has been obtained as colorless needles, which are sparingly soluble in cold, but more freely soluble in hot water and hot alcohol, and nearly insoluble in ether and chloroform. Its aqueous solution foams in a manner similar to that of a solution of saponin, and, on boiling, reduces in a slight degree an alkaline solution of copper, but somewhat more abundantly after it has been boiled for a long time with dilute sulphuric acid. Parillin appears to be closely related to sapogenin, but its exact composition and its products of decomposition have not been determined. The other constituents of sarsaparilla are a trace of essential oil, resin, pectin, albumen, and other common constituents. Otten obtained also between 2 and 3 per cent. of *saponin*, and determined the starch in the non-mealy varieties to vary between 3 and 13.8 per cent., while the mealy varieties contained sometimes as high as 45 per cent., and in rare cases as low as 10 or even 6.25 per cent. of starch.

Valuation.—Marquis (1875) estimated the amount of (impure) parillin by digesting the root with 30 per cent alcohol, evaporating to an extract, washing this with cold water, and exhausting with boiling alcohol, on the evaporation of which a yellowish mass was left, which was weighed as parillin. After modifying the process, Otten obtained similar results, tending to show that Honduras and Para sarsaparilla yield less parillin than the Vera Cruz and Jamaica varieties.

Allied Drugs. SMILAX CHINA, *Lin.*—This is a climbing shrub of Eastern and Southeastern Asia. It has irregular, tuberous rhizomes, varying in length from four to about ten inches, and in thickness from one to two inches. These are more or less covered with short branches, are reddish-brown, and more or less wrinkled externally, and internally light-brownish, somewhat mealy, or hard and dense internally. China root is inodorous, and has an insipid, faintly bitter, and somewhat acrid taste. Smilax pseudo-china, *Lin.*, and Sm. tamnoides, *Lin.*, which are natives of the United States, yield similar tuberous rhizomes, which are usually lighter in color and weight. The root of Sm. aspera, *Lin.*, of Southern Europe, has been employed there in place of sarsaparilla.

Off. Prep.—Decot. sarsæ, *Br.;* Decoct. sarsaparillæ (sarsæ) comp.; Extract. sarsaparillæ fluid. (sarsæ liquidum), *U. S.*, *Br.;* Ext. sarsaparillæ fluid. comp.; Syrup. sarsaparillæ comp., *U. S.*

History.—The Spaniards first brought sarsaparilla to Europe, about the middle of the sixteenth century, from Peru, St. Domingo, and Brazil. It was then believed to be a specific for constitutional syphilis, especially for the rheumatoid elements of that disease, and for its ulcerative symptoms. It had, however, quite fallen into neglect, when a belief in its virtues was for a time revived at the end of the eighteenth century; but it again gradually lost confidence as a remedy for syphilis, and was more largely used by nostrum-vendors than by physicians.

Physiological Action.—The operation of the active principle of this root (Smilacin, Parillin) is by no means a negative one. According to Palotta, in doses of six grains it occasions malaise and slowness of the pulse; eight grains produce nausea and constriction of the throat; ten grains general debility and diaphoresis; thirteen grains moderate vomiting of a bitter liquid, with irritation and constriction of the throat, faintness, and general exhaustion. These effects have been ascribed to a different principle from either of the above, but which has not been isolated. It is certain, however, that they may be caused by some derivative of sarsaparilla, however named, and that they have also been produced by large doses of the drug itself. In medicinal doses, neither sarsaparilla nor its usual preparations occasion any such phenomena. Their effects are manifested during a state of disease, rather than in health, and consist of an improved condition of the digestive and nutritive functions, and the gradual subsidence of the morbid derangement.

Medical Uses.—Although sarsaparilla has been recommended in chronic *gout*, *rheumatism*, and *skin diseases*, yet the only disease for the cure of which special virtues have been claimed for it, is constitutional *syphilis*, and the most eminent authorities upon this subject have generally agreed that its efficacy depends upon the patient having been previously subjected to a mercurial treatment. It is certain that with the disuse of mercury to produce salivation, and the dire consequences of the saturation of the system with that mineral, the use of sarsaparilla grew less and less frequent; so that it at last came to be prescribed, not so much from a belief in its utility as to gratify the popular faith in its virtues. Some have gone so far as to declare that the various decoctions of sarsaparilla are curative solely by means of the water which they contain; a judgment which, in view of the powers manifested by its active principles, seems to be exaggerated, if not erroneous. It is the more difficult to determine the value of sarsaparilla in the treatment of syphilis, because it is nearly always associated with other active medicines, as with guaiacum and mezereon in the compound decoction, and with guaiacum in the compound syrup of sarsaparilla. Of the officinal preparations the former is the only one that is worthy of being used. It is customary to associate with it iodide of potassium, which is commonly curative without the sarsaparilla.

Zittmann's decoction for the cure of syphilis is one of the most celebrated and efficient preparations of sarsaparilla. It is composed of two decoctions, a stronger and a weaker. The former is prepared as follows: Take 12 ounces of clipped sarsaparilla and 72 pints of water, and allow them to digest for twenty-four hours; then add ʒvj each of powdered sugar and alum, and in a covered vessel expose to a steam-bath until the liquid is reduced to 24 pints. Towards the close of the operation add anise and fennel of each ℥ss, of senna ℥iij, and of sliced liquorice root ℥iss. Press and strain, and, after standing until cool, decant the clear liquid and bottle 24 pints. In the original formula, besides the sugar and alum, there were added 4 parts (℥ss) of calomel, and 1 part (ʒj) of sulphuret of mercury inclosed in a linen bag, and allowed to remain in the liquid during the boiling, which furnished to it a very minute proportion of corrosive sublimate. The weaker decoction is prepared by adding, to the dregs of the stronger decoction, of fresh sarsaparilla ℥vj, and 72 pints of water, and boiling as before; but towards the end of the ebullition are added ʒiij each of lemon-peel, cinnamon, and liquorice root. In using this mode of treatment, which lasted from two to four weeks, the patient was required to live on a mild diet, and drink of the stronger and weaker decoctions alternately; *e. g.*, every morning from 10 to 16 fl. oz. of the former, and every evening the same quantity of the latter, or morning and evening a like quantity of the stronger decoction, but warm at the one time and cold at the other, and between the two an equal quantity (Oij) of the weak decoction. Of the virtues of this preparation we have the authority of Erasmus Wilson for saying that in extreme and very obstinate cases of the ulcerating forms of syphilis which have resisted both mercury and iodine, and particularly in those most difficult of all cases, where the disease has got possession of the tongue and the mucous membrane of the mouth, it may often be had recourse to with great success.

SASSAFRAS, *U. S.*—SASSAFRAS.

SASSAFRAS MEDULLA, *U. S.*—SASSAFRAS PITH.

Sassafras officinale, *Nees*, s. Laurus sassafras, *Lin.* Bentley and Trimen, Med. Plants, 220.

Nat. Ord.—Lauraceæ.

Origin.—Sassafras is indigenous to North America from Canada southward to the Gulf of Mexico. It remains shrubby in the North, but attains a height of 40 or 50 feet in the Southern States. The trunk has a rough furrowed gray bark, but the young branches are of a brown color. The wood is very strong and durable. The leaves are alternate, petiolate, three to six inches long, bright green and smooth above, downy beneath, especially when young; broadly ovate in shape, and entire or some of them two- or three-lobed, all, however, with a wedge-shaped base. The greenish-yellow flowers appear before the leaves in March and April or May, are diœcious, grow in downy racemes, and have linear bracts at the base and a deeply six-lobed perianth. The male flowers have nine stamens in three rows, and the female flowers six short imperfect stamens. The fruit is a dark blue, oval or ovoid, one-seeded drupe, supported in the permanent base of the perianth and on the thickened clavate reddish peduncle. The flowers have an agreeable though not a strong odor; the bark of the branches is aromatic, but differs in flavor from that of the root; the leaves contain a considerable quantity of mucilage.

Description.—The following parts are recognized by the Pharmacopœias:—

1. SASSAFRAS, *U. S.;* CORTEX SASSAFRAS. Sassafras bark, *E.;* Ecorce de sassafras, *Fr.;* Sassafrasrinde, *G.*—Only the root bark is employed. It is deprived of the dark gray, inert, corky layer, is nearly white in the fresh state, and is seen in commerce in irregular flattish or curved pieces, usually two or three inches in length and width. It is of a bright rust-brown color, on the inner surface finely striate and glistening, rather soft and fragile, breaks with a short corky fracture, and on transverse section is radially striate. It has a strong fragrant odor, and a sweetish, aromatic, somewhat astringent taste.

2. SASSAFRAS RADIX, *Br.;* Lignum sassafras, *P. G.* Sassafras root, *E.;* Bois de sassafras, *Fr.;* Sassafrasholz, Fenchelholz, *G.*—The root is medicinally employed in Europe, but not in the United States. It comes in crooked and branching pieces varying in size, and in color between yellowish-white and pale brownish or reddish. The wood is rather spongy, porous, light, composed of numerous annual layers, and marked by narrow medullary rays; it has the odor and taste of the bark, but in a much milder degree. The German name *Fenchelholz* (fennel wood) has reference to the fancied resemblance of its odor to that of fennel.

3. SASSAFRAS MEDULLA, *U. S.* Sassafras pith, *E.*—It is obtained from the branches, and is met with in slender, cylindrical, very light pieces, having a white color, being nearly inodorous, and having an insipid mucilaginous taste. When macerated in water, it forms a ropy but non-tenacious liquid, which is not precipitated by alcohol.

Constituents.—Sassafras bark was examined by Reinsch (1845), who obtained from it volatile oil (page 995), tannin, sassafrid, starch, resin, waxy matter, mucilage, and coloring matter. On treating the bark, previously exhausted by ether, with alcohol, evaporating the alcohol, and macerating the extract with water, *tannin* is dissolved, yielding with ferric salts bluish-green precipitates, and *sassafrid* remains behind as a light reddish-brown, inodorous, and nearly tasteless powder, which is nearly insoluble in ether, and separates from its hot concentrated alcoholic solution in yellowish-brown crystalline granules. Its solutions are colored red by alkalies, and precipitated carmine-red by alkaline earths, dark greenish-brown by ferric salts, and whitish by acetate of lead. It is doubtless an oxidation product of tannin. Pectin could not be found. The bark contains about 6 per cent. of tannin and over 9 per cent. of sassafrid. According to Procter (1866), fresh sassafras bark contains no sassafrid, but this is formed from the tannin on exposure to air. The woody portion of the root contains the same constituents, but in smaller proportion. The principal constituent of sassafras pith is *mucilage.*

Off. Prep.—1. *Of the bark and root:* Decoct. sarsaparillæ (sarsæ) comp., *U. S.*, *Br.;* Extract. sarsaparillæ fluidum comp., *U. S.* 2. *Of the pith:* Mucilago sassafras, *U. S.*

Medical Action and Uses.—Sassafras bark is believed to be somewhat stimulant, quickening the pulse slightly, promoting digestion, and increasing the secretions of the skin and kidneys. It was formerly used in the treatment of chronic *syphilis* and diseases of the *skin*, and is one of the medicines which are popularly supposed to purify the blood. Its real virtues, if any, are undetermined. It may be given, *ad libitum*, as an infusion made with from half an ounce to an ounce of the bark in half a pint of hot water.

Sassafras pith is used to form a mucilage with cold water. It is demulcent and at the same time a very mild local stimulant. An infusion of it may be used internally as a drink in *dysentery*, in inflammations of the *throat*, *air-passages*, and *stomach*, and in febrile affections generally. It forms an agreeable and efficient collyrium in cases of acute *conjunctivitis*, and serves as a vehicle for more active remedies.

SAURURUS.—Lizard's Tail.

Saururus cernuus, *Lin.* *Nat. Ord.*—Saururaceæ.

Description.—This is a common North American perennial, inhabiting swampy localities. Its stem is about two feet high, and rather weak. The leaves are alternate, petiolate, about four inches long, heart-shaped, entire, pointed, convergingly ribbed, slightly hairy, and underneath pale-green. The flowers are in a slender, crowded, terminal, spike-like raceme, which is three or four inches long, are destitute of any floral envelope, contain six hypogynous stamens, and three or four ovaries united at the base, and produce a somewhat fleshy berry-like fruit. The entire plant has an aromatic but rather unpleasant odor and a somewhat acrid taste.

Constituents.—The plant has not been analyzed.

Medical Action and Uses.—The root is used in poultices as an application to *abscesses* and other painful swellings, and a decoction of it is sometimes employed in irritations of the urinary passages and bowels.

SCAMMONIÆ RADIX, *Br.*—Scammony Root.

Racine de scammonée, Fr.; *Scammoniawurzel*, G.

SCAMMONIUM, *U. S.*, *Br.*—Scammony.

Scammonée, Fr.; *Scammonium*, G.

The root and the resinous exudation from the root of Convolvulus scammonia, *Lin.* Bentley and Trimen, Med. Plants, 187.

Nat. Ord.—Convolvulaceæ.

Origin.—The scammony plant is an herbaceous twining perennial, growing in Syria, Asia Minor, and Greece; has alternate, triangular-cordate, very acute leaves, large, funnel-shaped, pale-yellowish flowers, and ovate-globose capsules containing four angular seeds.

Description. 1. Scammony root.—It is one or two feet and more in length, two or three inches thick in the upper part, cylindrical, somewhat tapering below, more or less twisted, with several short stem-fragments at the crown, longitudinally wrinkled, of a grayish- or yellowish-brown color externally and paler within. The root is hard, and when fractured exhibits a thin bark, radially arranged wood-bundles and medullary rays, and resinous spots varying in size. It has but a slight odor, and a sweetish afterwards acrid taste.

2. Scammonium.—This is collected by laying the upper portion of the root bare, cutting the top off in an oblique direction, and collecting the milk-juice in shells, the contents of which are mixed together with the juice scraped from the root and dried. Scammony is met with in commerce in irregular angular pieces or circular cakes, of a greenish dark ash-gray or dark-brown nearly black color; it breaks readily with an angular or splintery fracture, and exhibits in the interior small fissures and cavities, and a resinous lustre. When triturated with water it yields a greenish emulsion; its powder has a gray or greenish-gray color. It yields to alcohol or ether not less than 75 (*U. S.*), and sometimes as much as 95 per cent. of its weight; and when the solvent has been evaporated and the

resinous residue dissolved in warm solution of potassa, no precipitate is produced on the addition of an acid. The portion left undissolved by alcohol or ether is nearly colorless, and is not colored blue by iodine. Scammony has a peculiar cheese-like odor and a slight taste, leaving an acrid sensation in the fauces.

The best quality of scammony is known in commerce as *virgin scammony.* Of late years, scammony is usually sold in the market, at least at wholesale, by the amount of resin it contains, a commendable custom, which we believe has been introduced in this country through the efforts of Dr. E. R. Squibb.

Adulterations.—A distinction has been sometimes made between *Aleppo* and *Smyrna* scammony, the former being regarded as the pure article; but we have seen in commerce scammony sold as one or the other kind which was very impure. The adulterations usually consist of farinaceous substances, chalk, and earthy material, which can easily be recognized by their insolubility in ether. Scammony thus adulterated is frequently smooth externally, dense, heavy, and effervesces when thrown into dilute hydrochloric acid, or its decoction with water yields a blue color on the addition of iodine.

A factitious scammony has been described by European writers as *Montpellier scammony*, and is said to be the milk-juice of Cynanchum monspelliacum, *Lin.*, mixed with other substances. It is said to have been occasionally imported into this country. Though it may be made to resemble true scammony in appearance, it does not show the behavior to solvents described above.

Constituents.—Scammony root is stated to be richest in resin immediately before the flowering period. Good roots will yield about 5 per cent. of resin. The other constituents are starch, mucilage, tannin, and other common principles. According to the British Pharmacopœia scammony should contain between 80 and 90 per cent. of resin. The pure resin has been named *scammonin;* its composition, derivatives, and relation to allied resins have been described on pages 777 and 1188.

Off. Prep.—1. *Of the root.* Resina scammonii, *Br.*

2. *Of scammony.* Confectio scammonii, Pil. colocynthidis comp., Pil. colocynth. et hyoscyami, Pulv. scammonii comp., *Br.;* Resina scammonii, *U. S.*, *Br.*

History.—Scammony, or, at least, the concrete juice of a convolvulus, was well known to the Greek, Latin, and Arabian medical writers, who agree in ascribing to it active irritant and purgative qualities. It was used externally in the treatment of cutaneous diseases, and in a tampon to provoke abortion. As a purgative they described its harsh, painful, and exhausting action, and its cholagogue qualities, and mention that it may produce cold sweats, syncope, and even death. To guard against its violent operation they advised that it be associated with certain gums, oils, mucilage, etc.

Physiological Action.—No other purgative is so uncertain as scammony, partly in consequence of its adulteration with inert substances, and in part from its slight solubility in the gastro-intestinal contents when these are acid. It is singular that while in some experiments upon animals it occasioned active, exhausting, and even fatal purgation, yet in others it inflamed the bowels and killed the animals without purging at all. Careful experiments show that the resin of scammony is a less active cathartic than scammony itself, unless finely divided by trituration. It appears also that in the case of both, very slightly increased effects are obtained by a large increase of the dose, a result doubtless due to the imperfect solubility of the medicine. That its active principle is absorbed appears from the following case: A healthy woman, nursing a healthy child two months old, took a dose of scammony to relieve herself of constipation; she suffered no purgation nor any other symptoms attributable to the medicine, but her child was presently seized with violent cholera morbus which rapidly ended in collapse and death.

Medical Uses.—Scammony is hardly ever used alone at the present day, although, on account of its tastelessness, it has been recommended as a purgative for children. Even in the cases for which it has been thought to be peculiarly applicable as a hydragogue, colocynth, jalap, and even gamboge are to be preferred; and the same may be said in regard to its association with calomel as a cholagogue purgative. The compound powder of scammony is possibly preferable to scammony or to jalap alone when a powerful derivative action from the brain is desired.

The *dose* of ordinary scammony is from ten to twenty grains, and of pure scammony or of its resin, from five to fifteen grains. It may be given powdered, in a wafer, but is inactive in the pilular form. It is also administered in emulsion with milk, almond milk, mucilage, or other demulcent, sweetened.

SCILLA, *U. S.*, *Br.*—SQUILL.

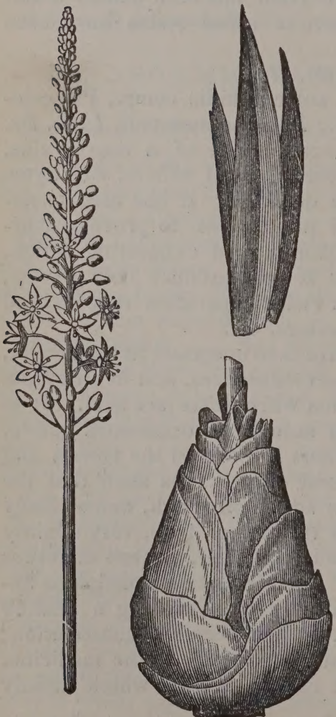
Bulbus scillæ, P. G.—*Squills*, E.; *Scille*, *Squille*, Fr.; *Meerzwiebel*, G.

The bulb of Scilla maritima, *Lin.*, s. Urginea scilla, *Steinheil*, s. Urg. maritima, *Baker.*

Nat. Ord.—Liliaceæ.

Origin.—The squill is indigenous to the basin of the Mediterranean from Syria westward to the coast of the Atlantic. It grows in sandy and sunny places near the seashore, but is likewise found inland to some extent and in hilly localities. Two varieties are known, which differ only in the color of their bulb-scales, being of a reddish tint in the one and whitish in the other variety. The leaves make their appearance during the flowering period, and are broad-lanceolate, twelve to eighteen inches long, channelled, finally recurved and spreading. The scape attains a height of three or four feet, and is terminated by a long raceme of whitish, green-nerved flowers, with six stamens inserted on the base of the sepals. Along the Mediterranean the bulb is frequently employed in the fresh state; but in the United States it is now rarely seen in this condition, being imported in dried segments to the amount of about 40,000 pounds annually.

Fig. 168.



Scilla maritima, *Lin.*

Description. — The bulb of squill is broadly ovate or somewhat pear-shaped, and is from three to six inches long and of the same thickness at its lower portion, weighing sometimes over four pounds. It consists of a large number of fleshy scales, which are either whitish or reddish, and covered by dry reddish-brown and scarious scales. The bulb is collected while leafless, about the month of August, freed from the inert outer and small central scales, and from the dense stem portion and rootlets, and then cut transversely into segments, which are dried in the sun. Thus prepared it is found in the market, and consists of narrow slices about one-quarter inch wide and one or two inches long, somewhat translucent, yellowish-white or reddish, brittle and pulverizable when dry, but very hygroscopic, and therefore often flexible. Squill is scentless, and even in the fresh state is but slightly odorous; it has a mucilaginous, somewhat bitter and acrid taste. When dried and powdered, it is easily converted into a solid hard mass from the absorption of moisture. In damp weather squill loses on drying from 10 to 14 per cent. of its weight.

Constituents.—Squill has been frequently the subject of chemical investigation, but even at the present time the medicinally important principles of this drug are not satisfactorily known. Two such principles are usually distinguished: one, having a bitter taste, is called *scillitin;* the other, being acrid, has received the name *skulein.* Wittstein (1850) observed that the expressed juice of fresh squill yields with alcohol a precipitate consisting mainly of gum, and amounting to 28 per cent. of the dry drug; the filtrate was freed from alcohol by evaporation, fermented with yeast, and, after the sugar had been thus destroyed, yielded with acetate of lead a slight precipitate. After removing the lead from the filtrate by sulphuretted hydrogen, the resulting extract had a bitter and acrid taste, the latter of which was removed by agitation with hydrate of lead, but not by baryta. The earlier investigations were less successful. Vogel's and Tilloy's *scillitin* was amorphous and neutral; both regarded the acrid principle as being volatile. Landerer and Marais (1857) obtained compounds which they regarded as alkaloids. But Tilloy (1854) proved the non-existence of such a body in squill, and announced then that squill does not contain any volatile acrid principle; the compound producing irritation of the skin was by him believed to be crystallized citrate of calcium. Labourdais (1849) obtained the bitter principle, after precipitating the infusion of squill with acetate of lead, by treating it with animal charcoal, and exhausting this with hot alcohol; and Bley obtained it once by this process in flexible needles. The presence of crystals in squill was recognized long ago, but these were generally considered to be either tartrate, carbonate, or citrate of calcium, until Schroff (1864) proved them to be very fine and sharp-pointed needles of *oxalate of calcium.* Schroff is likewise convinced of the existence of a non-volatile acrid, besides the bitter principle, and of the greater efficacy of the red-colored variety of the drug. The bitter principle forms a compound with tannic acid (Pharmacographia). The whole subject requires further investigation.

Off. Prep.—Acetum scillæ, *U. S., Br.;* Oxymel scillæ, Pil. ipecacuanha cum scilla, *Br.;* Pil. scillæ comp., Syr. scillæ, *U. S., Br.;* Syr. scillæ comp., *U. S.;* Tinct. scillæ, *U. S., Br.*

History.—Squill was used by the Greeks and their medical followers in Rome, Arabia, and Europe. Its preparations with honey and vinegar were anciently employed in dropsical affection, and the latter were extolled in the treatment of spongy and ulcerated gums, ulcerated throat, and debility of the digestive organs.

Physiological Action. *On Animals.*—Squill acts poisonously upon various animals. The camel is said to reject it from among the plants on which he browses. It is fatal to mice, rabbits, cats, dogs, swine, fowls, etc. In most of these animals it appears to occasion pain with vomiting, great distress and purging, and loss of muscular power, or convulsions. When administered to dogs the animals grow dull, slaver, and seem nauseated; vomiting and liquid stools follow. If the dose be large, trembling succeeds, and paralysis of the hinder and then of the anterior limbs. Convulsions ensue with general muscular resolution immediately before death. Four grains of scillitin have destroyed a dog of medium size within twenty-four hours. In rabbits the alcoholic extract of squill, and also scillitin, occasion contraction of the pupils, great debility, sinking of the pulse, diuresis, dyspnœa, and death. After death by scillitin, inflammation and erosion of the stomach, and hemorrhagic transudations about the heart and lungs and in the kidneys and brain, are found. Later experiments appear to show that in animals (cats, rabbits, pigeons, frogs) the extract of squill renders the pulse less frequent, and causes death by arresting the heart in systole before respiration is suspended; to this action, which implies an augmented arterial blood-pressure, the diuretic operation of the medicine is attributed. In these experiments the extract of squill (contrary to earlier observations) does not appear to have produced any lesion of the stomach, nor any inflammation of the kidneys or bladder; but the lungs, and sometimes the pleuræ, were congested as an effect of the impeded circulation through the heart. No depression of the animal temperature was observed (Husemann and König).

On Man.—The juice of the fresh plant applied to the skin acts a rubefacient, and has also occasioned diuresis. Even the powder of the dried corm applied to the denuded cutis has had the same effect in dropsy. Its local action is irritating, which is ascribed to the large proportion it contains of oxalate of lime. Internally the effects of a very large dose of squill are violent vomiting, purging, and colic, dysury or bloody urine, rapid breathing, a cold skin, coma, and general convulsions. It has even destroyed life. In small or medicinal doses it usually exerts a diuretic action, tends to relax the bowels, and reduces the frequency and increases the tension of the pulse. The characteristic effects are most distinctly produced by the powder or the wine of squill. The syrups of squill, in medicinal doses, and in disease, appear to act rather upon the bronchial mucous membrane. The continued use of squill impairs the appetite and digestion.

Medical Uses.—Although there is nothing in the results of scientific investigations even to suggest that squill acts upon the bronchial mucous membrane, the much more direct and conclusive evidence of clinical experience leaves no doubt of its great value in *bronchitis*, whether of an acute form, when the sputa are tenacious and scanty, or of a chronic type occurring without complication, or associated with obstructive disease of the heart and pulmonary emphysema. It is of daily use as an expectorant in the treatment of *spasmodic croup*, but in the form of compound syrup of squill, which owes its efficacy chiefly to the antimony it contains.

As a diuretic, squill is universally employed in *dropsy*. Even when the effusion is owing to some organic and incurable lesion, it may often be temporarily evacuated by squill. The experimental researches into its mode of action in dropsy have tended to confirm what was long ago established by clinical experience, that it is most useful in the passive forms of the disease, when the pulse is weak and the heart feeble or obstructed, and when there is neither fever nor an irritable condition of the kidneys present. Undoubtedly it is oftener useful in cardiac than in renal, splenic, or hepatic dropsy. Some persons conceive that its action is very analogous to that of digitalis, which, within certain limits, is true, but is not the whole truth. The diuretic action of neither medicine is due exclusively to its sensible sedative action on the heart. Squill is not so apt as digitalis to cause sudden and alarming depression. The best mode of using these medicines in dropsy is to combine them in the same prescription, in pilular form, or as tinctures with compound spirit of juniper, or with a solution of acetate of potassium in water. When the stomach is intolerant of the medicine, it may be administered by rubbing its tincture with that of digitalis into the skin, or applying compresses saturated with these liquids to the abdomen and covering them with impermeable cloth. The powdered drug, or drugs, may also be applied endermically. In the *hydrocele* of young subjects a cure has been effected by applications of vinegar of squill. Powdered squill has been used to remove *warts*.

The *dose* of squill in substance is from one to three grains three times a day in pilular form. It may gradually be increased to ten grains a day. As a general rule, if it disturbs the stomach the dose should be reduced. An infusion is sometimes employed, which is made with from half a drachm to a drachm of squill in half a pint of hot water, of which from two to four fluidrachms may be given at a dose.

SCOPARIUS, *U. S.*—BROOM.

Scoparii cacumina, Br.; *Herba scoparii.—Broom tops*, E.; *Genêt à balais*, Fr.; *Besenginster, Pfriemenkraut*, G.

The tops of Sarothamnus (Cytisus, *Link*) scoparius, *Koch*, Sar. vulgaris, *Wimmer*, Genista scoparia, *Lam.*, Spartium scoparium, *Lin.* Bentley and Trimen, Med. Plants, 70.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The broom is a shrub about three to six feet high, and grows in Western Siberia and throughout Southern Europe, but is more abundant in the western part of that continent and in Great Britain. It is sometimes cultivated in our gardens, and is occasionally met with wild in some of the Middle and Southern States. It prefers a sandy soil, and flowers in May and June. The shrub has long wand-like branches, small trifoliate leaves with obovate or elliptic-lanceolate sessile leaflets, and produces an abundance of large golden-yellow papilionaceous flowers, and a flat dark-brown legume, which is white-hairy on the edges, and contains about twelve olive-colored, oblong, and, below, truncate seeds.

Description.—The green twigs constitute the portion generally employed. They are long, thin, and flexible, pentangular, winged, but not spiny, smooth, except the extremities, which are pubescent, and usually free from leaves and flowers. In the fresh state they have a peculiar odor, but are nearly inodorous after drying; their taste is bitter and disagreeable. The *flowers* have been occasionally employed; on drying they usually become brown, and their honey-like odor is almost entirely lost; their taste is nauseous and bitter.

Constituents.—The analyses by Reinsch and Cadet de Gassicourt failed to isolate any important principle. Subsequently (1851) Stenhouse isolated two interesting principles, scoparin and sparteina. *Scoparin*, $C_{21}H_{22}O_5$, is obtained from the concentrated decoction of broom-tops, which gelatinizes on standing; the jelly-like mass is expressed, and purified by repeated solution in hot water and finally in hot alcohol. Scoparin is amorphous and brittle, or in small crystals, has a pale-yellow color, yields with lead acetates green-yellow precipitates, and furnishes picric acid when treated with nitric acid; it is inodorous and tasteless. *Sparteina*, $C_{15}H_{13}N_2$, is best obtained, according to Mills (1861), by exhausting broom with acidulated water, and distilling the concentrated liquid with soda. In its pure state it is a colorless, transparent, oily liquid, which becomes brown on exposure, has a slight anilin-like odor, changing on rectification, a very bitter taste, a strongly alkaline reaction, and yields amorphous and crystallizable salts. The alkaloid is but slightly soluble in water and alcohol. 150 pounds of the plant yielded 22 cubic centimeters of sparteina.

Off. Prep.—Decoct. scoparii, Succus scoparii, *Br.*

Allied Species. SPARTIANTHUS JUNCEUS, *Link* (Spartium, *Lin.*, Genista, *Lam.*), *Spanish Broom.*—This evergreen European shrub resembles the preceding, but has obtuse-lanceolate, at the base wedge-shaped, and on the lower side soft-hairy leaves, and nearly reniform seeds. The branches, leaves, and seeds have a bitter taste, and are stated to possess diuretic, purgative, and emetic properties.

CYTISUS LABURNUM, *Lin.*—This is a shrub or small tree of Southern Europe, which is cultivated for ornament. The leaves are pinnately trifoliate with oval-oblong, on the lower side soft hairy leaflets. The bright-yellow flowers are in lax racemes, and produce long, linear, many-seeded legumes, with dark-brown subreniform seeds. The leaves, and more so the seeds, have a nauseous, bitter, and acrid taste. The fruit contains two poisonous alkaloids, *cytisina* and *laburnina*, the former of which is deliquescent and neutralizes acids, while crystallizable double salts only have been obtained with laburnina. Both alkaloids were discovered by Husemann and Marmé (1865).

History.—Broom had long been known and used by the people as a remedy for dropsy, and its virtues had been celebrated by Floyer and by Culpepper in the 17th century, when Mead and Cullen introduced it into medical practice. Even the shepherds were accustomed to cure their dropsical sheep by feeding them with the fresh plant. A German clergyman, also, first published an account of its virtues in eczema and other cutaneous diseases.

Medical Action and Uses.—No other medicine is entitled to more credit than broom for removing *dropsical effusions.* Its diuretic virtues depend in part upon the carbonate of potassium which abounds in it, and in part, also, upon its proximate principle, sparteina. The latter is a sedative of the spinal reflex centres, and in a less degree of the circulatory system, and it even acts upon some of the lower animals in a slight degree as a narcotic (Fick). These effects have caused it to be compared with conia; but they do not in the least degree explain the value of broom as a diuretic medicine.

Broom is applicable to all forms of *chronic dropsy*, as one of the most efficient of hydragogues, acting both by the bowels and the kidneys. It is best given in a decoction prepared by boiling half an ounce of the tops in half a pint of water in a covered vessel for ten minutes. This quantity may be taken in divided doses in twenty-four hours. Or the officinal decoction (British Pharmacopœia) may be used instead. A compound decoction, which is still more efficient, may be prepared by boiling broom-tops and dandelion, of each half an ounce, in a pint and a half of water to a pint, and near the close of the process adding half an ounce of juniper berries. When cold, the decoction should be strained. One or two fluidounces may be given at a dose.

SCROPHULARIA.—FIGWORT.

Scrofula plant, E.; *Scrofulaire*, Fr.; *Kropfwurz*, *Knotenwurz*, G.

Scrophularia nodosa, *Lin.* *Nat. Ord.*—Scrophulariaceæ.

Origin and Description.—Figwort is a perennial herb growing in damp places in Europe and North America. The American plant is usually taller, growing to the height of four or five feet, and has an obtusely angled stem, but otherwise agrees closely with the European plant; it was formerly regarded as a distinct species, as Scrophularia marilandica, *Lin.* The plant has a horizontal branching, fleshy *rhizome*, to which numerous oblong or oval tubers of the thickness of a thumb are attached. The *leaves* are opposite, petiolate, ovate-oblong, rounded or heart-shaped at the base, and cut-serrate on the margin. The flowers are in a terminal loose panicle, have a greenish-brown, tubular-globose, five-lobed corolla with four stamens, and produce a two-celled many-seeded capsule. The fresh plant, bruised, has an unpleasant odor, and a nauseous, bitter, and acrid taste; after drying it is nearly inodorous.

Constituents.—The fresh flowering plant was analyzed by Walz (1853), who found in the aqueous distillate *acetic* and *propionic acids*, and a stearopten *scrophularosmin.* On treating the decoction with acetate and subacetate of lead, tannic, tartaric, citric, and malic acids, pectin and coloring matter were precipitated, and the filtrate, after freeing it from lead, yielded with tannin a precipitate containing *scrophularin.* This principle crystallizes in scales, has a bitter taste, and is soluble in water and alcohol. Scrophularia aquatica, *Lin.*, contains the same principle, and in addition thereto a resinous body, *scrophulacrin*, which is soluble in ether.

Medical Action and Uses.—S. nodosa and S. aquatica appear to possess analogous qualities. The generic name of the plant appears to have been gained through a popular belief that it was useful in *scrofula*. It was employed in the glandular form of the disease, and also in cutaneons affections originating in the strumous diathesis. It was also applied to hemorrhoids and anal ulcers, and as a dressing for unhealthy wounds and sores generally. The fresh juice, and also a decoction of the leaves or root, were employed.

SCUTELLARIA, *U. S.*—SKULLCAP.

Hoodwort, *Madweed*, E.; *Scutellaire*, Fr.; *Helmkraut*, G.

Scutellaria lateriflora, *Lin.* *Nat. Ord.*—Labiatæ, Stachydeæ.

Description.—This species, in some places known as *mad-dog skullcap*, is a common North American perennial herb, growing in swampy and wet places. Its stem is about two feet high, quadrangular, smooth, and much branched. The leaves are opposite, petiolate, about two inches long, oval-lanceolate, pointed, coarsely serrate, rounded at the base, thin, and smooth. The flowers are small, in slender axillary leafy racemes, with a minute filiform bract at the base of each pedicel, and with a pale-blue or purplish bilabiate corolla. The calyx is divided into two entire lips, the upper with a helmet-like appendage on the back. The herb flowers in July, and should then be collected; it has a slight odor and bitterish taste. Its constituents have not been ascertained.

Allied Species.—The following and probably other indigenous species of Scutellaria possess a more decidedly bitter taste and are occasionally employed:—

SCUT. INTEGRIFOLIA, *Lin.*—It is twelve to eighteen inches high, minutely hairy all over, has lance-oblong or linear-oblong, mostly entire, short petiolate leaves and terminal racemes of blue flowers, which are about an inch long.

SCUT. PILOSA, *Lin.*—It is one or two feet high, covered with spreading hairs, has rhombic- or oblong-ovate, crenate, petiolate leaves in distant pairs, and short terminal racemes of rather large purplish-blue flowers.

SCUT. GALERICULATA, *Lin.*—It is somewhat downy, has short-stalked, lance-ovate, crenately serrate leaves, which are rounded or heart-shaped at the base, and bears in the axils of the upper leaves rather large blue flowers, which are turned to one side. This species is indigenous to Europe, Northern Asia, and the northern section of North America.

BRUNELLA (PRUNELLA) VULGARIS, *Lin.;* Heal-all, Self-heal, *E.;* Pâquerette, *Fr.;* Braunelle, Braunheil, G.—This is a perennial herb common in fields, grassy places, and in woods in North America, Asia, and Europe. Its ascending stem is about twelve inches long; the leaves are about one inch and a half long, petiolate, oblong-ovate, entire or somewhat toothed, and more or less hairy. The flowers are purplish-blue, and form a dense leafy-bracted spike. The herb is nearly inodorous, and has a bitterish and somewhat astringent taste.

Constituents.—These plants doubtless contain principles which are similar to those found in other plants of the same order.

Medical Action and Uses.—Skullcap has been given in extract, fluid extract, and infusion, and has had some repute as a nervine, that is, in diseases presenting a depressed and disordered condition of the nervous functions. But there is no evidence of its virtues which entitles it to a place among officinal drugs.

SEDUM.—STONECROP.

Mossy stonecrop, E.; *Joubarbe âcre*, *Poivre des murailles*, Fr.; *Mauerpfeffer*, G.

Sedum acre, *Lin.* *Nat. Ord.*—Crassulaceæ.

Description.—This little moss-like spreading plant is indigenous to Europe, where it grows in dry fields and on old walls; it is cultivated in gardens, and runs wild in some places in North America. Its leaves are one-eighth of an inch long, alternate, nearly imbricate, in about six spirally turned rows, ovate, thick, convex on the back, and smooth. The flowers are on one side of the branched inflorescence, forming scorpoid cymes, and have four or five yellow petals, the same number of pistils, and twice that number of stamens. The plant is inodorous, and has a mucilaginous and acrid taste.

Constituents.—Mossy stonecrop is stated to contain mucilage and malates; its acrid principle has not been isolated.

Allied Species. SEDUM TELEPHIUM, *Lin.;* Live-for-ever, Garden-orpine, *E.;* Joubarbe des vignes, Grassette, *Fr.;* Grosse Fetthenne, *G.*—It is likewise indigenous to Europe, and in the United States has escaped from cultivation. It has a spindle-shaped root, an ascending stem about eighteen inches high, and oval or ovate, obtuse and toothed sessile leaves, which are two or three inches long, and are either alternate, opposite, or in whorls of three. The purplish or greenish flowers are in dense compound cymes.

SEMPERVIVUM TECTORUM, *Lin.;* Houseleek, *E.;* Grande joubarbe, *Fr.;* Hauswurz, Dachwurz, *G.*—It is indigenous to the Alps, but now grows spontaneously throughout Europe on roofs and old walls, and is cultivated in North America. It has numerous fleshy rosulate radical leaves, which are about an inch long, obovate in shape, of a green color, and on the margin stiff-hairy, and often of a brownish or reddish color. The flowers are rose-colored and purplish. The leaves have an acidulous taste and contain malates.

Medical Action and Uses.—Experiments upon animals appear to show that stonecrop is an active local irritant and a depressor of the nervous system. In man the expressed juice, in large doses, acts as an acrid emetic and purgative, and is capable of blistering the skin. Sedum was formerly in common use as a remedy for *scrofula*, and was administered internally in decoction, and applied to the ulcerated skin, etc. Its emeto-cathartic action was employed in the treatment of *intermittent fever*, and also in *epilepsy*, with a certain degree of success, but the plant appears to have been found more really useful when it was applied bruised, or its expressed juice was used as an application to scrofulous, cancerous, and other *ulcers*, as a resolvent to enlarged lymphatic *glands*, and as a dressing for chronic *diseases of the skin.* The juice has also been used to remove *warts* and *corns.* The dried plant was prescribed internally in powder in the *dose* of twelve or fifteen grains. Or a decoction was made with a handful of it in a pint of beer. The juice was given in doses of two or three fluidrachms in wine. Externally the bruised fresh plant was generally preferred.

Houseleek has been described as refrigerant, astringent, antispasmodic, and detergent. Its expressed juice was once prized in *dysentery*, and in *hysterical* disorders, and externally as a dressing for *ulcers* and chronic *skin diseases*, *hæmorrhoids*, etc. It is also used to soften *corns* and *warts.*

SELINUM.—MARSH PARSLEY.

Radix olsnitii.—Sélin (Persil) des marais, Fr.; *Sumpfsilge, Elsenich*, G.

The root of Selinum (Thysselinum, *Hoffm.*, Peucedanum, *Moench*) palustre, *Lin.* *Nat. Ord.*—Umbelliferæ, Orthospermæ.

Origin.—This is a perennial plant, indigenous to Europe, and growing in swampy and moist localities. It is two to four feet high, has twice or thrice pinnately divided and cleft leaves with linear-lanceolate lobes, large and lax compound umbels of white flowers, and oval-oblong brown fruits.

Description.—The root is four to six inches long, in the upper part one-half to one inch thick, one- or several-headed, annulate above, with deep longitudinal wrinkles, grayish-brown, and with scattered whitish suberous warts. On transverse section the bark is seen to be thick, spongy, and brown, and to contain a circle of rather large laticiferous vessels; the meditullium is soft, and often radially cleft. The root has a strong, disagreeable, somewhat terebinthinate odor, and a pungent and acrid taste. (See also p. 743.)

Constituents.—The chemical constituents are analogous to those of other umbelliferous roots: volatile oil, mucilage, sugar, etc. Peschier's *selinic acid* has not been further investigated.

Medical Action and Uses.—The juice of this plant is said to be irritating and even caustic in its action. Many years ago it was found to be a popular remedy for *epilepsy* in the Russian province of Courland. It afterwards attracted a good deal of attention in Paris, and received for a time greater credit than it deserved. It was exhibited in powder, in the *dose* of thirty or forty grains several times a day. This medicine is no longer employed in epilepsy.

SENECIO.—GROUNDSEL.

Seneçon, Fr.; *Kreuzkraut*, *Jacobskraut*, G.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—Several European species of this genus have been employed, among which may be mentioned Sen. sarracenicus, *Lin.;* S. doronicum, *Lin.;* S. jacobæa, *Lin.;* and S. vulgaris, *Lin.* The latter, with rayless flower-heads, is a common weed in Europe, and sparingly naturalized in North America. It has lanceolate, pinnatifid, and toothed, clasping and rather fleshy leaves, and a cylindrical involucre; it is inodorous, and has a bitterish and saline taste. The most common North American species is Senecio aureus, *Lin.*, known as *golden ragweed*, *squaw-weed*, and *life-root*. It is found on the borders of streams, in thickets, and in swamps, and has a thin horizontal rhizome with numerous slender rootlets; long-petioled, round or roundish heart-shaped, and crenately toothed radical leaves; lyrate or pinnatifid, usually lanceolate stem-leaves, and a corymbose inflorescence with many-flowered heads, having bright-yellow pistillate ray-florets. There are many varieties, differing chiefly in the shape of the radical leaves.

Medical Action and Uses.—Groundsel appears to be emollient and also slightly acrid. It is used in France to prepare gargles for *sore-throats*, to make poultices for *boils* and local *cutaneous eruptions*, and to prepare emollient and laxative enemas.

SENEGA, *U. S.*—SENEKA.

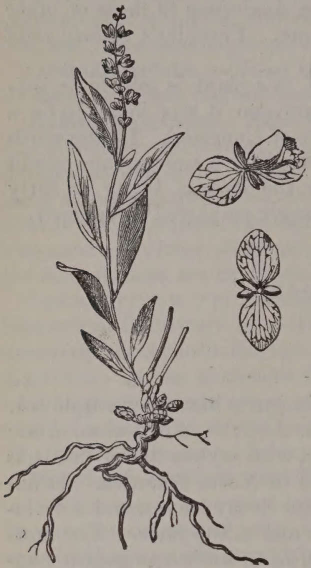
Senegæ radix, Br.—*Senega root*, *Senega snakeroot*, E.; *Polygale de Virginie*, Fr.; *Senegawurzel*, G.

The root of Polygala senega, *Lin.* *Nat. Ord.*—Polygalaceæ.

Origin.—Seneka is a native of North America, from Canada southward to South Carolina, and westward to Wisconsin. It has numerous slender stems, about a foot high from each root. The leaves are alternate, sessile, lanceolate or oblong-lanceolate, rough on the margin, otherwise smooth, and narrowed to both ends. The flowers are nearly sessile, in slender terminal spikes, and have five sepals, of which the two lateral ones are round, petaloid, and rose-colored; the three petals are whitish. Seneka flowers in May and June, and ripens its small two-celled and two-seeded capsule in July. The root is collected in autumn mainly in the Southern and Western States.

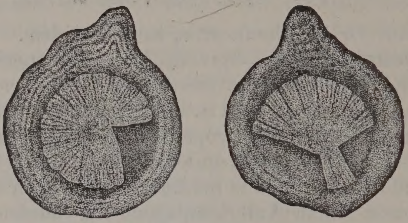
Description.—Seneka root has a head or crown which is one-half or one inch in diameter, very knotty from the numerous thin remnants of stems, and is below contracted into the root having a diameter of one-sixth or one-quarter inch. The root is four to six inches long, and divided into several branches nearly uniform in thickness, which are tapering below, usually spreading, more or less tortuous, fleshy and round when fresh, but after drying twisted and furnished with a projecting ridge or keel, which runs around the root in about one spiral turn from near the base to the tip. Opposite the keel are sometimes seen irregular annulations; otherwise the root is longitudinally wrinkled. Externally it varies in color between yellowish-gray and brownish-yellow, and is whitish internally. When cut transversely, it presents a porous, yellowish, radially striate ligneous portion, and a thick white bark. The wood is circular near the crown, and surrounded by bark nearly uniform in thickness. At some distance from the head, the wood presents a more or less irregular appearance, being rounded on one side, and only partially developed on the opposite side. The bark is seen to consist of two layers, the inner one of which is found chiefly on the rounded side of the wood, and projects conically into the keel, which is therefore formed by the one-sided development of the inner bark. On soaking the root in water, the outer bark swells to a greater extent than the inner layer, and the root becomes again nearly cylindrical. Seneka root has a slight odor when dry, but the liquid preparations of it have a characteristic, rather nauseous odor; the taste is sweetish, and afterwards persistently acrid. The root is brittle, and breaks with a short fracture.

Fig. 169.



Polygala senega, *Lin.*

Fig. 170.



Transverse sections of seneka root.

Constituents.—The acrid taste of seneka root is due to *polygalic acid*, so called by Peschier (1821), who obtained it in an amorphous and adhesive state. Quevenne (1836) prepared it in a purer condition; and Procter (1859) obtained 5½ per cent. of it by exhausting the root with 60 per cent. alcohol, concentrating the tincture to about one-half the weight of the root, removing coloring matter by means of ether, and mixing the syrupy liquid with strong alcohol and ether, which precipitates the polygalic acid as a light fawn-colored powder, requiring to be washed with a mixture of ether and alcohol. On setting aside the liquid from which polygalic acid had been precipitated, Procter obtained a small quantity of crystals, which appear to be the salt of an organic acid. Polygalic acid was called *senegin* by Gehlen (1804), who obtained it in an impure state, and by other investigators. Others called it *polygalin*, but the polygalin of Peschier is volatile, and contained in the aqueous distillate of the root, therefore identical with the trace of volatile oil, so called by Dulong (1827). Bucholz, and afterwards Bolley (1854), regarded senegin as identical with *saponin*, and this view seems to be sustained by the observations of Christophsohn (1874) and Schneider (1875). But Quevenne obtained from an aqueous solution of senegin only a slight precipitate with acetate of lead, which disappeared on the addition of more of the reagent; while Rochleder and Schwarz state that saponin yields, with the same salt, a gelatinous precipitate, which according to Bucholz is soluble in acetic acid. According to Braconnot and Bussy, saponin is not precipitated by acetate of lead. On the other hand the products of decomposition of the two bodies by acids appear to be identical; and the gelatinous mass, observed by Quevenne to be produced from his polygalic acid with cold concentrated hydrochloric acid, and with boiling dilute mineral acids, appears to be *sapogenin*. Evidently further investigations are required to determine the chemical relations of these bodies. According to Trommsdorff (1832) and Schneider, the activity of seneka resides chiefly if not exclusively in the cortical portion.

Seneka contains also *pectin* compounds, which frequently render the liquid preparations of the root gelatinous. This jelly may, under certain conditions, also contain sapogenin, and is rendered soluble again on the addition of an alkali. The *virgineic acid* of Quevenne, and the bitter principle *isolusin* of Peschier, have not been sufficiently investigated. Other less important constituents of seneka are a little resin, fixed oil, 7 per cent. of sugar, etc.

Impurities and Substitutions.—Ginseng root and the rhizome of cypripedium are sometimes found among commercial seneka as accidental impurities. We have been shown two samples of roots which were offered as seneka, but which are entirely distinct from this root and do not resemble it. A third substitute was offered a few years ago as *white seneka;* we have been unable to procure a specimen, nor could we obtain the plant from which this false seneka is derived, but have learned that it was collected in Southwestern Missouri. Greenish recently (1878) described a seneka met with in English commerce which was lighter in color, had a thinner bark, and contained no keel; after a histological examination he concluded that it was a true seneka, but young and immature. We believe this conclusion to be erroneous, for the small roots of all young seneka plants which we have seen had the unmistakable characters of seneka. It is, however, not improbable that the roots of other species of Polygala may have served to furnish the substitute.

Off. Prep.—Decoct. senegæ, Extr. senegæ, Extr. senegæ fluid., *U. S.;* Infusum senegæ, *Br.;* Syrup. scillæ comp., Syr. senegæ, *U. S.;* Tinct. senegæ, *Br.*

Physiological Action.—The following symptoms were caused by taking twenty grains of seneka three times within six hours: An unpleasant irritation of the fauces and throat, with copious salivation, was succeeded by heat at the epigastrium and violent mucous vomiting. The skin, meanwhile, grew moister and warmer, and sharp colic with watery diarrhœa followed. The urine was increased, and scalded when voided. In larger doses seneka excites severe burning pain in the stomach, violent vomiting, purging, anxiety, and giddiness.

The action of *saponin* has been more closely studied. When a bottle containing it is applied to the nostrils, it excites sneezing and a bronchial and post-sternal irritation, which may last for an hour. A strong solution of it applied to the skin of a frog's thigh, or a rabbit's shaven skin, occasions redness due to a thorough capillary congestion, with anæsthesia of the part. The red corpuscles thus aggregated appear to wilt and lose their shape and color.

When a strong solution of saponin is injected into a frog's thigh it impairs the motility and sensibility of the limb, and abolishes the reflex excitability of the muscles. The muscular flaccidity may ultimately be succeeded by tonic rigidity. These effects occur even when the limb is partially or wholly severed from the body of the animal, and are therefore independent of the great nervous centres. If the poison is directly applied to the heart, through the circulation or otherwise, it reduces the frequency and force of the contractions of the organ, and finally paralyzes it. The local effects of its application elsewhere are the first to appear, but gradually the heart and nervous centres become involved.

These phenomena may be described in the current pharmaco-dynamical language of the day as follows: "Saponin, introduced into the blood, paralyzes the muscles and the nerves, and in a peculiar manner the nerves of the heart, since it paralyzes as well the terminations of the vagus and the inhibitory centres, and the accelerator nerves derived from the sympathetic, and finally arrests the movements of the heart. . . Saponin also acts speedily upon the vaso-motor centre, paralyzing it, slowly or rapidly according as the dose is small or large."

Medical Uses.—Physiological investigation of the action of seneka and saponin has shed no light upon their clinical applications. They are useless as practical anæsthetics and cardiac sedatives. Nor does their mode of action help to explain the recognized utility of seneka in the different forms of bronchial and pulmonary disorder in which it has been found advantageous. These are, first, *typhoid pneumonia*, in which, *à priori*, a stimulant and not a sedative remedy is indicated; yet it is precisely in that affection and not in the inflammatory form of pneumonia that seneka has won its reputation, and especially in the decline of the disease, when it would seem that a stimulant expectorant is called for. In like manner seneka is useful in *broncorrhœa* and in chronic *bronchitis* with profuse expectoration. Even in *croup* (spasmodic laryngitis) it is appropriate only after the inflammatory stage with spasm has passed, and the affection has become a simple catarrhal laryngitis. In like manner, when it was prescribed in the treatment of *amenorrhœa*, the cases in which it seems to have done good were those of passive and not of active congestion of the uterine system. The diuretic operation of seneka is too inconsiderable to constitute it a trustworthy remedy in any form of dropsy.

The *dose* of powdered seneka is from ten to twenty grains. The decoction, extract, fluid extract, and syrup are officinal. Of these the decoction and the syrup are most commonly used.

SENNA, *U. S.*—Senna.

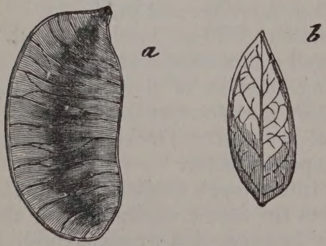
Folia sennæ.—*Senna leaves*, E.; *Feuilles de séné*, Fr.; *Sennesblätter*, G.

The leaves of Cassia acutifolia, *Delile;* of C. obovata, *Colladon;* and of C. elongata, *Lémaire-Lisancourt.* Bentley and Trimen, Med. Plants, 89, 90, 91.

Nat. Ord.—Leguminosæ, Cæsalpineæ.

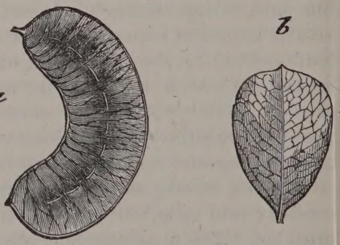
Origin.—The subgenus *Senna* of the genus Cassia is regarded by some botanists as a distinct genus, characterized by the absence of glands from the rachis of the leaves, by the axillary racemose inflorescence, and by the flat, broad, papyraceous legumes, which are indehiscent, cleft on the margin at maturity, and contain near the middle the small triangular or truncately wedge-shaped seeds. The senna-yielding species are small shrubs two or three feet high, have small, persistent stipules, and axillary racemes of yellow flowers.

Fig. 171.



Cassia acutifolia, *Del.*

Fig. 172.



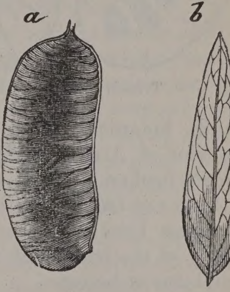
Cassia obovata, *Colladon.*

Cassia acutifolia, *Delile* (C. lanceolata, *Nectoux;* C. senna β, *Lin.;* C. lenitiva, *Bischoff;* Senna acutifolia, *Batka*).—It is found in Upper Egypt, and southward to Nubia, Sennaar, and Kordofan, and westward in some other parts of tropical Africa. The leaflets are mostly in four or five pairs, vary in shape between oval, lance-oval, and lanceolate, and are acute or rather pointed, mucronate, on the under side somewhat hairy or nearly smooth, and are rather thick in texture. The stipules are subulate, and the fruit is broadly oblong, about two inches long, and contains about six seeds.

Cassia obovata, *Colladon* (C. senna, *Forskal;* C. obtusa, *Wallich;* C. obtusata, *Hayne;* Senna obovata, *Batka*).—It is found in Arabia and in Africa from Egypt southward, in Nubia, Abyssinia, and Southern Africa, and westward to Tripoli and Senegal. The leaflets are in four to seven pairs, obovate or oblong-obovate, mucronulate, clothed with few appressed hairs, or nearly smooth. The stipules are linear-lanceolate, acute and rigid, and the legume is curved, rounded at both ends, an inch and a half long, and contains about ten seeds. Batka distinguishes three varieties: α *genuina*, with the leaflets rounded or mucronulate at the apex; β *obtusata*, with the leaflets more blunt; and, γ *platicarpa*, with shorter racemes, and broader and less curved legumes than the preceding. C. obovata is cultivated, and has been naturalized in Jamaica.

Cassia elongata, *Lém.* (C. angustifolia, *Vahl;* C. lanceolata, *Wight and Arnott;* C. acutifolia, *Nees;* C. medicinalis, *Bisch.;* Senna officinalis, *Roxb.;* S. angustifolia, *Batka*).—It is found in Southwestern Arabia, along the Somali coast of Africa, and eastward in Northern India. The leaflets are in four to eight pairs, from one to two inches long, vary in shape from narrow-lanceolate to lance-ovate and oblong-ovate; are narrowed above to the mucronate apex, slightly pubescent, and beneath somewhat glaucous. The stipules are narrow, and the legumes oblong or oval, about two inches long, and contain about eight seeds. Batka distinguishes three varieties, namely, α *dilatata* (α genuina, *Bisch.*), the leaflets are broadest above the base and in the middle, and are gradually tapering to the apex; β *arcuata* (β Royleana, *Bisch.*), the leaflets are narrowed at the base, broadest below the middle, and more pointed and thinner than in the preceding variety; γ *genuina* (γ Ehrenbergii, *Bisch.*), the leaflets are narrower than the preceding varieties, linear-lanceolate, and pointed. The variety β seems to be a form produced by cultivation at Tinnevelly, in Southern India.

Fig. 173.



Cassia elongata, *Lém.*

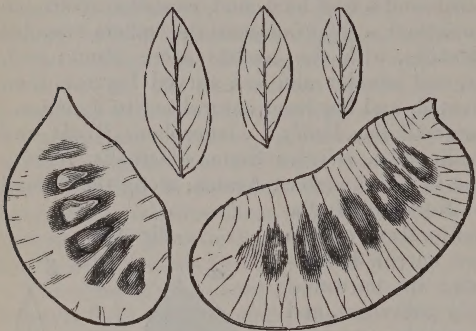
Collection.—In Nubia the collection of senna appears to be carried on in the same manner now as it was at the time when Nectoux visited that country near the close of the last century. In the month of September, after the termination of the rains, the natives cut down the shrubs and dry them on the rocks in the sun, after which they are stripped. The leaves are then packed in bags made of palm leaves, and transported by camels to the Nile, and thence to Cairo and Alexandria, from which port the drug derives its name and finds its way into commerce. A second crop, which is frequently very limited, is obtained about the middle of March, when the fruit ripens.

Between 150,000 and 200,000 pounds of senna leaves are annually imported into the United States.

Description.—Under the designation Senna, the U. S. Pharmocopœia recognizes the leaflets of the three species described above, while Folia sennæ, P. G., refers only to the leaflets of Cassia acutifolia. The same leaflets are the Senna alexandrina, *Br.*, and Senna indica, *Br.*, is the Tinnevelly (Tinivelly) senna described below. The principal variety of senna leaves used in the United States is—

Alexandria Senna.—This variety has been very variable in quality, and sometimes much broken up and mixed with leaf-stalks and fragments of the branches. Leaflets of the three species of cassia described above have at times been observed in the commercial article, but of late years the drug consisted chiefly of the leaflets of *C. acutifolia*, to the exclusion of the other species. Recently (1878), however, we have seen samples containing again, to a limited extent, the leaflets of *C. obovata*, which is called by the Arabs *senna baladi* (*wild senna*), and is regarded in Egypt as much less valuable than the *senna jebeli* (*mountain senna*), the *C. acutifolia*. Alexandria senna frequently requires sifting and picking in order to free it from stalks, foreign leaves, fruits, earthy and other impurities, some of which are described below. We have repeatedly removed such impurities which, including finely broken leaves, amounted to from 40 to nearly 60 per cent. of the weight of the drug. Alexandria senna is of a pale-green color, of a thickish texture, plainly veined, finely hairy mainly on the midrib, and possesses a somewhat tea-like odor, and a mucilaginous, afterwards bitterish and nauseous taste. The leaflets are very nearly an inch long, and, like the other varieties of senna, are oblique, and uneven towards the base.

Fig. 174.



Tripoli senna. Leaflets and legumes.

Identical with the preceding in its botanical origin is the *Tripoli senna*, which comes by caravans from the interior of Africa to Tripoli, but rarely reaches this country. It is frequently much broken up, and even discolored, but otherwise free from foreign leaves, though not from other impurities, including legumes, stalks, and earthy matters.

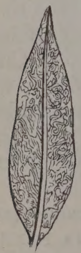
East India senna is next in importance to Alexandria senna. It consists solely of the leaflets of *C. angustifolia*, but is met with of different qualities, the handsomest being—

Tinnevelly senna.—It consists of the carefully dried and fully matured leaflets of the variety *arcuata*, which are from one to two inches long, dull green in color, smooth or slightly pubescent beneath, and are free from stalks, legumes, broken or discolored leaves, and other impurities. Their odor is similar to that of Alexandria senna, but the taste is more mucilaginous and less nauseous.

East India or *Bombay senna* has the same origin, but is less carefully dried, and frequently contains smaller and discolored leaflets. It is not unfrequently sold here as Tinnevelly senna.

Arabian or *Mecca senna*, also sold as *Bombay senna*, is collected and dried with still less care, and is often mixed with brown leaflets and with legumes.

Fig. 175.



Solenostemma argel, *Hayne*.

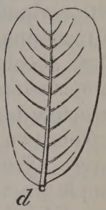
Adulterations.—The principal adulteration of Alexandria senna, aside from stalks and earthy admixtures, has been the leaves of Solenostemma (Cynanchum, *Delile*) argel, *Hayne*, s. Cyn. oleæfolium, *Nectoux*. These resemble senna leaves closely in size, shape, and color, but are readily distinguished by the indistinctness of their lateral veins, and by their even base; they are also more leathery in texture, of a grayish-green color, and of a more decidedly bitter taste. They are often accompanied by the whitish flowers, or by the flower-buds of the same plant, or by its slender pear-shaped fruit, which is one or two inches long, and contains numerous hairy tufted seeds. The plant is an asclepiadacea, inhabits Upper Egypt, but is never collected with senna, the addition being made to supply the demand.

The leaflets of Tephrosia (Galega, *Delile*) appolinea, *D. C.*, a leguminous plant of Southern Europe, have been rarely noticed as adulterations. The leaflets are somewhat uneven at the base, but their shape is obovate, and they are emarginate at the apex.

The leaves of *Coriaria* are described on page 460, and the leaflets of *Colutea* on page 442; they are rarely, if ever, met with now as adulterations of senna.

Mecca senna has occasionally been found mixed with the leaflets of Cassia (Senna, *Batka*) pubescens, *R. Br.*, s. C. Schimperi, *Steudel.* These are nearly one inch long, oval or ovate, obtuse, mucronate, hairy on both sides, and ciliate on the margin.

Fig. 176.



Tephrosia apollinea, *D. C.*

The leaflets of the Central American C. brevipes, *D. C.*, were at one time (1875) sent to Great Britain. They resemble Tinnevelly senna, but have three veins running nearly parallel from the base towards the blunt apex, and their infusion was found by Holmes to be destitute of purgative properties.

Constituents.—Senna leaves have been frequently subjected to analysis, but the results are even at the present time by no means satisfactory. Lassaigne and Feneulle's *cathartin* was found by Heerlein (1843) to be destitute of active cathartic properties. Winckler (1849) obtained the bitter principle again in an impure state; but in the same year *chrysoretin* was isolated by Bley and Diesel, and this substance was subsequently (1857) pronounced by C. Martius to be identical with *chrysophanic acid*, and to be mixed with *phæoretin* and fatty acids. Ludwig (1864) obtained an acrid and a bitter principle, both of which are absorbed by charcoal, but *sennacrol* is soluble, and *sennapicrin* is insoluble in ether. From the investigations of Dragendorff and Kubly (1866) and Groves (1868), there seems to be no doubt that the cathartic properties of senna reside in the calcium and magnesium salts of *cathartic acid*, which are insoluble in alcohol, but soluble in water, and may be obtained by precipitating a concentrated infusion of senna with strong alcohol. Cathartic acid, as at present obtained, is black, amorphous, nearly insoluble in water and alcohol, soluble in alkalies and alkaline carbonates, contains sulphur and nitrogen, and when boiled with hydrochloric acid and alcohol is split into sugar and *cathartogenic acid.* Dragendorff and Kubly obtained also a saccharine substance, *cathartomannite*, in verrucose crystals, and regard the yellow coloring matter as similar to, but distinct from chrysophanic acid. L. Siebold (1875) found that senna leaves treated with strong alcohol are rather less purgative than the unextracted leaves, but he confirmed the earlier observations that the alcoholic extract is destitute of such action, though it removes the griping principles. Diehl (1875) made similar observations.

Pharmaceutical Uses. FOLIA SENNÆ SPIRITU EXTRACTA, *P. G.*—Senna leaves are macerated for two days with four times their weight of alcohol, expressed, and dried.

SPECIES LAXANTES ST. GERMAIN, *P. G.*—Senna leaves extracted by alcohol sixteen parts, elder flowers ten parts, fennel and anise each five parts, are cut, bruised, and mixed with three parts of cream of tartar.

Off. Prep.—Confectio sennæ, *U. S.*, *Br.*; Extract. sennæ fluid., Extr. spigeliæ et sennæ fluid., *U. S.*; Infus. sennæ, *U. S.*, *Br.*; Mistura sennæ comp., Pulv. glycyrrhizæ comp., *Br.*; Syrup. sarsaparillæ comp., *U. S.*; Syrup. sennæ, *Br.*; Tinct. rhei et sennæ, *U. S.*; Tinct. sennæ, *Br.*

Physiological Action.—A decoction of senna injected into the veins of a dog produces agitated movements of the abdomen and bilious vomiting. It readily purges swine, dogs, cats, and horses. In man an infusion of senna injected into the veins has occasioned both vomiting and purging. Some persons are so susceptible to its action as to be purged even by the odor of senna or of its infusion. It renders the milk of a nursing woman purgative to her infant. It is very apt to create flatulence, nausea, and colic, unless associated with some lenitive or aromatic substance. It produces yellow stools, and its action is not followed by constipation. It never occasions hypercatharsis. Its operation is said to be promoted by bitter medicines, such as colombo, and hence it is a valuable purgative when constipation is associated with debility of the bowels.

Medical Uses.—The uses of senna were originally derived from the Arabians, who employed it in various local affections, especially of the skin. Their later authorities refer to its tendency to gripe, to obviate which they recommend its association with violets, prunes, and other correctives. Even now it is seldom given alone, but generally with some corrective of its griping qualities, as with coriander in the simple infusion, or with tamarinds, or with Epsom or Rochelle salt, manna, and fennel seed, as in the infusion known as the "black draught." Care should be taken not to let the leaves macerate too long, nor to use any compression of them when the liquid of the infusion is decanted, lest their acrid principle be taken up and produce griping. The *dose* of either of these infusions is from two to four fluidounces, repeated every two or three hours until its purgative effects begin to be felt. The infusions are better purgatives than the simple tincture, for water extracts from senna a larger proportion of its purgative principle than alcohol. An excellent laxative is the compound powder of liquorice, whose active ingredient is senna.

SERPENTARIA, *U. S.*—SERPENTARIA.

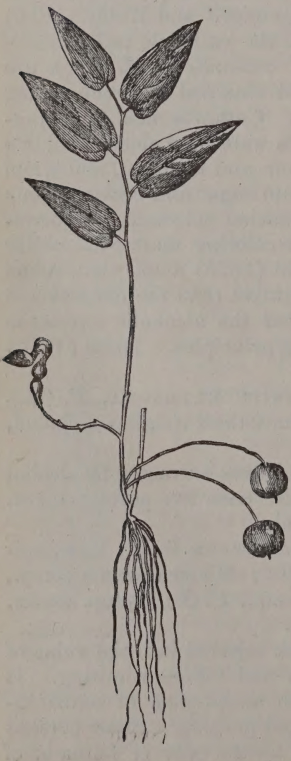
Serpentariæ radix, Br.—*Virginia snakeroot*, *Serpentary root*, E.; *Serpentaire* (*Couleuvrée*) *de Virginie*, Fr.; *Virginische Schlangenwurzel*, G.

The rhizome and roots of Aristolochia (Endodeca, *Klotzsch*) serpentaria, *Lin.;* of Aristolochia reticulata, *Nutt.;* and of other species of Aristolochia.

Nat. Ord.—Aristolochiaceæ.

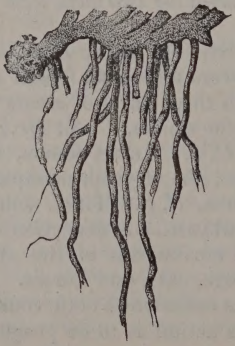
Origin.—The two plants from which Virginia snakeroot is derived are perennial herbs, with slender erect zigzag stems about 12 inches high, alternate cordate or cordately-ovate leaves, and with purple flowers, which grow on slender flexuose branches from the lower nodes, and have the tube of the perianth inflated at both ends and bent

Fig. 177.



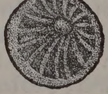
Aristolochia serpentaria, *Lin.*

Fig. 178.



Rhizome with rootlets.

Fig. 179.



Transverse section of rhizome.

like the letter **S**. *Arist. serpentaria* has the leaves petiolate, pointed, thin, and somewhat pubescent, and is found in rich woodlands from Connecticut westward to the Mississippi, and southward in the middle and southern part of the United States; it is not common except near the Allegheny Mountains. The variety *hastata* (Arist. sagittata, *Muhl.*, Ar. hastata, *Nutt.*) is smaller, more slender, has narrow lance-oblong auriculate leaves, and grows in South Carolina and westward. *Arist. reticulata* has the leaves subsessile, obtuse, thickish, reticulate, and hirsute, and is indigenous to Louisiana and Texas.

Description.—Virginia snakeroot consists of a rhizome, which is about an inch long, one-eighth of an inch thick, is bent up and down, and bears on the upper side the short approximate stem-remnants which are flat or slightly convex above; below and on the sides are numerous thin branching rootlets, three to five inches long, and matted together. It is of a dull yellowish-brown color, and has an aromatic camphoraceous odor, and a bitterish, aromatic, camphoraceous, and somewhat terebinthinate taste.

The drug derived from *Ar. reticulata* is sometimes distinguished in commerce as *Red River* or *Texas snakeroot;* it closely resembles the preceding, but has a somewhat thicker rhizome, and coarser, rather longer, and less interlaced rootlets.

On transverse section the rhizome is seen to consist of a thin bark containing some oil-cells, and an excentric wood with broad medullary rays, and inclosing a pith which is near the upper side. The rootlets have a thick bark containing scattered oil-cells and a thin angular ligneous cord.

Constituents.—Bucholz (1807) determined the presence in serpentary of a half per cent. of volatile oil, and of resinous, extractive, and mucilaginous matters. The *volatile oil* is brownish-yellow, lighter than water, and has an odor and taste resembling those of a mixture of valerian and camphor. The *bitter principle* was obtained by Chevallier (1820) by precipitating the decoction with acetate of lead, exhausting the precipitate with hot alcohol, evaporating, and treating the residue with water, which dissolves the bitter principle. Feneulle (1826) found the bitter principle in the filtrate from the precipitate occasioned in the decoction by acetate of lead. It is yellow, amorphous, soluble in water and alcohol, yields precipitates with tannin and various metallic salts, and appears to resemble the bitter principle contained in the rhizome of Aristolochia clematitis, *Lin.* A small quantity of tannin, malic acid, albumen, sugar, and other common constituents are also contained in serpentary. According to T. S. Wiegand (1844) Red River snakeroot has the same constituents, but is more mucilaginous, and yields a somewhat larger proportion of volatile oil.

Impurities and Adulterations.—As found in commerce, serpentary frequently has portions of the stem attached, sometimes with leaves and with the six-sided and six-celled capsules. Ginseng root and the rhizomes of cypripedium and of hydrastis are occasionally met with as accidental impurities; but Milleman (1874) also observed hydrastis as an evident intentional adulteration of serpentary. Spigelia is occasionally used for the same purpose. All these impurities and adulterations may, however, be easily identified from the characters of these drugs, as described elsewhere.

Off. Prep.—Extract. serpentariæ fluid., *U. S.;* Infusum serpentariæ, Tinct. cinchonæ comp., Tinct. serpentariæ, *U. S.*, *Br.*

History.—Serpentaria was used by the American aborigines as a cure for snake-bites (whence its name), and by the early colonists as a tonic and stimulant. It was introduced into medicine, in London, in 1633. Sydenham alludes to it as a remedy for intermittent fever, when infused in white wine and taken so as to produce sweating before the fit.

Medical Action and Uses.—In large doses it occasions nausea, eructation, vomiting, and flatulence, but not diarrhœa; it gives rise to some fulness of the head, and quickens the circulation. In certain states of the system it promotes perspiration, but experiments with it on healthy persons give no indications of its virtues in disease. These are manifested in *typhus* and *typhoid fever*, and in the *typhoid state* generally, whenever the pulse is feeble or irregular, the skin cool and clammy, the mouth fuliginous, the eyes injected and dull, and the mind delirious or stupid. When, in addition, the urine and feces are dark and fetid, the skin covered with ecchymoses, etc., serpentaria is indicated, and with it cinchona and alcohol. Such an association of medicines exists in the compound tincture of cinchona, which, from the days of Huxham, who invented it, has been an habitual remedy in these affections. In *typhoid pneumonia* serpentaria is much relied on, and in low forms of *diphtheria.*

The *dose* of serpentaria in powder is from ten to thirty grains. The infusion, which is officinal, is the best simple preparation of the medicine; but the compound tincture is more commonly employed.

SESAMUM, *U. S.*—BENNE.

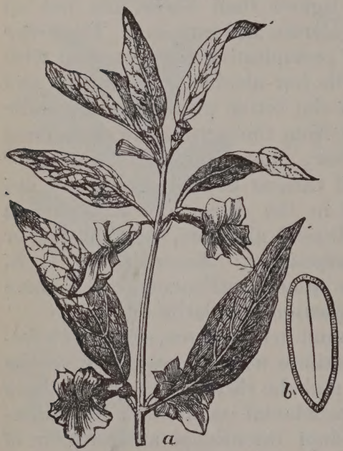
Sesamé leaves, E.; *Feuilles de sésame*, Fr.; *Sesamblätter*, G.

The leaves of Sesamum indicum, *Lin.*, and of Sesamum orientale, *Lin.* Bentley and Trimen, Med. Plants, 198.

Nat. Ord.—Pedaliaceæ.

Origin.—Benne is an annual herb which is indigenous to India, but is largely cultivated and naturalized in most tropical countries and in the warmer portions of the temperate zone. It grows from two to four or five feet high, and has an erect, branching, bluntly quadrangular and hairy stem; alternate or sub-opposite leaves, and short-stalked axillary flowers, with large white bell-shaped five-lobed and somewhat two-lipped corollas. The fruit is capsular, two-valved, four-celled, quadrangular and linear-oblong in shape, and contains numerous seeds, which are small, flattened, oval or ovate, smooth and shining, vary in color between whitish, yellow, reddish-brown, and blackish, and contain a straight embryo with a short radicle and large plano-convex oily cotyledons. *Ses. orientale* is now regarded as being not distinct from *Ses. indicum.*

Fig. 180.



Sesamum indicum, *Lin.* *a.* Flowering branch. *b.* Section of seed.

Description.—The leaves are mostly employed in the fresh state. They are from three to five inches long, long-petiolate, ovate or lance-oblong in outline, narrowed or rounded or somewhat heart-shaped at the base, more or less pointed above, entire on the margin or irregularly toothed, and the lower ones frequently cut into three-toothed lobes or distinct leaflets. The leaves are prominently veined on the lower surface, are smoothish or somewhat pubescent, and have a mucilaginous taste.

Constituents.—The principal constituent of benne leaves is mucilage, which is precipitated from its aqueous solution by alcohol. The seeds contain a considerable amount of a bland fixed oil (see p. 995).

Medical History and Uses.—Sesamum was anciently ranked among the most nutritious grains, and as tending especially to fatten, but it was also considered as difficult of digestion. Hippocrates recommended consumptives to use bread made of it instead of wheat, and in pulmonary catarrhs prescribed an emulsion prepared with sesame, almond, and melon seeds. To this day it serves to make bread in the East. Its oil was anciently used, and in India continues to be employed, for the same purposes as olive oil; but it has always been regarded as less agreeable, and as less digestible. Externally the bruised or ground seeds were used in maturative poultices; and a decoction prepared with them was held to be emmenagogue and abortive. No mention is made by ancient writers of the mucilage of the young leaves. The seeds of sesame are used by the negroes of South Carolina in making broths, and are also eaten by them parched. The oil, which is very bland, is applied to the same purposes as olive oil. The mucilage is generally prepared from the fresh young leaves by infusing them in cold water. It is much esteemed as a demulcent drink in *cholera infantum*, *dysentery*, and other disorders of the bowels.

SEVUM, *U. S.*—SUET.

Sevum præparatum, Br.; *Sebum*, P. G.; *Sebum ovillum.*—*Prepared suet*, *Mutton-suet*, E.; *Suif*, Fr.; *Talg*, *Hammeltalg*, G.

The prepared suet of Ovis aries, *Lin.*, the sheep.

Class Mammalia. *Ord.* Ruminantia.

Origin.—The sheep is domesticated everywhere, and is by zoologists considered to be a variety either of the *argali* of Siberia, Ovis ammon, *Lin.*, or of the South European *muflon*, Ovis musimon, *Lin.* The part employed is the internal fat of the abdomen, which is cut into small pieces, melted by the aid of a moderate heat and strained.

Properties.—Mutton-suet is a white, smooth, solid, nearly inodorous fat, which on exposure to air gradually becomes rancid. It has a neutral reaction, melts between 45° and 50° C. (113° and 132° F.), and congeals between 37° and 40° C. (98.6° and 104° F.), with a rise of temperature of 1° or 2° C. (1.8° to 3.6° F.). It dissolves in 44 parts of boiling alcohol of specific gravity .821, and according to Lecanu requires over 60 parts of cold ether for solution.

Composition.—According to Chevreul and Heintz, mutton suet consists principally of *stearin*, with some *palmitin* and a little *olein* and *hircin*; the latter is the glyceryl compound of *hircic acid*, which is a colorless oil, of a peculiar goat-like and acetous odor, has a strong acid reaction, and is freely soluble in alcohol.

Off. Prep.—Cerat. resinæ comp., *U. S.;* Emplast. cantharidis, *Br.;* Ungu. hydrargyri, *U. S., Br.;* Ungu. picis liquidæ, *U. S.*

Medical Action and Uses.—Suet, when perfectly fresh, forms a suitable dressing for blistered and other excoriated surfaces; but it is very apt to grow rancid, and is then decidedly irritant. It is used as an ingredient of various ointments, cerates, and plasters, and gives them a firmer consistence than they would derive from lard.

SIMARUBA, *U. S.*—SIMARUBA.

Simarouba, Fr.; *Ruhrrinde*, G.

The bark of the root of Simaruba officinalis, *D. C.*, s. Simaruba amara, *Aublet*, s. Sim. guianensis, *Rich.*, s. Quassia simaruba, *Lin. fil.* Bentley and Trimen, Med. Plants, 56.

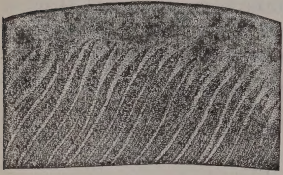
Nat. Ord.—Simarubaceæ.

Origin.—This species is a native of South America from Guiana to Northern Brazil. It is sixty to seventy feet high, and has some resemblance to the ash.

The leaves are alternate, pinnate, and have from eight to twelve or sixteen oval-oblong, obtuse or mucronate, entire, and short-stalked leaflets about four inches long. The diœcious or monœcious flowers are small, white, and are aggregated in few-flowered clusters on the slender alternate branches of an elongated racemose inflorescence.

Description.—The bark of the root comes in curved or quilled pieces, which are several feet long, one to two or three inches wide, and about one-eighth or sometimes one-quarter inch thick. Its external surface is uneven, rough, and wrinkled, covered with a yellowish or brownish suberous layer, or if this is removed of a grayish-brown color. The coarsely fibrous bast layer is thick and dull-brownish; the inner surface is of a lighter color and striate. The bark is very tough, and breaks with difficulty in a transverse direction, but may be longitudinally torn, the pieces remaining united by some of the long and tough bast fibres. When cut transversely, the outer tissue is seen to contain scattered brown-yellow granules, and the inner layer is radially striate in an oblique direction caused by the long and wavy bast wedges. Simaruba bark is without odor, and has a strong and persistent bitter taste.

Fig. 181.



Simaruba bark. Transverse section, magnified.

Variety.—Of late years we have more frequently met with another kind of simaruba bark, which is derived from Simaruba medicinalis, *Endl.* (Sim. amara, *Hayne*, Sim. glauca, *D. C.*, Quassia simaruba, *Wright*). The tree resembles the preceding species, but has smaller oblong wedge-shaped leaflets, and grows in Jamaica and other West Indian islands. The bark is very similar to the one recognized by the Pharmacopœia, but is paler and of a pale yellowish-brown color, has a smoother inner surface, and is equally bitter.

Constituents.—Simaruba bark was analyzed by Morin (1822), and found to contain a little volatile oil, resin, traces of gallic acid, malate and oxalate of calcium, and other salts. The bitter principle is not precipitated by lead salts; it was obtained as an extract-like mass, and is supposed to be identical with *quassin.*

Allied Drugs.—Most if not all the species belonging to the order of Simarubaceæ have a very bitter wood and bark. In addition to quassia, described on page 1164, Samadera indica, *Gaertn.*, indigenous to India and some of the East Indian islands, and Simaba ferruginea, *St. Hil.*, a native of South America, may be mentioned. Their medical properties appear to be similar to those of the drug described above.

Medical Action and Uses.—Like quassia, to which it is nearly allied, simaruba is intensely bitter, but also slightly aromatic. In moderate doses its action is that of the simple bitters; in large doses, like them also, it operates as an emetic and purges. In South America, its native country, it is said to have been long employed as a specific for dysentery, and it was first introduced into Europe in the beginning of the eighteenth century for a like purpose. Although it has ceased to be used in the early treatment of *dysentery*, it is occasionally employed as a bitter tonic in the decline of that disease, and in *dyspepsia.* At one time it was regarded chiefly as an emetic, and it was even proposed to use it as a substitute for ipecacuanha. It has also been prescribed in various conditions of debility associated with scrofula, chronic diarrhœa, etc. At present it is hardly ever used.

Simaruba may be given in powder in the *dose* of from ten to thirty grains, but this form is ineligible owing to the difficulty of reducing the bark to powder. It is best administered in a decoction or infusion made with two drachms of the bark in a pint of water.

SINAPIS ALBA, *U. S.*—WHITE MUSTARD.

Semen erucæ.—Yellow mustard seed, E.; *Moutarde blanche*, Fr.; *Weisser Senf*, G.

The seed of Sinapis (Leucosinapis, *Spach*, Brassica, *Hook. f.*) alba, *Lin.* Bentley and Trimen, Med. Plants, 23.

SINAPIS NIGRA, *U. S.*—BLACK MUSTARD.

Semen sinapis, P. G.—*Moutarde noire* (*grise*), Fr.; *Schwarzer Senf*, G.

The seed of Sinapis (Brassica, *Koch*) nigra, *Lin.*, s. Brassica sinapioides, *Roth.* Bentley and Trimen, Med. Plants, 22.

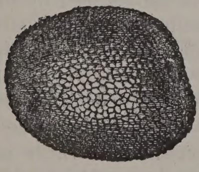
Nat. Ord.—Cruciferæ, Siliquosæ.

Origin.—Both white and black mustard have escaped from cultivation in the United States, and are sometimes found wild here. Both are indigenous to Southern Europe and Western Asia, and now grow as weeds throughout a great portion of Europe and Middle Asia, black mustard extending further to the north, and white mustard further eastward to China. The two plants are annuals, and have thin, branching, spindle-shaped roots, lyrate-pinnatifid lower leaves, compact and finally elongated racemes of yellow flowers, and beaked three to six-seeded pods. *White mustard* is retrorsely hairy, has the upper leaves stalked, three-lobed and toothed, and the pods hairy, ascending, beaded by the seeds, and furnished with a prominent sword-shaped beak, containing a seed at its base. *Black mustard* is larger, three or sometimes four feet high, smooth above, has the upper leaves slightly toothed or entire, and produces smooth linear pods, which are appressed to the axis, and furnished with a short beak. The United States import annually between one and a quarter and two million pounds of mustard seed.

White and black mustard seeds are recognized by the British Pharmacopœia together as *sinapis*, but separately by the U. S. and French Pharmacopœias. The German Pharmacopœia recognizes black mustard seed alone as *semen sinapis*.

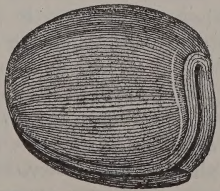
Description.—1. WHITE MUSTARD SEED.—The seeds are globular, or nearly so, from one-sixteenth to one-twelfth of an inch in diameter, on one end marked with a small circular hilum, and on the inner side with two shallow grooves. The testa is of a yellowish or pale grayish-brown color, very finely pitted, and somewhat rough. The seed is inodorous, but when masticated has a pungent and acrid taste. Its internal structure is identical with that of the next.

Fig. 182.



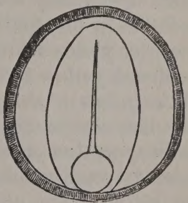
Black mustard seed; entire, magnified.

Fig. 183.



Embryo.

Fig. 184.



Transverse section.

2. BLACK MUSTARD SEED resembles the preceding in shape, but has only about one-half its diameter, is blackish-brown or deep reddish-brown, has the

testa covered with shallow pits, and when crushed and macerated with water, acquires a strong and pungent odor.

Both seeds, after the integuments have been removed, are found to contain an embryo having the shape of the seed, the cotyledons of which are folded along their midribs, one covering the other, while the radicle is curved back and inclosed between the folds of the inner cotyledon. This arrangement is well shown on a transverse section of the seed, which exhibits on one side the round radicle, near and between the edges of the plano-convex folds of the inner cotyledon, and these are surrounded by the concavo-convex folds of the outer cotyledon. In both seeds the embryo is yellow and very oily, and imparts to the powder of white mustard a dull pale-yellow, and to that of black mustard a yellowish-green color.

Constituents.—Both seeds are free from starch, and when crushed and subjected to pressure, yield from 20 to 25 per cent. of a yellow fixed oil, which congeals between —15° and —17.5° C. (5° and .5° F.) to a butyraceous mass. This *fixed oil of mustard* does not readily turn rancid, consists of olein with some stearin and the glyceride of *erucic acid*, $C_{22}H_{42}O_2$, and has a bland taste; but when expressed between heated plates from black mustard, it has to some extent the pungent odor and taste of these seeds after maceration in water. Erucic acid forms white shining tasteless needles, which fuse at about 34° C. (93.2° F.). It was discovered by Darby (1849), who isolated also another fatty acid, *sinapoleic acid*, which, according to Städeler (1853), has the formula $C_{20}H_{38}O_2$. The two kinds of mustard seed contain a considerable amount of mucilage in the epidermis, and various proteids, the most interesting of which is *myrosin*, and this is obtainable, according to Bussy (1839), from the cold infusion of white mustard, by concentrating it below 40° C. (104° F.), and precipitating the syrupy liquid with not too large a quantity of alcohol. Myrosin acts as a ferment upon two distinct principles, one being contained in white, and the other in black mustard, and yields among their products of decomposition those compounds to which the acrid and pungent properties of both seeds are due. Myrosin is coagulated by heat and by alcohol; hence black mustard introduced into boiling water does not yield the volatile oil.

The principle of white mustard yielding the acrid compound was fully investigated by H. Will (1870), and named by him *sinalbin*, $C_{30}H_{44}N_2S_2O_{16}$. It had been previously obtained in a nearly pure state, and was experimented with by Henry and Garot, Boutron, Robiquet, Winckler, Babo, and others, being described as *sulphocyanide of sinapin*, *sulpho-sinapisin*, *sinapin*, and under various other names. Sinalbin is obtained from white mustard, which has been deprived of its fixed oil, by exhausting it with boiling alcohol, from which it crystallizes on cooling. When pure it forms small glass-like prisms, which are freely soluble in water, but sparingly soluble in cold alcohol, and insoluble in bisulphide of carbon; it is perfectly neutral, is not colored by ferric chloride, yields white precipitates with corrosive sublimate and nitrate of silver, is colored yellow by traces of alkalies, and by myrosin is decomposed into sugar, acid *sulphate of sinapina*, $C_{16}H_{15}NSO_9$, and *sulphocyanide of acrinyl*, C_8H_7NSO. This last compound is obtainable by agitating the aqueous liquid with ether, on the evaporation of which it remains as a nearly colorless thick non-volatile oil, which is readily soluble in alcohol and ether, has a sweetish, afterwards acrid and biting taste, and possesses epispastic properties; it is not colored red by ferric chloride until after its alcoholic solution has been heated with an alkali and again acidulated. *Sinapina* is an alkaloid which has not been isolated, since it is readily decomposed; the solutions of its salts are colored yellow by alkalies, and on boiling the mixture yield a strong base *sinkalina*, and *sinapic acid*, the barium salt of which is nearly insoluble in cold water; Von Babo and Hirschbrunn (1852) gave these two compounds the formulas $C_5H_{13}NO$ and $C_{11}H_{12}O_5$.

A principle analogous to sinalbin exists in black mustard, and was recognized by Bussy as a peculiar acid, *myronic acid*, combined with potassium. Although he observed also volatile oil of mustard among its products of decomposition by myrosin, the exact composition and behavior of *myronate of potassium*, for which Will (1870) proposed the name *sinnigrin*, were not ascertained until investigated by Will and Körner (1863). Sinnigrin is obtained from black mustard exhausted with boiling strong alcohol, by treating it with cold water, adding a little barium carbonate to the infusion, evaporating to a syrupy consistence, and boiling this residue repeatedly with 85 per cent. alcohol, on the evaporation of which sinnigrin is left. The yield is .5 to .6 per cent. When pure it is in white silky needles, or, if crystallized from water, in short glass-like prisms, has a cooling bitter taste, dissolves in water, is insoluble in chloroform, ether, and benzol, and nearly insoluble in absolute alcohol. When treated with myrosin it is decomposed into *sulphocyanide of allyl* or *volatile oil of mustard*, C_4H_5NS (see page 996), acid sulphate of potassium, $KHSO_4$, and sugar. The analogous decompositions of the peculiar principles of white and black mustard are explained by the following equations :—

Sinalbin, $C_{30}H_{44}N_2S_2O_{16} = C_8H_7NSO + C_{16}H_{15}NSO_9 + C_6H_{12}O_6$.

Sinnigrin, $C_{10}H_{18}NS_2KO_{10} = C_4H_5NS + HKSO_4 + C_6H_{12}O_6$.

Adulteration.—Mustard seed is not subject to adulteration, but ground mustard is very often mixed with various farinaceous substances, and the cold decoction will then acquire a blue or greenish tint on the addition of an aqueous solution of iodine. Ground white mustard has a dull gray-yellow color, which is often rendered brighter by the addition of turmeric ; it will then respond to the test for starch, and will acquire a red-brown color with solution of boracic acid or of borax.

Allied Drugs.—BRASSICA (Sinapis, *Lin.*) JUNCEA, *Hook. f.*, is extensively cultivated in Southern Russia, and constitutes the *Sarepta* or *Russian mustard.* It is likewise cultivated in Africa and India, and is exported from the latter country to Europe. The seeds closely resemble those of black mustard, and yield the same products.

BR. SINAPISTRUM, *Boissier*, s. Sinapis arvensis, *Lin.*, called *charlock*, is a European annual, and a troublesome weed in some parts of the United States, and has nearly smooth, dark brown seeds, which are smaller and less pungent than those of black mustard.

BR. CAMPESTRIS, *Lin.*, is extensively cultivated in several varieties, the seeds of which are larger and less pungent than black mustard seed. One of these varieties, *Br. rapa*, is used for obtaining the bland yellowish *rape-seed oil.*

Off. Prep.—Cataplasma sinapis, *Br.;* Charta sinapis, *U. S.*, *Br.;* Oleum sinapis, *Br.*

History.—Mustard has been used medicinally from the earliest periods. Hippocrates described a variety of its applications, but chiefly as an external or local stimulant, to dissipate slight inflammations, diminish coma, allay pain, promote the growth of hair, relieve deafness, etc. Internally he recommended it as a remedy for intermittent fever. Subsequent ancient writers enlarged its sphere of usefulness, applying it as a counter-irritant in nearly all chronic diseases and painful affections, and using it as an emetic and a vermifuge. They were well acquainted with the fact that a sinapism made with vinegar is weaker than one mixed with water.

Physiological Action. *On Animals.*—Essential oil of mustard is a virulent poison. In rabbits it occasions the following symptoms : great frequency of the heart's action, speedy loss of sensibility and muscular power, feebleness of the heart's pulsations, difficult respiration, repeated convulsions, insensibility, coldness, and death. The odor of the oil is very distinct in the internal organs, the urine has a characteristic smell, and the irritability of the heart and voluntary muscles continues for a long time after death.

On Man.—Mustard seeds, taken whole in doses of a teaspoonful three or four times a day, have a laxative action upon the bowels, and are discharged without perceptible change. As cases have occurred in which an accumulation of them has obstructed the bowel, and as they also may possibly find their way, with fatal effect, into the vermiform appendix, they should be used cautiously, and swallowed with a large quantity of water.

Powdered mustard applied to the tongue or throat causes prickling and burning. It promotes the digestion of food, but too much of it or its prolonged use enfeebles the stomach. In large quantities, a teaspoonful or more, diffused through tepid water, it acts as a prompt and efficient emetic. Care should be taken to evacuate all of the mustard swallowed.

Applied as a sinapism to the skin, it produces after several minutes an acute prickling, stinging, and burning pain, the skin grows red, and, if the application is too prolonged, is blistered. The blisters are followed by ulcers which are very difficult to heal. The rapidity and completeness of the effect depend upon the delicacy of the skin to which the sinapism is applied. Hence great caution should be observed in prescribing it for children and females. Gangrene and death have resulted from applying a mustard poultice to the swollen glands of a child's neck.

On the other hand, when the skin is naturally tough, and when its vitality is impaired by collapse, chill, or low states of the system generally, sinapisms may fail to exert any influence whatever. In these several cases sinapisms made with water are referred to; those made with vinegar are of very inferior activity, and the mustard is less active in proportion as the vinegar is stronger. This fact, although generally unknown, the ancients were well acquainted with, as already stated.

The effects of a general mustard bath at 86° F. are singular. At first wandering chills are felt in the loins, back, abdomen, and limbs, followed by a feeling of decided coldness and twitching of the extremities. There is even suffering from a sense of cold. Later, and even after the skin has become red, the sensation of coldness continues until the patient leaves the water, when reaction is speedily established, with stinging and burning in the integument.

Volatile oil of mustard is a powerful irritant. A single drop of it upon the tongue causes a severe burning pain which extends to the throat, nose, and stomach. Upon the skin it acts promptly as a vesicant and caustic.

Medical Uses.—For internal purposes, and particularly where the whole seed is given, white mustard seed is to be preferred. In *atonic dyspepsia* with *constipation*, it has long been employed with advantage, given in the dose of a teaspoonful in a draught of water, before or after meals. It prevents flatulence, promotes digestion, and keeps the bowels regular. But, like all condiments, it loses its effect by use. In obstinate *hiccough* an infusion of mustard has sometimes succeeded in arresting this harassing symptom. It is one of the most prompt and efficient emetics which can be used in cases of *narcotic poisoning*. In the early stage of *delirium tremens* a mustard emetic will sometimes cut short the attack. In *atonic dropsy* mustard whey, or an infusion of whole mustard seed in cider, is not one of the least powerful diuretics. That the active principle of mustard is carried into the circulation is shown by the benefits accruing from the use of white mustard seed in *chronic bronchitis*, *chronic rheumatism*, and some *cutaneous affections*. This use of the medicine has been condemned as being destitute of a rational basis; but the only rational basis for the use of a medicine is its power to cure, and that is sufficiently attested in the present case.

Externally, oil of mustard has been successfully used in the treatment of *scabies*. But one of the most usual and useful applications of mustard is in the form of poultice, plaster, or bath, to produce a lively stimulation, and thereby arouse the nervous system, as in the insensibility of *swooning* and *hysteria*, in which it acts by exciting a sense of pain, and in the *convulsions* of children, in which it stimulates the nervous system and disperses morbid accumulations of blood in the central nervous organs. In foot-baths it relieves *headache*, and cerebral and other internal *congestions*, especially uterine congestion accompanied with *dysmenorrhœa.* General baths, at a temperature of from 77° to 82° F., containing two or three ounces of mustard, and applied for the space of half an hour, have been used with great advantage in allaying the violence of *insanity.* Large poultices or epithems containing mustard, and sinapised hip-baths have been beneficial in analogous conditions. However it may be explained, it is certain that mustard pediluvia, and even mustard plasters employed to relieve pain, frequently induce sleep; indeed it sometimes happens that the patient falls asleep while the plaster is "drawing," with the result of producing painful and intractable sores.

When the action of a part is morbidly diminished, or that of an internal organ is morbidly increased, as in *retrocedent gout* or *rheumatism;* or where a part is too anæmic for the application of *leeches;* or where a muscle or muscles suffer partial *atrophy*, mustard poultices, etc. are sometimes beneficial.

Every form, almost, of local pain may be relieved in the same manner, as that of subacute and chronic *articular rheumatism*, *pleurodynia*, *neuralgia*, *toothache*, *earache*, *flatulent colic*, *muscular rheumatism*, and *dysmenorrhœa.* The same is true of various abnormal discharges, such as *vomiting*, *diarrhœa*, *cholera-morbus*, and *dysentery.* In epidemic *cholera*, general mustard baths have frequently been found beneficial in the early stages of the disease, and occasionally in the cyanotic stage.

Administration.—Of white mustard *seed* one or two teaspoonfuls in three or four ounces of water may be taken once a day or oftener. The *infusion* of mustard, for an emetic, is prepared by adding one, two, or three teaspoonfuls of mustard flour to a pint of warm water. Mustard *whey* is made by adding to a pint of milk mixed with a quart of water, an ounce and a half of bruised mustard seed, boiling the mixture until it is curdled, and straining off the whey. A wineglassful may be given every hour or two. The *sinapism*, or mustard plaster, is made by adding cold or lukewarm water to equal quantities of mustard and wheaten or rye flour, and stirring until a thick paste is formed. This is spread upon linen or other convenient tissue, and applied to the skin. It is well to interpose a piece of gauze between the plaster and the body, to prevent the former from adhering. It should remain applied from ten minutes to an hour, according to the degree of its action. The mustard *cataplasm* (Pharm. Br.) is an ordinary poultice with which mustard has been mixed; it is intended to maintain a gentler but more prolonged action than the sinapism. "*Mustard leaves*" should be dipped in water before being applied. Sinapised *pediluvia* are formed by adding a sufficient quantity (a tablespoonful or two) of mustard flour to an ordinary foot-bath. When pediluvia are used as general stimulants they should be as warm as they can be borne; but when employed as derivatives, especially from the head and chest, their temperature should not exceed that of the blood, or from 98° to 100° F. The *essential oil* of mustard has been prescribed internally in an emulsion, in the dose of from $\frac{1}{12}$ to $\frac{1}{4}$ of a drop. It may be used externally as a rubefacient in the proportion of twenty-four drops of the oil to an ounce of alcohol, or five or six drops to a fluidrachm of almond oil. Care must be taken to proportion the strength of the liniment to the delicacy of the skin. The best application for the sores produced by mustard, is lime-water liniment; if the pain be severe, the part may first be covered with stramonium ointment. Later, poultices of grated raw carrots, and, finally, oxide of zinc ointment may be employed.

SODA, *U. S.*, *Br.*—SODA.

Soda caustica, Br.; *Natrum causticum s. hydricum.*—*Caustic soda, Sodium hydrate*, E.; *Soude caustique*, Fr.; *Natron, Aetznatron*, G.

Formula NaHO. Molecular weight 40.

Preparation.—Take of Solution of Soda a convenient quantity. Evaporate it rapidly in an iron vessel until ebullition ceases and the soda melts. Pour this on a flat stone, and when it has congealed, break the mass into pieces, and keep them in a well-stopped bottle. *U. S.*

Take of Solution of Soda two pints. Boil down rapidly in a silver or clean iron vessel until there remains a fluid of oily consistence, a drop of which, when removed on a warmed glass rod, solidifies on cooling. Pour the fluid on a clean silver or iron plate, or into moulds, and as soon as it has solidified, break it in pieces, and preserve it in stoppered green-glass bottles. *Br.*

The preparation of solution of soda is described on page 850. On evaporating it, hydrate of sodium is left, and this is either moulded into thin cylinders or congealed on a plate or tile. Vessels of porcelain, glass, etc. are readily corroded; soda must, therefore, be prepared in clean iron or silver vessels.

Properties.—Caustic soda is white or grayish-white, hard, very alkaline in reaction, and strongly corrosive. It imparts a yellow color to flame; when heated it melts to a colorless oily liquid, and at a strong red heat is slightly volatilized. On exposure to the atmosphere it absorbs water and becomes liquid, and subsequently it solidifies again in consequence of the absorption of carbonic acid and the crystallization of sodium carbonate.

Tests.—Alcohol dissolves caustic soda, but leaves most of the salts behind which are likely to be present. When dissolved in water, and the solution acidulated with nitric acid, only scanty white precipitates should be obtained with nitrate of silver and chloride of barium. Forty grains of soda dissolved in water should leave scarcely any sediment, and require for neutralization about 900 grain-measures of the volumetric solution of oxalic acid (*Br.*), indicating the presence of about 90 per cent. of NaHO.

Composition.—The formula of soda is NaHO. When pure it contains 22.5 per cent. H_2O and 77.5 per cent. Na_2O. Crystallized hydrates of sodium are also known, containing $3\frac{1}{2}$ and $1\frac{1}{2}$ molecules of water, and respectively 30.1 and 46.3 per cent. Na_2O.

SODIUM s. *Natrium* was isolated by H. Davy (1807), and is prepared on a large scale by heating in an iron retort an intimate mixture of 30 parts of exsiccated carbonate of sodium, 13 parts of coal, and 5 parts of chalk; the reduction takes place at a lower temperature than is required for the isolation of potassium.

Sodium is silver-gray, has a strong metallic lustre, and at ordinary temperatures may be cut like wax. It melts near 90° C. (194° F.), and at a red heat volatilizes. Its density is .97. In contact with air it is oxidized, and therefore requires to be kept under petroleum naphtha, or should be protected by being coated with a layer of paraffin as proposed by Wagner (1863). It unites with oxygen, forming *monoxide* Na_2O, and *dioxide* Na_2O_2, of which the former only and its compounds are of importance in medicine and the arts.

SALTS OF SODIUM.—Soda is nearly as strong a base as potassa, and yields salts which are colorless, unless the acid is colored, have a neutral reaction, except those with weak acids, and are not volatilized at a red heat. They impart a yellow color to flame, are mostly readily soluble in water, and these solutions yield with hydrofluosilicic acid gelatinous precipitates, and, when neutral or alkaline, afford, with metantimoniate of potassium, white crystalline precipitates. Similar precipitates are obtained with most other metallic salts, which must therefore be removed by the proper reagents, with the exception of those of potassium, before the test for sodium is applied.

The following sodium compounds are officinal: Soda, Sod. acetas, Sod. arsenias, Sod. bicarbonas, Sod. boras (Borax), Sod. carbonas, Sod. carbonas exsiccata, Sod. chloridum, *U. S.*, *Br.;* Sod. hypophosphis, Sod. hyposulphis, *U. S.;* Sod. nitras, Sod. phosphas, Sod. sulphas, *U. S.*, *Br.;* Sod. sulphis, *U. S.;* Sod. valerianas, *Br.;* Potass. et sod. tartras (Soda tartarata), Sapo, *U. S.*, *Br.*

The following pharmaceutical preparations contain sodium compounds: Cataplas. sodæ chloratæ, *Br.;* Ceratum saponis, *U. S.;* Empl. resinæ, *Br.;* Empl. saponis, Extract. colocynthidis comp., Linim. saponis, Liqu. sodæ, Liqu. sodæ chlorinatæ (chloratæ), *U. S.*, *Br.;* Liqu. sodæ effervescens, *Br.;* Liqu. sod. arseniatis, Pilulæ aloes, Pil. aloes et assafœtidæ, *U. S.*, *Br.;* Pil. assafœtidæ, *U. S.;* Pil. cambogiæ comp., *Br.;* Pil. cathart. comp., Pil. ferri comp., Pil. opii, Pil. rhei, *U. S.;* Pil. rhei comp., Pil. scammonii comp., *Br.;* Pil. saponis comp., Pil. scillæ comp., Trochisci sod. bicarbonatis, *U. S.*, *Br.;* Sodæ citrotartras effervescens, Suppos. acidi carbolici cum sapone, Suppos. acidi tannici cum sapone, Suppos. morphiæ cum sapone, *Br.*

Medical Action and Uses.—Caustic soda, although less deliquescent and therefore more manageable than caustic potassa, is not so generally employed as an escharotic. It would appear probable, also, that as it is more assimilable, and therefore less apt than potassa to be immediately secreted with the urine, it should be better adapted than the latter for all cases in which it is desired to render the blood and the secretions more alkaline. But in either case the carbonates are preferable to the alkalies themselves. Soda is administered in the officinal solution, and in *doses* of from ten to twenty minims.

SODÆ CITRO-TARTRAS EFFERVESCENS, *Br.*— EFFERVESCENT CITRO-TARTRATE OF SODA.

Preparation.—Take of Bicarbonate of Soda in powder seventeen ounces; Tartaric Acid in powder eight ounces; Citric Acid in powder six ounces. Mix the powders thoroughly, place them in a dish or pan of suitable form heated to between 200° and 220° F., and when the particles of the powder begin to aggregate stir them assiduously until they assume a granular form; then, by means of suitable sieves, separate the granules of uniform and most convenient size, and preserve the preparation in well-closed bottles. *Br.*

This officinal preparation represents the granular powders which are described on page 1153. If preserved in a dry state it keeps better than a simple mixture of the ingredients in the state of powder, which soon undergoes decomposition. When thrown into water it dissolves with a brisk effervescence.

Medical Action and Uses.—This preparation is equivalent in its action to the effervescing draught, and may be prescribed with advantage to moderate fever, promote perspiration, and diminish the acidity of the urine and other secretions. It is conveniently employed in *fevers* and *inflammations*, and especially in acute articular *rheumatism.* *Dose*, from sixty to one hundred and twenty grains, in several fluidounces of water.

SODII ACETAS, *U. S.*—ACETATE OF SODIUM.

Sodæ acetas, Br.; *Natrum aceticum*, P. G.; *Acetas sodicus* (*natricus*); *Terra foliata tartari crystallisata.*—*Acetate of soda*, E.; *Acétate de soude*, Fr.; *Essigsaures Natron*, G.

Formula $NaC_2H_3O_2.3H_2O$. Molecular weight 136.

Preparation.—Acetate of sodium may be prepared by neutralizing acetic acid, or by decomposing acetate of lead with carbonate of sodium, in the latter case filtering from the insoluble carbonate of lead, and evaporating the clear liquids to crystallization. The salt is, however, manufactured on a large scale in the process for purifying acetic acid from wood-vinegar (see p. 17).

Properties.—This salt crystallizes in colorless transparent prisms, which are odorless, have a bitterish saline taste, are somewhat efflorescent on exposure, melt below the boiling point of water, and part with their water of crystallization, the loss amounting to nearly 40 per cent. Acetate of sodium requires at ordinary temperatures about 3.5 parts of water for solution, but dissolves in rather less than half its weight of boiling water; it dissolves in 2.1 parts of alcohol, but is insoluble in ether. The anhydrous salt, when carefully heated, melts and at a higher temperature is decomposed, yielding aceton and leaving carbonate of sodium.

Tests.—When dissolved in 40 parts of distilled water, the solution is not rendered turbid or precipitated by sulphuretted hydrogen (absence of *lead* and other *metals*), carbonate of sodium (absence of *calcium*, etc.), nitrate of barium (absence of *sulphate*), or nitrate of silver (absence of *chloride*). Concentrated solutions of sodium acetate yield with nitrate of silver a crystalline precipitate consisting of acetate of silver.

Pharmaceutical Uses.—Acetate of sodium is employed in preparing Ferri arsenias, Ferri phosphas, and Syrupus ferri phosphatis, *Br.*

Medical Action and Uses.—Acetate of sodium resembles acetate of potassium in its action, but is milder, less apt to derange the digestion, and more efficient as a diuretic. Its *dose* is from twenty to forty grains in a large quantity of water, as a diuretic. In doses of a drachm or more it is apt to be laxative.

SODII ARSENIAS, *U. S.*—ARSENIATE OF SODIUM.

Sodæ arsenias, Br.; *Natrum arsenicicum*, *Arsenias natricus* (*sodicus*).—*Arseniate* (*arsenate*) *of soda*, E.; *Arséniate de soude*, Fr.; *Arsensaures Natron*, G.

Formula $Na_2HAsO_4.7H_2O$. Molecular weight 312.

Preparation.—Take of Arsenious Acid in fine powder two troyounces; Nitrate of Sodium in fine powder eight hundred and sixteen grains; Dried Carbonate of Sodium in fine powder five hundred and twenty-eight grains; Distilled Water boiling hot half a pint. Having mixed the powders thoroughly, put the mixture into a large clay crucible, and cover it with the lid. Expose the mixture to a full red heat until effervescence has ceased, and complete fusion has taken place. Pour the fused salt on a porcelain slab, and, as soon as it has solidified, and while it is still warm, put it into the hot water, and stir until it is dissolved. Filter the solution, and set aside to crystallize. Drain the crystals, and, having dried them rapidly on filtering paper, keep them in a well-stopped bottle. *U. S.*

Take of Arsenious Acid ten ounces; Nitrate of Soda eight and a half ounces; Dried Carbonate of Soda five and a half ounces; Boiling Distilled Water thirty-five ounces. Reduce the dry ingredients separately to fine powder, and mix them thoroughly in a porcelain mortar. Put the mixture into a large clay crucible, and cover it with the lid. Expose to a full red heat, till all effervescence has ceased, and complete fusion has taken place. Pour out the fused salt on a clean flagstone, and as soon as it has solidified, and while it is still warm, put it into the boiling water, stirring diligently. When the salt has dissolved, filter the solution through paper and set it aside to crystallize. Drain the crystals, and, having dried them rapidly on filtering paper, inclose them in stoppered bottles. *Br.*

On fusing arsenious acid in the proper proportions with carbonate and nitrate of sodium, carbonic acid gas, CO_2, and nitrous anhydrid, N_2O_3, are given off, and the residue is converted into pyroarseniate of sodium, as will be seen from the equation $As_2O_3+2NaNO_3+Na_2CO_3=Na_4As_2O_7+N_2O_3+CO_2$. The pyroarseniate, on being dissolved in water, is converted into orthoarseniate by combining with water; $Na_4As_2O_7+H_2O$ yields $2Na_2HAsO_4$, and this salt crystallizes with $7H_2O$. The carbonate may be conveniently replaced by an equivalent quantity of solution of caustic soda, in which the arsenious acid may be dissolved, and the residue, left on evaporation to dryness, should then be oxidized by fusion with sodium nitrate; all danger of expelling arsenic by injudicious heating will then be avoided. The same salt is also obtained on oxidizing arsenious to arsenic acid, by means of hot nitric acid, dissolving the dry residue in hot water, and adding sodium carbonate as long as effervescence is produced.

Properties.—Arseniate of sodium crystallizes in colorless transparent prisms, which usually contain $7H_2O$ or 40.4 per cent.; when obtained at a low temperature they contain $12H_2O$ or 53.7 per cent. The officinal salt is slightly deliquescent in a moist atmosphere, but in dry air it effloresces and loses $5H_2O=28.8$, the white powder which is finally left having the composition $Na_2HAsO_4.2H_2O$, and containing 16.2 per cent. of water of crystallization, which is given off above 130° C. (266° F.). The salt dissolves in from 2 to 3 parts of water; the solution has an alkaline reaction, and yields white precipitates with the soluble salts of barium, calcium, iron, and lead, and a red-brown precipitate with nitrate of silver, all the precipitates being soluble in nitric acid. Sulphuretted hydrogen produces in the cold slowly, but rapidly on being acidulated and heated, a yellow precipitate, which is completely soluble in sulphydrate of ammonium. When heated upon charcoal before the blowpipe, the salt gives off an alliaceous odor. An aqueous solution of ten grains of the residue, left after heating the salt to 150° C. (302° F.), treated with 53 grain measures of the volumetric solution of soda, continues to give a precipitate with the volumetric solution of nitrate of soda, until 1613 grain measures of the latter have been added. *Br.*

Other Arseniates of Sodium.—If an excess of carbonate of sodium is used in the formula given above, the aqueous solution will contain *trisodic arseniate* and yield crystals having a stronger alkaline reaction, and the composition $Na_3AsO_4.12H_2O$. With an excess of arsenic acid, crystals of *monosodic arseniate* $NaH_2AsO_4.H_2O$ may be obtained.

Off. Prep.—Ferri arsenias, *Br.;* Liquor sod. arseniatis, *U. S.*, *Br.*

Medical Action and Uses.—Arseniate of sodium is said to be less apt than arseniate of potassium to produce the phenomena of arsenical poisoning, whether locally, upon the stomach, or, through the blood, upon the eyelids, conjunctivæ, etc. It might be suspected that the difference, if real, would indicate that it is less efficient. The fact, however, is declared to be otherwise. This preparation is seldom used, and then in the form of the officinal solution. The *dose* of the arseniate is from one-twentieth to one-eighth of a grain.

SODII BICARBONAS, *U. S.*—BICARBONATE OF SODIUM.

Sodæ bicarbonas, Br.; *Natrum bicarbonicum*, P. G.; *Natrum carbonicum acidulum*, *Bicarbonas sodicus.*—*Bicarbonate of soda*, *Sodium hydrocarbonate*, E.; *Bicarbonate de soude*, *Sel digestive de Vichy*, Fr.; *Doppeltkohlensaures Natron*, G.

Formula $NaHCO_3$. Molecular weight 84.

Preparation.—Take of Carbonate of Soda two pounds; Dried Carbonate of Soda three pounds; White Marble in fragments four pounds; Hydrochloric

Acid one gallon; Water two gallons; Distilled Water a sufficiency. Fill with the marble a tubulated glass bottle having a few small holes drilled in the bottom, connect the tubulure tightly by a bent tube and corks with an empty two-necked bottle, and connect this with another bottle filled with the carbonates of soda well triturated together, and let the tube be long enough to reach the bottom of the bottle. Before fixing the cork in the bottle containing the carbonate of soda, partially immerse the bottle containing the marble in the hydrochloric acid previously diluted with the water and placed in any convenient vessel. When the whole apparatus is filled with carbonic acid gas, fix in tightly the cork of the bottle containing the carbonate of soda, and let the action go on until the gas ceases to be absorbed. Pour upon the damp salt which is formed half its weight of cold distilled water, and shake it occasionally during the course of half an hour; then drain the undissolved portion, and dry it by exposure to the air on filtering paper placed on porous bricks. *Br.*

This salt is rarely if ever prepared by the pharmacist, but is manufactured on the large scale, one of the processes being described above. Bicarbonate of sodium does not contain any water of crystallization; a portion of the carbonate is therefore used in the exsiccated state, and another portion in crystals which, if used in the proportion given above, contain more than sufficient water for the conversion of all the carbonate used into bicarbonate. This is produced according to the equation $Na_2CO_3+CO_2+H_2O=2NaHCO_3$, the excess of water requiring to be removed by draining and exposure to the air. In the United States the process of Dr. F. R. Smith (1830) is employed by some manufacturers. Crystallized carbonate of sodium is placed in a chamber, arranged in such a manner that water may be drained off; carbonic acid gas is then conducted into the chamber, and, combining with the salt, forms bicarbonate, while the water is liberated, and is carried off to prevent its action as a solvent. By this arrangement the crystalline structure of the carbonate is usually not disturbed, except that the crystals lose their transparency and become opaque in proportion as the carbonate is converted into bicarbonate, and are porous and friable.

It is obviously not essential that the carbonic acid needed in this operation should be generated from marble; the same gas is largely produced in establishments where saccharine substances are undergoing fermentation, and is obtained as a waste product in many chemical operations. In some manufactories the products of combustion of the fuel used for heating steam boilers are deprived of their impurities by washing, and subsequently utilized for saturating, at least in part, the carbonate of sodium with carbonic acid.

Bicarbonate of sodium as obtained by the above processes is recognized by the United States Pharmacopœia as *Sodii bicarbonas venalis*, or *commercial bicarbonate of sodium*. It often contains carbonate of sodium and sometimes other impurities, from which it should be freed before it is used for medicinal purposes. A suitable process is the following:—

Sodii bicarbonas, *U. S.*—Take of Commercial Bicarbonate of Sodium in powder sixty-four troyounces; Distilled Water six pints. Introduce the powder into a suitable conical glass percolator, cover it with a piece of wet muslin, and pour the water gradually upon it. When the liquid has ceased to drop, or when the washings cease to precipitate a solution of sulphate of magnesium, remove the bicarbonate of sodium from the percolator, and dry it on bibulous paper, in a warm place. *U. S.*

Bicarbonate of sodium is far less readily soluble in cold distilled water than the impurities which are usually present, and in percolating water slowly through it, these foreign compounds, consisting mainly of carbonate and of traces of sulphate and chloride of sodium, are dissolved, together with a portion of the bicarbonate. The percolate may be utilized, after boiling for a short time, as a solution of carbonate of sodium.

Properties.—*Commercial bicarbonate of sodium* is a white powder, has a saline not unpleasant taste, and is completely soluble in cold water. It imparts a yellow color to the flame of alcohol, usually colors moistened turmeric paper red-brown from the sodium carbonate contained in it, and dissolves with brisk effervescence in diluted acids, forming solutions in which chloride of platinum causes no precipitate. If the salt is treated with a small quantity of water, insufficient for solution, the liquid frequently reacts in the cold with a solution of sulphate of magnesium, producing a white precipitate, and causes with a solution of corrosive sublimate a dark brown-red precipitate, both reactions being due to carbonate of sodium, which is usually present in small amount. The solution of the bicarbonate in a slight excess of nitric acid occasions an opalescence or turbidity on the addition of nitrate of barium or of nitrate of silver, due in the one case to the presence of a little sulphate, and in the other to some chloride of sodium. When prepared from cryolite, aluminium may be contained in it, and is detected by dissolving a portion in an excess of warm dilute hydrochloric acid and supersaturating the liquid with ammonia, when a white gelatinous precipitate will make its appearance.

Pure bicarbonate of sodium has the same appearance as the commercial article, but differs from it in the absence of those reactions which are occasioned by the impurities. By careful evaporation at a low temperature of its aqueous solution it may be obtained in flat transparent crystals, which do not alter the color of moistened curcuma paper, but restore the blue color to red litmus. It remains unaltered in dry air, but when exposed to a moist atmosphere or when kept in solution, it parts slowly with a portion of its carbonic acid and acquires an alkaline reaction. On boiling its solution in water, carbonic acid gas is given off, and the salt is converted into sesquicarbonate, and finally into monocarbonate. According to Poggiale, 100 parts of water dissolve at 10° C. (50° F.) 8.88, at 20° C. (68° F.) 9.84, and at 60° C. (140° F.) 13.68 parts of sodium bicarbonate. When 100 grains are heated to redness, they lose altogether 36.8 grains, consisting of water and one-half the carbonic acid, sodium carbonate being left behind. Eighty-four grains exposed to a red heat leave fifty-three grains of an alkaline residue, which requires for neutralization 1000 grain measures of the volumetric solution of oxalic acid; 20 grains of the bicarbonate neutralize 16.7 grains of citric acid, or 17.8 grains of tartaric acid. (*Br.*)

Composition.—The formula of bicarbonate of sodium given above represents 36.94 per cent. Na_2O, 52.36 per cent. CO_2, and 10.70 per cent. H_2O.

Tests.—The most readily applied tests for recognizing impurities are given above, and are accurate for the detection of aluminium (sodium aluminate), sulphates and chlorides. But sodium carbonate, if present in small quantity, is not indicated by a cold solution of magnesium sulphate. A more reliable test is a dilute solution of corrosive sublimate, which is not precipitated by pure bicarbonate of sodium, or in a more concentrated solution yields a white precipitate, while carbonate of sodium produces a brown-red precipitate of mercuric oxychloride $(HgCl)_2(HgO)_3$. Should, however, ammonia be present or the sodium salt be used in excess, a white precipitate would still be obtained. A still better test for carbonate was proposed by Hager, and consists in agitating one part of calomel with two parts of sodium bicarbonate and three parts of water: the mixture will assume a more or less deep gray color in the course of a day, in proportion to the amount of carbonate of sodium present.

Off. Prep.—Liquor sodæ effervescens, *Br.;* Pulveres effervescentes, Pulv. effervescentes aperientes, *U. S.;* Sodæ citro-tartras effervescens, *Br.;* Troch. sod. bicarbonatis, *U. S.*, *Br.*

Physiological Action.—Bicarbonate of sodium is much less apt than the carbonate of the same base, or than the carbonates of potassium, to derange the stomach, because, it may be, that it belongs to the natural constituents of the body, and is not so promptly eliminated with the urine. This statement has been illustrated by the comparative results of injecting into the veins of animals sodium and potassium carbonates. The latter occasion sudden death, while the former produce no ill effects whatever. The protracted administration of carbonate of sodium gives rise to symptoms which will be pointed out under that article. They are, to a greater or less degree, observed when the system is saturated with the bicarbonate. Although when taken moderately and for a short time no ill effects are produced, and although in many cases it is habitually used without sensible injury, it nevertheless tends to augment the acid secretions of the stomach, and to perpetuate the evil it was designed to cure. It probably tends to diminish the richness of the blood, and hence to impair nutrition. If it is taken by persons who lead a sedentary life, and in whom there is always a predominance of acids in the gastric and renal secretions, it may be less injurious than when active and laborious pursuits restrain the formation and accumulation of acids. For the same reason, probably, a very large amount of bicarbonate of sodium may be used, not only without injury, but with conspicuous advantage, in diseases distinguished by an excess of acid in the humors, as in inflammation, gout, acid gravel, rheumatism, and diabetes; while it uniformly aggravates affections in which the crasis of the blood is impaired, as in the so-called putrid fevers and chronic affections attended with impoverishment of the blood, as albuminuria, anæmia, scurvy, etc. It is stated that the eminent chemist, Thénard, produced in himself a real alkaline cachexia by continuing for several months the use of bicarbonate of sodium in the daily dose of nearly an ounce of this salt. The danger of its continued use in large doses is also made very striking by its cachectic effects in Bright's disease, and by its excessive and unduly prolonged administration in the form of Vichy waters, even in appropriate cases, such as gout, gravel, and rheumatism.

Medical Uses.—The form of *dyspepsia* in which bicarbonate of sodium is peculiarly useful is that attended with acidity of the primæ viæ, and of which the chief symptoms are sour eructation and vomiting, heart-burn, flatulence, and acid liquid stools. In many cases the disorder is exclusively gastric, as in acid dyspepsia. In not a few hypochondriac symptoms are superadded. But in all the bicarbonate of sodium can do no more than palliate the special symptoms due to an acid fermentation of ingesta; a radical curative treatment must be attempted by other means, of which tonic medicines and regimen are the most influential. The palliative symptomatic treatment referred to is of essential service in the case of children in whom interference with primary digestion leads to grave and even fatal disorders. This is especially the case when their sole aliment consists of cow's milk, and the mischief can often be mitigated by adding a small portion of the bicarbonate to each portion of their food.

In *lithiasis* a tendency to the formation of acid sand and gravel may be obviated by the use of this sodium salt after every meal. But it must not be overlooked that, according to competent testimony, the potassium salt is even more efficacious; and the plausible reason is assigned for the alleged fact that the latter passes off more readily than the former by the urine, and therefore tends more to maintain this fluid in a normal if not in an alkaline state. There is some reason to believe that bicarbonate of sodium is capable of producing the solution of urinary concretions already formed. This salt is reported to be singularly efficient in *suppression of urine* from renal disease, and even in that form of Bright's disease of the kidney in which the cause of the obstruction of the renal tubules by casts is proved by their abundance in the urinary sediment.

In *saccharine diabetes* occurring in persons of an obese tendency there is little doubt that the habitual use of the salt under consideration is sometimes of marked benefit. It is less so when the patients are thin and of a nervous constitution. Such has been the result of observation at Vichy, Carlsbad, and other alkaline mineral springs renowned for their virtues in this affection. The same waters are celebrated for their utility in *gout*. They are especially so in the simple and regular forms of the disease occurring in persons of good constitution and not yet exhausted by repeated attacks, or by the complications to which the gouty become subject. In the latter case the system is already impaired, and unable to sustain the debilitating influence of an alkaline treatment. Under such circumstances a free use of alkaline waters is apt to occasion a transference of the gout to internal organs, and sometimes it has led to a fatal termination of the disease.

In *acute articular rheumatism*, and notably in those cases of it in which many joints are involved, and in which there is high fever, acid sweats, and loaded urine, the bicarbonate of sodium is of inestimable benefit, provided that it be given so as to maintain a neutral condition of the urine. Its efficiency is increased when the affected joints are swathed in compresses saturated with a solution of the salt.

Bicarbonate of sodium may be prescribed in *doses* of from five to thirty grains and upwards. The largest doses are required in acute rheumatism. When the doses must be large, the medicine is most conveniently administered in carbonated water.

SODII BORAS, *U. S.*—BORATE OF SODIUM.

Borax, Br., P. G.; *Natrum biboricum (biboracicum)*; *Boras sodicus.*—*Borax*, E., Fr., G.; *Borate de soude*, Fr.; *Borsaures Natron*, G.

Formula $Na_2B_4O_7.10H_2O$. Molecular weight 382.

Origin and Preparation.—Borax is found native as *tincal* in Persia, Thibet, and other localities, as a saline incrustation on the shores of certain lakes, and as a crystalline deposit at the bottom of the borax lake in California. The incrustation and the deposit are continually renewed by crystallization from the lake waters as fast as the borax is removed. Tincal requires to be washed with a solution of caustic soda for effecting the removal of fatty matter with which the crystals are covered, and, on being afterwards recrystallized from water, yields borax.

Borax is also prepared from various native borates which are found in certain parts of South America, Europe, and Asia, and which are known as the minerals *boracite*, *borosodocalcite*, *cryptomorphite*, etc. These consist of boracic acid combined in varying proportions with sodium, calcium, and magnesium, and mixed with sulphates, chlorides, and silica, and yield borax on being treated with carbonate of sodium and after recrystallization from water.

The crater of the Liparian island of Volcano, situated north of Sicily, contains a deposit of *boracic acid;* and the same acid is found in the vapors which issue from fissures in the volcanic rocks of Tuscany in Italy. To obtain this acid, a series of basins or *lagoons* are constructed on the side of the mountain, either by excavation or masonry, so as to surround the clefts in the rocks. The basin is then filled with water from a mountain stream; the hot vapors in passing through the water yield to it boracic acid and heat the water at the same time. The solution of boracic acid thus obtained is passed from one basin to another lower one, subsequently into evaporating pans, and finally into vats, where the acid is deposited. The crude boracic acid is converted into borax by preparing a solution of 13 parts of crystallized carbonate of sodium in 15 or 16 parts of water, heating to boiling, and adding gradually 12 parts of the boracic acid; after combination has been effected, the solution is permitted to settle, and drawn off clear into lead-lined vats where it crystallizes. The product thus obtained requires to be recrystallized to fit it for medicinal uses and for the arts.

Properties.—Borax forms large, colorless, hexahedral, flattened crystals, which are transparent, and, in dry air, effloresce superficially and become opaque. When heated it gives off its water of crystallization, and is converted into a light white spongy mass, which at a red heat melts, and, on cooling, forms a transparent glass. Borax has the specific gravity 1.72, has a weak alkaline reaction, is insoluble in alcohol, but dissolves in glycerin and in water. The glycerin solution imparts a green color to flame (Senier Lowe, 1878). According to Poggiale, 100 parts of water dissolve at 10° C. (50° F.) 4.65 parts, at 20° C. (68° F.) 7.88 parts, at 30° C. (84° F.) 11.90 parts, at 40° C. (104° F.) 17.90 parts, and at 100° C. (212° F.) 201.43 parts of crystallized borax. If a saturated solution of borax is prepared at an elevated temperature, and kept at a temperature exceeding 56° C. (133° F.), borate of sodium containing $5H_2O$ will crystallize in octohedral crystals, which are harder than borax. A cold solution of borax absorbs considerable quantities of carbonic acid and sulphuretted hydrogen, both gases being again expelled on heating and evaporating the liquid.

Composition.—The water of crystallization amounts to 47.12 per cent.; Na_2O to 16.23, and BO_3 to 36.65 per cent.

Tests.—The solution of borax is not colored or precipitated by sulphuretted hydrogen (absence of *heavy metals*), and does not yield any precipitate with carbonate of sodium (salts of *calcium*, etc.), nor, if sufficiently diluted, with barium chloride (*sulphate* and *phosphate*), or with nitrate of silver (*chlorides*). If a mineral acid is added to a hot saturated solution of borax, on cooling, a scaly crystalline precipitate is obtained, the alcoholic solution of which burns with a green flame. 191 grains dissolved in 10 fluidounces of distilled water require for saturation 1000 grain-measures of the volumetric solution of oxalic acid, *Br.*

Pharmaceutical Uses.—ACIDUM BORICUM S. BORACICUM, *P. G.;* Boracic acid; formula H_3BO_3; molecular weight 62. This acid was first obtained by Homberg (1702), and was formerly known as *Sal sedativus Hombergi.* It is prepared by adding hydrochloric acid to a hot solution of borax, and crystallizes in white translucent scales of a slight pearly lustre and of a very slight acid taste; when heated it melts, disengaging vapors of water which contain some of the acid, and afterwards yields a transparent mass which congeals into a hard, brittle, transparent glass. Crystallized boracic acid is insoluble in ether, soluble in alcohol, and requires about 30 parts of cold and 3 parts of boiling water for solution; the solution imparts a brown color to turmeric paper, and is not precipitated by nitrate of silver or chloride of barium.

TARTARUS BORAXATUS and POTASSII TARTRO-BORAS are described on page 1143.

Off. Prep.—Glyceritum sodii boratis, Mel sodii boratis (boracis), *U. S.*, *Br.*

Physiological Action.—In the dose of six drachms borax has created no unpleasant effects except a temporary sense of oppression in the stomach, or, at most, nausea and vomiting. Continued large doses produce the same consequences as the prolonged use of other salts of sodium, viz., liquefaction of the blood and scorbutic symptoms, and sometimes an impetiginous eruption on the skin. It is largely eliminated by the kidneys either unchanged, or, after decomposition, as urate of sodium. Physiological experiment does not illustrate the action of this salt upon the uterine system, for it is only in certain special conditions of that system that its powers are manifested.

Medical Uses.—This substance is supposed to be described by Pliny under the name of Chrysocolla; by the Arabians it was called Tankâr (Sontheimer). The former speaks of its drying and healing action upon wounds when applied as a powder; of its use in sore throat, and in collyria for removing opacities of the cornea, and in plasters for effacing scars. The latter allude to its cleansing and astringent virtues, to its use in caries of the teeth, etc., and speak of its being used by goldsmiths as a flux for gold. A solution of borax (gr. xxx to f℥j) is quite efficient in diminishing and even removing *freckles*, *chloasma*, and those unseemly eruptions by which some women are annoyed at the menstrual periods. A drachm of borax in half an ounce of cold cream forms an excellent ointment for *chilblains*. As a lotion for *ringworm of the scalp* a solution has been recommended of one drachm of borax in two ounces of distilled vinegar. Borax has also been applied with good effect in *pityriasis versicolor*, and for removing *opacities of the cornea*. It is used to heal *ill-conditioned ulcers*, and especially those of the mouth occurring in *ulcerative stomatitis*, and also to restore their firmness to *spongy gums*. In the last cases particularly it should be associated with honey and myrrh. It is less efficient in these affections than chlorate of potassium, but, like it, acts only as a local stimulant. It is of constant use for the cure of *aphthæ* of the mouth and fauces occurring in nursing children. In the first-named affections it should be finely powdered with white sugar, and applied directly to the affected part. It is equally efficacious in *thrush*, which proceeds from the acid fermentation of the milk, and occurs in the buccal cavity, about the anus, etc. The officinal preparations of borax with honey and with glycerin will answer the same purpose, but perhaps less efficiently. These, or the powder, or a simple watery solution, may be applied to aphthous sores of the *vulva* and *vagina*, to fissures of the *nipples*, and similar lesions. It is sometimes advantageous to associate with the borax Peruvian balsam, benzoin, or some analogous agent to modify and strengthen its action. They may be incorporated in a mixture made with yelk of egg, oil of almonds, etc. A solution of borax is one of the best topical applications in *prurigo pudendi*, and one of the most efficient vaginal injections for *leucorrhœa*, especially when it is due to superficial ulcers of the cervix.

In subacute *laryngitis*, especially as it occurs in children, a mixture of powdered borax, with honey or syrup, has been found serviceable by its stimulating action upon the adjacent pharyngeal mucous membrane. A like effect has been observed in *aphonia* due to laryngeal congestion merely, or to exhaustion of the larynx by an excessive use of the voice. The best mode of using it is to allow a piece of borax, of the size of a pea, gradually to dissolve in the mouth.

Very few writers upon therapeutics admit that borax stimulates the uterine system, *promoting menstruation* and *labor*, and checking *hemorrhage*. The difficulty of determining the precise value of an emmenagogue medicine is notorious, and in this case at least, as much as in others, large assertion is mixed with little proof. The power attributed to borax of exciting the gravid uterus to contraction does not appear to us susceptible of well-grounded doubt; and, while believing that it is efficacious in uterine hemorrhage, we should find a demonstration of its value difficult.

The utility of solutions of borax in cases of *uric acid gravel* is very great. Entering the urine nearly unchanged, a great part of the borax taken presents itself to the uric acid, which decomposes it, forming a soluble urate of sodium, which, with the freed boracic acid, is discharged. Borax may be given internally in the *dose* of from five to thirty grains in watery solution largely diluted.

SODII BROMIDUM.—BROMIDE OF SODIUM.

Natrium bromatum, *Bromuretum sodicum*.—*Bromure de sodium*, Fr.; *Bromnatrium*, G.

Formula NaBr. Molecular weight 103.

Preparation.—Bromide of sodium may be prepared in a manner similar to bromide of potassium (see page 1110). A solution of ferrous bromide, boiled with a solution of carbonate of sodium, yields a precipitate, the filtrate from which is evaporated and crystallized.

Properties.—At a temperature of about 20° C. (68° F.) and below, colorless, transparent, oblique, rhombic prisms are obtained, having the composition $NaBr.2H_2O$, and, when heated, melt and give off the water of crystallization. But when the solution is kept at a temperature above 30° C. (86° F.), anhydrous cubes of bromide of sodium are obtained, which have a rather alkaline taste, though neutral to test-paper, and dissolve in 1¼ times their weight of cold, and less than their own weight of hot water. The salt differs from bromide of potassium in imparting a yellow color to flame, and in not being precipitated from its concentrated solution by a strong solution of acid tartrate of sodium.

Medical Action and Uses.—Physiological experiment and clinical observation agree in teaching that sodium bromide possesses but in a slight degree the characteristic sedative and hypnotic properties of bromide of potassium. It has been claimed to be more eligible than the latter salt, because it produces neither an eruption of acne nor hebetude of mind or body; but the latter symptom is the very index of the efficiency of the potassium salt, and its failure to occur under bromide of sodium can only be taken as a proof that this salt is inoperative in cases for which the potassic bromide is appropriate.

SODII CARBONAS, *U. S.*—CARBONATE OF SODIUM.

Sodæ carbonas, Br.; *Natrum carbonicum crudum*, P. G.; *Carbonas sodicus, Sal sodæ.—Sal soda, Washing soda*, E.; *Carbonate de soude*, Fr.; *Kohlensaures Natron, Soda*, G.

Formula $Na_2CO_3.10H_2O$. Molecular weight 286.

Origin and Preparation.—Carbonate of sodium exists in a large number of mineral waters, mostly, however, as bicarbonate. It is contained in the waters of certain lakes in India, Egypt, Central Africa, Mexico, and South America, and is found in the ashes of many plants growing near the seashore, such as *Salsola*, *Statice*, *Salicornia*, *Atriplex*, *Mesembryanthemum*, and others. These ashes are known in commerce as *barilla*, *salicor*, etc., the former containing nearly 30 per cent., the latter about 14 per cent., of sodium carbonate. *Kelp* and *varec*, the ashes of various marine algæ, contain much less soda, and are at present not employed for obtaining this salt. Egyptian *trona*, a native carbonate of sodium, contains both carbonate and sesquicarbonate. In Hungary and some other countries, carbonate of sodium effloresces from the earth.

The most important sources of this salt are cryolite and the sulphate and chloride of sodium. *Cryolite* is a mineral found in Greenland, and consists of fluoride of sodium and aluminium. When boiled with an excess of burned lime, insoluble fluoride and aluminate of calcium are obtained, and caustic soda remains in solution; and when a mixture of cryolite and chalk is cautiously heated to redness, but not to fusion, fluoride of calcium and aluminate of sodium are produced, this last compound being soluble in water and decomposed by carbonic acid, which precipitates hydrate of aluminium and generates carbonate of sodium.

Carbonate of sodium is obtained by *Leblanc's process* from sulphate of sodium, which is mixed with chalk and coal, and the mixture ignited; the mass is exhausted with water and the solution concentrated, the carbonate separating from the hot liquid being removed while fresh portions of the solution are added, until the carbonate becomes too much contaminated with foreign salts, when it is calcined with charcoal and afterwards recrystallized. In the first part of this process carbonate of sodium and sulphate of calcium are formed by double decomposition, and the sulphate is reduced by the coal to sulphide; but the ignited mass contains also caustic soda, sulphate and hyposulphite of sodium.

On conducting into a cold concentrated solution of chloride of sodium, first ammonia gas and afterwards carbonic acid, there are formed chloride of ammonium and bicarbonate of sodium; most of the latter salt is deposited, and after having been heated to redness requires to be dissolved in water and crystallized, in order to obtain carbonate of sodium. In the first part of this process the reaction takes place between bicarbonate of ammonium and chloride of sodium, but the conversion of the latter salt into bicarbonate is never complete.

Properties.—As obtained in commerce, carbonate of sodium is in large, colorless, rhombic crystals, or frequently in crystalline lumps, and has a harsh alkaline taste, and a decided alkaline reaction. On exposure it becomes white and friable from the loss of water of crystallization, the amount of this loss depending upon the temperature; the last molecule of water is expelled near the temperature of boiling water. The salt is insoluble in alcohol and ether, but dissolves in about 2 parts of water at the ordinary temperature.

Tests.—Commercial carbonate of sodium usually contains small but variable quantities of sulphate and chloride, and its solution in water acidulated with nitric acid, therefore, produces precipitates with barium chloride and with nitrate of silver. Cryolite is the source of an impurity which is sometimes met with, and which consists of alumina, rendered soluble in water by the soda; it is best detected by acidulating its solution in water with muriatic acid, heating to boiling, and then supersaturating with ammonia, when gelatinous aluminium hydrate will be precipitated. The British Pharmacopœia directs that 143 grains of it should require for neutralization at least 960 grain-measures of the volumetric solution of oxalic acid, consequently the salt should contain not less than 96 per cent. of crystallized carbonate of sodium. The United States Pharmacopœia requires it merely to be free from sulphate.

SODII CARBONAS PURA; Natrum carbonicum purum, *P. G.*—This is obtained by recrystallizing the commercial salt from distilled water, until free from the impurities described above. 20 grains of it neutralize 9.7 grains citric acid or 10½ grains tartaric acid.

Composition.—Pure crystallized carbonate of sodium contains 62.9 per cent. of water, 21.7 per cent. of Na_2O, and 15.4 per cent. CO_2. When boiled with a little water, a salt is deposited containing only 14.5 per cent. of water = $1H_2O$. Several other salts are obtainable, which crystallize with 3, 5, and 7 H_2O. Besides the carbonate and bicarbonate of sodium, another compound of intermediate composition may be obtained; this *sesquicarbonate* requires about 7 parts of water for solution, and contains nearly 22 per cent of water.

Pharmaceutical Uses.—Carbonate of sodium is used in preparing Aluminii sulphas, *U. S.;* Antimonii oxidum, *Br.;* Antim. oxysulphuretum, Bismuthi subcarb., Bism. subnitras, Cadmii sulphas, *U. S.;* Calcii carbonas, *U. S.*, *Br.;* Ferri subcarbonas, *U. S.;* Liquor sodæ, Liquor sodæ chlorinatæ (chloratæ), *U. S.*, *Br.;* Magnes. carbonas, *Br.;* Pil. ferri carbonatis, Pil. ferri comp., *U. S.;* Potass. et sodii tartras (Soda tartarata), *U. S.*, *Br.;* Sodæ bicarbonas, *Br.;* Sod. carbonas exsiccata, Sod. phosphas, Zinci carbonas præcipitata, *U. S.*, *Br.*

SODII CARBONAS EXSICCATA, *U. S.*—DRIED CARBONATE OF SODIUM.

Sodæ carbonas exsiccata, Br.; *Natrum carbonicum siccum*, P. G.—*Dried carbonate of soda*, E.; *Carbonate de soude sec*, Fr.; *Getrocknete Soda*, G.

Formula Na_2CO_3. Molecular weight 106.

Preparation.—Take of Carbonate of Sodium a convenient quantity. Expose it to heat, in an iron vessel, until it is thoroughly dried, stirring constantly with an iron spatula; then rub it into powder. *U. S.*

Take of Carbonate of Soda eight ounces. Expose the carbonate of soda in a porcelain capsule to a rather strong sand heat until the liquid which first forms is converted into a dry cake; and, having rubbed this to powder, inclose it in a stoppered bottle. *Br.*

Properties.—It is a white powder, which has the properties of the crystallized carbonate, but is free from water of crystallization, and yields with sulphuric acid 41.5 per cent. of carbonic acid gas. 53 grains of it dissolved in water are completely neutralized by 1000 grain-measures of oxalic acid.

History.—Under Nitrate of Potassium allusion has been made to the confusion between nitrum and natron, nitre and soda, in medical and natural history. It is probable that anciently they were not clearly distinguished from one another. It appears that originally the term nitre was applied to native carbonate of sodium, and that the same name was afterwards given to the substance procured by lixiviation of the ashes of the beech, oak, and other trees.

Soda was used by the ancients only as an external remedy for repressing fungous granulations, stimulating indolent sores, curing eruptions of the skin, repressing perspiration, whitening the teeth, and destroying vermin. It was habitually used with water as soap is at present, and baths of a strong solution of it were employed in the treatment of gout, tetanus, etc.

Physiological Action.—Necessarily the action of the carbonate of sodium must be closely analogous to that of the bicarbonate, but it differs in being much more irritating. In experiments on animals the continued use of large doses occasions loss of appetite, vomiting, diarrhœa, and sometimes albuminuria, followed by death. On dissection the gastro-intestinal mucous membrane is tumid, the follicles are enlarged, the Malpighian corpuscles of the spleen increased in size and number, the acini of the liver degenerated, the renal tubules obstructed, and the gums swollen and spongy. In experiments on man, the secretions at first diminish and the body gains weight; subsequently a reverse effect occurs. These changes chiefly affect the watery element of the urine; the urea is undiminished, but the uric acid at first declines, to rise again subsequently, notwithstanding the continued use of the alkaline carbonate. However these things may be, carbonate of potassium is certainly diuretic when duly administered. According to current chemico-physiological doctrines, the carbonates are converted by the gastric juice into chloride of sodium, which in its turn increases the secretion of acid in the stomach, and promotes the digestion of food. It may also tend to dissolve the glairy mucus which in certain dyspeptic conditions coats the interior surface of the stomach, hinders the close contact of the food with the mucous membrane, and thereby diminishes the acid secretion. It also may neutralize the fatty acids which in certain morbid conditions are generated in the stomach, and which prevent the due digestion of starchy food for which a feebly alkaline menstruum is necessary (Husemann).

Carbonate of sodium is generally assumed to promote the secretion of all mucous surfaces and glands, which is altogether probable on clinical grounds, although experiments do not demonstrate it.

Experimental researches have shown that when from one to five drachms of this salt are daily taken by men for ten successive days, the blood grows lighter in color, the proportion of its white corpuscles and water increases, while that of its other solid constituents declines, and the clot exhibits a diminished firmness. Meanwhile the strength diminishes and the skin grows pale. In excessive doses carbonate of sodium is irritant and corrosive, but not so much so as carbonate of potassium. Its proper antidotes are vinegar, lemon juice, or a solution of tartaric acid. Subsequently cream or olive or almond oil may be administered.

Medical Uses.—In regard to the internal uses of carbonate of sodium, little need be said in detail. They are the same as those of the bicarbonate, but they are much less frequently resorted to, on account of the greater mildness of the action of the latter salt. The carbonate is especially used now, as it was in ancient times, for the treatment of *diseases of the skin.* It is most frequently applied in a general bath, from four to sixteen ounces of the salt being dissolved in a sufficient quantity of water at the temperature of about 80° F. Each bath should last for at least an hour. The effect of it is to redden the skin, to stimulate the affected portions to assume a more healthy action, and to remove the sebaceous and acid secretions adhering to it. If the skin is already in an irritable condition, very little of the alkali should be used, and its acrimony should be blunted by the addition of mucilage or bran to the water. Naturally the dry eruptions (lichen, prurigo, lepra, psoriasis, pityriasis) are most apt to be benefited by this treatment, while pustular and vesicular affections (impetigo, eczema) are unsuited for its use, unless the solution is very weak. Lotions containing carbonate of sodium are useful in many local eruptions, as those of the scalp; in herpes circinatus, lichen agrius, intertrigo, and pruritus of the vulva. In some cases of inveterate scaly diseases, and in a less degree in chronic papular and pustular affections, the long-continued internal use of this medicine is sometimes curative, but seldom until it has produced more or less of the cachectic phenomena above mentioned.

Carbonate of sodium has also been employed in glandular *scrofula*, *whooping cough*, *congestion of the liver*, etc., but, except in the form of alkaline mineral waters, without notable results.

This salt is seldom administered internally; but its *dose* may be stated to be from five to twenty grains dissolved in water, and copiously diluted. From two to eight ounces may be used in a general bath for diseases of the skin. A lotion for the same purpose should contain fifteen or twenty grains to the ounce of water for scaly affections, and about half that proportion for lichenoid eruptions. A solution of the latter strength is appropriate as a wash for the mucous membrane of the female genital organs. An ointment for diseases of the skin may be made with about one drachm of the salt to an ounce of lard, with the addition of one or two fluidrachms of laudanum.

The medicinal qualities of dried carbonate of sodium are identical with those of the common carbonate. It is represented to be convenient for administration in pills; but the irritant qualities of the salt render this mode of prescribing it not only ineligible, but imprudent. The *dose* of it is stated to be from three to ten grains.

SODII CHLORIDUM, *U. S.*, *Br.*—CHLORIDE OF SODIUM.

Natrium chloratum purum, P. G.; *Chloruretum sodicum*, *Sal commune s. culinare.*—*Common salt*, *Table salt*, *Sodium chloride*, E.; *Chlorure de sodium*, *Sel commun*, *Sel de cuisine*, Fr.; *Chlornatrium*, *Kochsalz*, G.

Formula NaCl. Molecular weight 58.5.

Origin and Preparation.—Chloride of sodium is found native in extensive beds and in different geological formations, though mostly associated with clay and sulphate of calcium, and constitutes *rock salt* or *sal gem* if very pure and transparent. This is mined, mechanically freed from the adhering impurities, and sold as rock-salt, or purified by recrystallization. In some places holes are dug into the rock and filled with water, which is pumped up when nearly saturated with salt, and evaporated.

Most saline springs contain chloride of sodium. If the salt is present in sufficiently large proportion, it is recovered by evaporation; but, if present in the solution only in limited proportion, the spring water is first concentrated, in some parts of France and Germany, by pumping it up on a high scaffolding and causing it to trickle over layers of brushwood, whereby, from the largely extended surface exposed to the air, much water is evaporated, and a brine is obtained which may be economically concentrated by artificial heat. Sometimes the brine contains, also, considerable proportions of gypsum and sulphate of sodium, which salts are deposited from the boiling brine and raked out; when nearly free from these salts and sufficiently concentrated, the liquor is no longer mixed with fresh portions of the brine, but is maintained at an elevated temperature, and the salt removed as it crystallizes. The size of the crystals, called grain of the salt, varies with the heat, and increases as the temperature falls.

Sea-water is a solution of various salts, prominent among which is chloride of sodium, which is contained in the waters of the large oceans to the amount of from 2.6 to 2.9 per cent., but is much less in the large bays and seas which are surrounded by land, and sinks, for instance, in the water of the Baltic Sea, to ½ per cent. The extraction of the salt from sea-water depends upon the climate, the water being removed either by freezing or by evaporation. When frozen, sea-water yields pure ice, and leaves a more concentrated saline solution. In warmer countries the concentration is effected by spontaneous evaporation in shallow pits, the brine as it concentrates being conducted into other pits, and finally into reservoirs, where the salt is deposited.

The mother-liquors, which are obtained in the various processes described, are solutions of various salts, usually sulphates and chlorides, in some cases, also, of bromides of sodium, potassium, calcium, and magnesium, and they frequently yield salts or double salts of definite composition by being concentrated and exposed to either a low or an elevated temperature; they are used up in the preparation of sulphate of sodium, sulphate of magnesium, and bromine.

Properties.—When crystallized by spontaneous evaporation, chloride of sodium forms transparent cubes; but when the solution is evaporated at an elevated temperature, the crystals aggregate on the surface of the liquid in the form of hollow pyramids. It is very frequently kept in the form of a white, granular, crystalline powder, which is permanent in the air, unless contaminated with chloride of magnesium, when it becomes moist in a damp atmosphere. On the application of heat chloride of sodium usually decrepitates, and at a red heat it melts and is slowly volatilized. It has a neutral reaction to test-paper, a density of 2.16, and a purely saline taste. It is very sparingly soluble in strong alcohol, and requires a little less than three parts of hot or cold water for solution. 100 parts of water dissolve at 0° C. (32° F.) 35.52 parts, at 25° C. (77° F.) 36.13 parts, at 60° C. (140° F.) 37.25 parts, and at 100° C. (212° F.) 39.61 parts of chloride of sodium (*Poggiale*). On cooling the saturated aqueous solution to below the freezing point of water, transparent colorless prisms, $NaCl.2H_2O$, are obtained, which melt above 0° C. (32° F.), and deposit a granular powder of the anhydrous salt. Dilute aqueous solutions of sodium chloride produce at a low temperature ice which is free from the salt; and concentrated solutions deposit crystals of the salt before they freeze.

Composition.—Chloride of sodium contains 60.6 per cent. of chlorine and 39.4 per cent. of sodium. Heated with sulphuric acid, hydrochloric acid is given off.

Tests.—The aqueous solution of chloride of sodium is not precipitated by chloride of platinum (absence of *potassium*), but gives with nitrate of silver a white precipitate, soluble in ammonia, but insoluble in nitric acid (*chloride*). When pure, it is not precipitated by carbonate of sodium (absence of *calcium*, *magnesium*, etc.), chloride of barium (*sulphate*), sulphuretted hydrogen, or sulphydrate of ammonium (*compounds of heavy metals*).

Pharmaceutical Uses.—Chloride of sodium is used in the preparation of chlorine, hydrochloric acid, corrosive sublimate, and calomel.

History.—The economic and dietetic value of salt has been known from the remotest antiquity, and this, as well as its medicinal virtues, were dilated upon by Dioscorides, Pliny, and later authorities. Pliny, after speaking of its wonderful influence upon grazing animals, adds: "Ergo hercule vita humanior sine sale non quit degere: adeoque necessarium elementum est, ut transierit intellectûs ad voluptates animi quoque. Nam ita sales appellantur." According to Dioscorides, salt is drying, astringent, and tonic. It preserves animal bodies from putrefaction for ages. Medicinally, it is stimulating, cleansing, and resolutive. Mixed with various oils and other substances, it is used as an application to the stings of insects, the bites of serpents, and other animals, etc.; it relieves headaches, cures bruises, heals ulcers, pustules, and papules, and represses the growth of warts and fungous granulations. It cures ulcers and swellings of the throat, mouth, and tongue, and a variety of cutaneous eruptions; mixed with wine it is a wholesome purgative and anthelmintic; heated and inclosed in bags it relieves muscular and other pains; and it is also an antidote to opium poisoning. The Arabians dwell upon its dietetic virtues when eaten with fish, cheese, and food prepared with vinegar, and upon its power of sharpening the appetite and promoting digestion. They pronounced it fitter for full-blooded persons than for the thin and nervous, and they used it as a topical application in leucoma, pterygium, and granular lids, etc.

Physiological Action.—A strong solution of salt stimulates the skin, and is generally said to irritate the mucous membrane; but a weak one smarts the nasal passages less than simple water, a fact which the use of the nasal douche has made familiar. Kept in contact with the skin, a strong solution excites a papular eruption. There is no evidence of the absorption of salt by the unbroken skin. The serum of the blood contains from four to six parts per thousand of chloride of sodium, while the red corpuscles contain chloride of potassium. The former abounds more in arterial than in venous blood, and in the portal more than in the hepatic veins. Salt exists in all the secretions, and is the chief source of the muriatic acid secreted by the stomach. Its special action in the blood is held to be that it promotes the passage of albumen to and from the cells, by the perpetual changes which it occasions in the relative densities of the fluids within and without them. A large increase in the proportion of salt used with the food causes a corresponding increase in the excretion of urea; at the same time it quickens tissue change, and raises the temperature of the body. A few days after the complete withdrawal of salt from the food, gastric oppression occurs, with a sense of tightness in the head, and general weariness. Sometimes albumen appears in the urine; and, on the other hand, in albuminuria it sometimes diminishes the abnormal excretion. Salt, in excess, retards the coagulation of the blood and reddens it; and, conversely, when salt is deficient, the blood grows dark.

In due proportion salt increases largely the secretions of the salivary and gastric glands, stimulating the appetite. At the same time it promotes the digestion of vegetable food, and renders it more apt for absorption. Hence probably the greed for salt of all herbivorous animals, and the utility of those "salt-licks" to which the bison, deer, and other wild animals resort. For this reason, also, in part, it is customary to mix salt with the fodder of horses and horned cattle. It is related that during a famine in Cornwall, Eng., when the poor had only potatoes to eat, they declared that they would be contented if only they could eat them with salt. "In Holland, the ancient laws ordained men to be kept on bread alone, unmixed with salt, as the severest punishment that could be inflicted. The effect was terrible; these wretched criminals are said to have been devoured by worms engendered in their own stomachs." (Somerville.)

Salt is useful, also, by exciting a thirst for liquids, which aid in the solution of the food, and render it fitter for absorption. In moderate quantities it augments the urine; but if long and largely consumed, it lessens this excretion and renders it irritating, unless the thirst which it excites is gratified with copious draughts of water. It is notorious that an exclusive diet of salt food tends to produce scurvy, one of the most deplorable incidents of a sailor's life on long voyages. In this disease there is an extravasation of the blood, which may be illustrated by the experiment of immersing a frog's foot in salt water; a free transudation of the red corpuscles takes place.

In very large quantities salt occasions vomiting or diarrhœa, or both. The case is recorded of a man who swallowed a pound of salt in a pint of ale. He died within twenty-four hours with all the symptoms of irritant poisoning. His stomach and intestines were found excessively inflamed.

Medical Uses.—It has been proposed to use salt for the cure of *intermittent fever* upon the ground that this agent causes contraction of the spleen enlarged by the disease. From half an ounce to an ounce has been given for this purpose during the apyrexia, and usually, unless dissolved in too much water, it neither vomits nor purges. This is said to be a popular medicine in some river localities and among the boatmen, who ususually swallow a tablespoonful or so of salt mixed with gin. There is no sufficient proof of the efficacy of the medicine. A similar remark may be applied to its use in pulmonary *phthisis*, notwithstanding certain physicians of repute have attested its benefits. This judgment does not apply to an ordinary incident of consumption, *hæmoptisis*, for which a teaspoonful of dry table salt may be given at intervals of fifteen or twenty minutes. Nothing appears to be so successful in arresting this form of hemorrhage, but all the ingenious hypotheses invented to explain its apparent action are chimerical. If the hemorrhage, like most others, did not usually cease spontaneously when the patient is kept perfectly still, the action of the salt would be less ambiguous. The same remarks are more or less applicable to the use of salt to arrest *epistaxis*, in which, however, it most generally fails to give any proof of its hæmostatic virtues.

In the various forms of *scrofula*, affecting the glands, the skin, or the bones, salt has been used internally and externally, but chiefly in the latter mode, in sea baths, and the baths of various mineral springs, and doubtless these agents are often useful through their stimulant operation, without any reference to their special saline constituents, in so far as they promote tissue change. Gargles of salt water have been used with some advantage to promote the separation of the false membranes in *diphtheria*.

As salt is essential to the digestion of food, so is it of use in certain forms of *dyspepsia*, doubtless by promoting the secretion of the gastric juice, and perhaps also by its direct solvent action upon some kinds of aliment. It is especially indicated in those forms of dyspepsia which are attended with decomposition of the food in the stomach, causing flatulence, acidity, and pain, and either diarrhœa as in children, or constipation as in adults. It may be best administered in the form of natural mineral waters, rich in this ingredient, or in carbonated water.

In epidemic *cholera* the injection of salt and water into the veins has frequently been followed by temporary improvement; and it is claimed that a tablespoonful of a solution of one ounce of salt in half a pint of water given at intervals of a quarter of an hour has repeatedly arrested the disease. If such be the fact, its explanation may probably be that the saline solution acts directly upon the cholera poison, whose influence upon the gastro-intestinal mucous membrane produces the serous exhalation which constitutes the primary element of the disease. Salt is an ancient, and continues to be a popular, remedy for intestinal *worms*, especially for lumbricoid worms. There is no doubt that their production is favored by food that does not contain salt, and that a diet of salt food tends to dislodge them. Enemas of salt water form an excellent remedy for *ascarides* of the rectum. Probably in both cases the parasites are destroyed by the salt abstracting the water from their tissues. In a similar manner when leeches are sprinkled with salt they are made to disgorge the blood which they have swallowed. It has been supposed that the anthelmintic virtues of helminthocorton, or Corsican moss, depend upon the saline element which saturates it.

Salt has been employed with some effect in *diabetes*, and certainly some of the mineral waters used in that disease contain it. But given in simple watery solution it is alleged to reduce the proportion of sugar and the amount of urine voided.

It is a familiar fact that salt meat, olives, and other saline articles tend to prevent *alcoholic intoxication;* and enemata of salt water have been repeatedly employed with success to rouse drunkards from their lethargy, or abate their delirious pugnacity. Similar injections are in common use to relieve *congestion of the brain*, which they do more speedily than can be explained by the mere removal of feces from the rectum. Salt water is often employed as an emetic to empty the stomach gorged with food or containing narcotic or other poisons. It is a direct antidote to *nitrate of silver* by converting it into the comparatively innocuous chloride.

The local applications of salt are numerous. It is used to limit the action of nitrate of silver applied to the *eye*, *throat*, *vagina*, etc.; in an atomized solution for the treatment of subacute and chronic affections of the *pharynx* and *larynx;* and by the nasal douche in *catarrh of the nostrils* and *ozæna.* The solution used for the purpose should not contain more than twenty grains of salt to a pint of water. Stronger solutions are apt to be painful and to aggravate the disease. A similar solution inspired from the hands, while the head is bent forward almost horizontally, will often answer the purpose as well. Salt and water may also be used as a wash for *mercurial sore mouth;* as an injection in vaginal *leucorrhœa;* as a wash for indolent *ulcers*, for *pruritus vulvæ*, and for the *stings and bites of insects.* Hot salt inclosed in bags is an excellent application in *colic*, *dysmenorrhœa*, *toothache*, and *muscular rheumatism;* a solution of it in whiskey is a popular remedy for the last-named disease, and for discussing *bruises*, *glandular swellings*, etc.; and, finally, a warm salt footbath is one of the best palliatives of congestive *headache*, *uterine pain*, and similar disorders.

SODII HYPOPHOSPHIS, *U. S.*—HYPOPHOSPHITE OF SODIUM.

Sodæ hypophosphis, Br. Add.; *Natrum hypophosphorosum, Hypophosphis sodicus.*—*Hypophosphite of soda*, E.; *Hypophosphite de soude*, Fr.; *Unterphosphorigsaures Natron*, G.

Formula $NaH_2PO_2.H_2O$. Molecular weight 106.

Preparation.—An aqueous solution of hypophosphite of calcium is accurately precipitated by carbonate of sodium; insoluble carbonate of calcium and soluble hypophosphite of sodium are produced and separated by filtration; on evaporating the filtrate, the latter salt is left behind, and may be freed from carbonate of sodium by redissolving it in alcohol, filtering, and evaporating. During the evaporation, decomposition with explosion has occasionally been noticed, which was probably caused by too high a heat; the temperature of the evaporating solution should therefore be kept below that of boiling water.

Properties.—Hypophosphite of sodium is usually obtained in the form of a white granular salt, but by the slow evaporation of its alcoholic solution may be procured in pearly tabular crystals, which, when dried over sulphuric acid and afterwards heated not quite to 200° C. (392° F.), lose nearly 17 per cent. of water. At a higher heat, spontaneously inflammable phosphoretted hydrogen is evolved, and a porous mixture of pyrophosphate and metaphosphate of sodium is left. The salt has a peculiar bitter saline taste, is deliquescent in the air, though less so than hypophosphite of potassium, and is easily soluble in water and likewise in absolute alcohol, but is insoluble in ether. When evaporated with dilute nitric acid and finally ignited, a residue is obtained weighing 97 per cent. of the weight of the hypophosphite, and consisting of metaphosphate of sodium.

Medical Action and Uses.—This salt has been administered in chronic *bronchitis*, and in cases of *nervous depression* with a sense of heaviness or numbness in the limbs, in sexual *impotence*, and various other exhausted states of the nervous system, including those produced by *scrofula, syphilis*, and *anæmia*. It and the other alkaline and earthy phosphites and hypophosphites have also been used with alleged success in *phthisis*, but the allegations have been unsupported by the results of experience. The apparent value of the phosphatic compound in the above named diseases is to be explained by the associated medicinal and hygienic treatment. The *dose* of hypophosphite of sodium is eight grains or more given during digestion.

SODII HYPOSULPHIS, *U. S.*—HYPOSULPHITE OF SODIUM.

Natrum subsulfurosum (hyposulfurosum), P. G. *Hyposulphis sodicus.*—*Hyposulfite de soude, Sulfite sulfuré de soude*, Fr.; *Unterschwefligsaures Natron*, G.

Formula $Na_2S_2O_3.5H_2O$. Molecular weight 248.

Preparation.—The process proposed by Walchner is as follows: A mixture of 3 parts of exsiccated carbonate of sodium and 1 part of sulphur is heated in a porcelain dish gradually to the fusing point of sulphur and repeatedly stirred to facilitate contact with the air. Sulphide of sodium is first formed and then oxidized to sulphite, Na_2SO_3; this salt is dissolved in a little water, and, by boiling with more sulphur, converted into hyposulphite, the solution is filtered from the excess of sulphur, and the nearly colorless filtrate concentrated for crystallization.

In the purification of illuminating gas prepared from coal, by dry lime, the *gas-lime* contains carbonate, hyposulphite, and pentasulphide of calcium, and is utilized for the manufacture of hyposulphite of sodium by a process proposed by Graham. The gas-lime is exposed to the air so as to convert the sulphide into hyposulphite; $2CaS_5+3O_2$ yields $2CaS_2O_3+3S_2$. It is then treated with its own weight of cold water, and the filtrate which contains the hyposulphite of calcium is converted into the sodium salt by double decomposition with sodium carbonate, whereby insoluble calcium carbonate is produced and a solution of hyposulphite of sodium obtained, which is concentrated and crystallized; $CaS_2O_3+Na_2CO_3$ yields $CaCO_3+Na_2S_2O_3$. The residue left in the preparation of soda (see page 1276), called *soda waste*, contains sulphide of calcium, and is converted into hyposulphite of sodium by a process nearly identical with the one just described. In decomposing hyposulphite of calcium, the sodium carbonate may be replaced by sodium sulphate, in which case sulphate of calcium is precipitated.

Properties.—Hyposulphite of sodium is in large, transparent, colorless crystals, which are inodorous, and have a cooling, bitter, slightly alkaline, and sulphurous taste. It is permanent in the air, but at an elevated temperature parts with its water of crystallization, which amounts to 36.3 per cent. The salt is fusible between 45° and 50° C. (113° and 122° F.), and, if melted in a clean flask, the liquid heated to boiling, and the flask instantly corked and slowly cooled, the mass will remain liquid until the cork is removed and the surface of the liquid is touched with a hard substance, when the whole will suddenly congeal, a considerable elevation of temperature being observed at the same time. The crystallized salt dissolves in its own weight of water at 15° C. (59° F.), and in half its weight at 40° C. (104° F.); but it is insoluble in alcohol. The solution, if kept in a stoppered bottle, slowly deposits sulphur, and leaves sulphite of sodium in solution; but, on exposure to the air, sulphate of sodium is formed. On the addition of an acid, one-half of the sulphur is precipitated, and sulphurous acid set free, the hyposulphurous acid being unknown in the free state.

Hyposulphite of sodium dissolves chloride and iodide of silver readily, and is employed for this purpose by photographers, and such a solution may be employed for silvering copper and brass. Iodine is decolorized by a solution of hyposulphite of sodium, iodide and *tetrathionate of sodium* being formed, according to the equation $2Na_2S_2O_3+I_2=2NaI+Na_2S_4O_6$. This reaction affords a convenient method for the estimation of iodine, 127 parts of which are decolorized by 248 parts of the hyposulphite. A similar reaction takes place with chlorine, and makes the salt a useful and cheap *antichlor* for the removal of chlorine retained by fabrics and other substances which have been bleached by chlorine. Hyposulphite of sodium is also a solvent for the insoluble salts of lead and other metals. It affords a white precipitate in a concentrated solution of chloride of barium, which is soluble in water.

Impurities.—If contaminated with sulphate or carbonate of sodium, the dilute solution of hyposulphite of sodium produces a white precipitate with solution of chloride of barium.

Medical Action and Uses.—This, among the compounds of sulphurous acid, has been, perhaps, most largely employed for the purpose of correcting that hypothetical fermentation to which a large number of febrile and other diseases have been attributed. But the results of experience are far from confirming faith in this hypothesis. The success of the medicine, in *erysipelas* for example, is equally great whether the administration be internal or external; in other words, its direct action is purely negative; but indirectly it saves the sick from heroic perturbative treatment, and allows the disease to run its normal course towards cure. The influence of the medicine over the course and issue of *typhus* and *typhoid fever*, the *eruptive fevers*, *yellow fever*, *diphtheria*, and *purulent infection*, has been loudly proclaimed, but the proofs of its efficacy are wanting. On the other hand, there is more evidence in favor of its utility in *intermittent fever;* and although the natural tendency of this disease to cure under various circumstances must be admitted, the apparently almost uniform curative influence of the hyposulphite cannot rationally be denied.

A much more tangible evidence of its value is furnished by its use in the treatment of *dyspepsia*, not that it in the least acts upon any of the vital conditions accompanying gastric disorders, but it effectually prevents fermentation in the stomach and bowels, and thereby prevents acidity and flatulence with their accompanying distress, and their ulterior mischievous effects. In like manner this medicine may be used to destroy the products of putrefactive fermentation, whether within the body or not. Thus it may be used to deodorize all *putrid products*, either after their discharge or while they are still in the stomach, rectum, bladder, vagina, uterus, etc. Atomized solutions of this and the allied compounds may be inhaled in *gangrene of the lung*, in *fetid bronchitis*, etc. The dyspeptic fermentation referred to above is accompanied by the rapid development of low vegetable organisms to which the compounds of sulphurous acid are hostile; and this mode of action has been invoked in the local treatment of *sycosis*, *favus*, *impetigo*, etc., by means of a solution of about forty grains of the hyposulphite, or, still better, of the sulphite of sodium in an ounce of water. A similar solution is useful as a lotion in *prurigo pudendi*. A saturated solution may be used in the proportion of about one-sixth to decolorize tincture of iodine.

The *dose* of hyposulphite of sodium is fifteen grains and upwards, largely diluted.

SODII IODIDUM.—IODIDE OF SODIUM.

Natrum iodatum.—Iodure de sodium, Fr.; *Jodnatrium*, G.
Formula NaI. Molecular weight 150.

Preparation.—This salt may be obtained by processes analogous to those which afford iodide of potassium (see page 1128), either from iodine and solution of caustic soda, or from decomposing a solution of iodide of iron with carbonate of sodium. The latter process is the more profitable one, since on the reduction of iodate of sodium by charcoal a portion of the salt is converted into carbonate of sodium.

Properties.—When crystallized at a temperature above 40° C. (104° F.), anhydrous iodide of sodium is obtained in cubes, which are deliquescent on exposure and dissolve at 0° C. (32° F.) in two-thirds of their weight of water, and at 100° C. (212° F.) in less than one-third of water. At a lower temperature the solution yields short prismatic crystals, which have the composition $NaI.2H_2O$, and the molecular weight 186. This salt effloresces in dry air, but on exposure is deliquescent. It has a saline and somewhat acrid taste, and is soluble in alcohol and glycerin.

Tests.—Iodide of sodium differs from potassium iodide in imparting a yellow color to flame, and in not being precipitated from its concentrated aqueous solution by a strong solution of bitartrate of sodium. Contamination with iodate, chloride, bromide, and carbonate may be detected in the same manner as described on page 1130.

Medical Action and Uses.—In 1865 this salt was used with alleged advantage as a substitute for iodide of potassium in the treatment of constitutional syphilis, but it does not appear that the results then claimed have been confirmed by other observers.

SODII NITRAS, *U. S.*—NITRATE OF SODIUM.

Sodæ nitras, Br.; *Natrum nitricum*, P. G.; *Nitras (Azotas) sodicus, Nitrum cubicum.—Nitrate of soda, Cubic nitre*, E.; *Azotate (Nitrate) de soude, Nitre cubique, Nitre de Chili*, Fr.; *Chilisalpeter*, G.
Formula $NaNO_3$. Molecular weight 85.

A native salt, purified by crystallization from water.

Origin and Preparation.—Nitrate of sodium is found in immense quantities, in certain districts of Chili and Peru, imbedded in clay and sand, and more or less mixed with sulphates and chlorides of sodium, calcium, and magnesium. The stratum containing this saline mass, which is called *caleche* or *terra salitrosa*, is blasted, the salt extracted by boiling with water, and the decanted solution crystallized. In this condition nitrate of sodium is brought into the market in damp crystalline masses, which are more or less colored by intermixed earth, and require to be purified by recrystallization.

Properties.—Purified nitrate of sodium crystallizes in colorless obtuse rhombohedrons, which are permanent in dry air, slightly deliquescent on exposure, and are soluble at ordinary temperatures in a little more than their own weight, and at the boiling point in one-half their weight, of water. The salt has a cooling, saline, and somewhat bitter taste, melts when heated to about 310° C. (590° F.), and congeals on cooling to a white mass. It is decomposed when heated to redness, oxygen and afterwards nitrogen and some hyponitric acid being given off. Thrown on the fire it deflagrates, and when mixed with inflammable substances it detonates less violently than nitrate of potassium. It is slightly soluble in strong alcohol and in wood-spirit. The hot aqueous solution mixed with chloride, carbonate, or sulphate of potassium yields crystals of nitrate of potassium.

Tests.—On being warmed in a test-tube with sulphuric acid and fragments of copper, red nitrous vapors are given off. The concentrated aqueous solution is not precipitated by a solution of bitartrate of sodium (absence of *potassium*), and yields no precipitates with nitrate of barium (*sulphate*) or nitrate of silver (*chloride* or *iodide*). The presence of *iodide* is detected by treating the solution with a little chlorine water, and agitating it with bisulphide of carbon, when this liquid will assume a purplish color, and if this color is produced only after treatment with diluted sulphuric acid and zinc, *iodate* is present. *Metals*, if present, would be indicated by a precipitate with sulphuretted hydrogen or sulphydrate of ammonium, and *earthy impurities* by a white precipitate with carbonate of sodium. One hundred grains of pure sodium nitrate, treated with an excess of sulphuric acid and afterwards heated to redness until vapors cease to be given off, yield a residue weighing 83.5 grains (*U. S.*).

Pharmaceutical Uses.—Nitrate of sodium is used in preparing nitric acid and arseniate of sodium.

Medical Action and Uses.—Nitrate of sodium, according to experimental investigations of its action, does not directly lessen the force or frequency of the pulse, nor lower the animal temperature, nor increase the elimination of urea. In large doses, acting as a purgative, it may produce these effects. Its solution dissolves false membranes. It has hence been used with the atomizer to diminish *fibrinous exudations* in the pharynx and larynx. Its chief medicinal virtue is that of a mild purgative, and it has been used with advantage in *diarrhœa* and in *dysentery*. For these purposes it may be given in *doses* of one or two ounces, largely diluted.

SODII PHOSPHAS, *U. S.*—PHOSPHATE OF SODIUM.

Sodæ phosphas, Br.; *Natrum phosphoricum*, P. G.; *Phosphas sodicus*, (*natricus*), *Sal mirabile perlatum*.—*Phosphate of soda*, E.; *Phosphate de soude*, Fr.; *Phosphorsaures Natron*, G.

Formula $Na_2HPO_4.12H_2O$. Molecular weight 358.

Preparation.—Take of Bone calcined to whiteness and in fine powder one hundred and twenty troyounces; Sulphuric Acid seventy-two troyounces; Carbonate of Sodium, Water, each a sufficient quantity. Mix the powder with the sulphuric acid, in an earthen vessel; then add eight pints of water, and, having stirred the mixture thoroughly, digest for three days, occasionally adding a little water to replace that which is lost by evaporation, and frequently stirring the mixture. At the expiration of that time, pour in eight pints of boiling water, and strain through muslin, gradually adding more boiling water until the liquid passes nearly tasteless. Set by the strained liquid that the dregs may subside, and, having poured off the clear solution, boil it down to eight pints. To the concentrated liquid, poured off from the newly formed dregs, and heated in an iron vessel, add, gradually, carbonate of sodium previously dissolved in hot water, until effervescence ceases, and the phosphoric acid is completely neutralized; then filter the liquid and set it aside to crystallize. Having removed the crystals, add, if necessary, a small quantity of carbonate of sodium to the liquid, so as to render it slightly alkaline; then alternately evaporate and crystallize so long as crystals are produced. Keep the crystals in a well-stopped bottle. *U. S.*

Take of Bone-ash in powder ten pounds; Sulphuric Acid fifty-six fluidounces; Distilled Water four and one-half gallons, or a sufficiency; Carbonate of Soda sixteen pounds, or a sufficiency. Place the bone-ash in a capacious earthenware or leaden vessel, pour on the sulphuric acid, and stir with a glass rod until the whole powder is thoroughly moistened. After twenty-four hours, add gradually and with constant stirring a gallon of the water; digest for forty-eight hours, adding distilled water from time to time to replace what has evaporated. Add another gallon of the water, stirring diligently, digest for an hour, filter through calico, and wash what remains on the filter with successive portions of distilled water, till it has almost ceased to have an acid reaction. Concentrate the filtrate to a gallon, let it rest for twenty-four hours, and filter again. Heat the filtrate to near the boiling point, add the carbonate of soda previously dissolved in two gallons of the water, till it ceases to form a precipitate and the fluid has acquired a feeble alkaline reaction. Filter through calico, evaporate the clear liquor till a film forms on the surface, and set it aside to crystallize. More crystals will be obtained by evaporating the mother-liquor, a little carbonate of soda being added if necessary to maintain its alkalinity. Dry the crystals rapidly and without heat on filtering paper placed on porous bricks, and preserve them in stoppered bottles. *Br.*

The inorganic matter of bones consists of tricalcium phosphate which is decomposed by sulphuric acid with the formation of sulphate and acid phosphate of calcium, according to the equation $Ca_32PO_4+2H_2SO_4=2CaSO_4+CaH_42PO_4$. The decomposition is known to be completed when the mixture is uniformly smooth and free from grittiness. On being treated with water the freely soluble acid phosphate of calcium enters into solution, together with a small quantity of sulphate of calcium and any excess of sulphuric acid which may have been employed. On adding carbonate of sodium to the solution the calcium salt is decomposed, one-half the phosphoric acid forming insoluble dicalcium phosphate, while the other half unites with the sodium of the sodium carbonate forming disodium phosphate, liberating carbonic acid gas, and producing water; $CaH_42PO_4+Na_2CO_3$ yields $CaHPO_4+Na_2HPO_4+CO_2+H_2O$. The filtrate from the phosphate of calcium contains the sodium salts of phosphoric, sulphuric, and carbonic acids, of which the last two should be present in small quantity only, and requires to be evaporated to crystallization. If sulphuric acid and carbonate of sodium have not been used too largely in excess, the first crop or two of crystals will be pure phosphate of sodium, but those subsequently obtained are usually contaminated with carbonate and sulphate, and should be recrystallized from water before they are used. 100 parts of calcined bones require from 60 to 70 parts of concentrated sulphuric acid and from 100 to 110 parts of crystallized carbonate of sodium, and yield between 100 and 105 parts of crystallized phosphate of sodium.

Properties.—This salt crystallizes in colorless, transparent, obliquely four-sided prisms, which are of the specific gravity 1.55, react slightly alkaline upon test-paper, and have a cooling saline taste. The crystals effloresce somewhat in dry air, melt when heated to 35° C. (95° F.), and congeal on cooling to a crystalline mass. At 100° C. (212° F.) they part with their water of crystallization, amounting to 60.3 per cent., and are converted into a white saline mass. Above 300° C. (572° F.) the basylous water is expelled and pyrophosphate of sodium is left; $2Na_2HPO_4$ yields $H_2O+Na_4P_2O_7$. Crystallized phosphate of sodium requires at 10° C. (50° F.) 16 times, at 20° C. (68° F.) nearly 7 times, at 30° C. (86° F.) $2\frac{1}{2}$ times, and at the boiling point $\frac{3}{4}$ times its weight of water for solution. The solution saturated at a higher temperature deposits near 35° C. (95° F.) transparent crystals, which contain only 47 per cent. of water of crystallization and have the formula $Na_2HPO_4.7H_2O$. Phosphate of sodium is insoluble in alcohol, and imparts a yellow color to flame.

Tests.—The aqueous solution yields with nitrate of silver a yellow precipitate, soluble in nitric acid and in ammonia (*orthophosphate*), and with ferric chloride a white precipitate insoluble in acetic acid. The solution does not effervesce with acids (absence of *carbonate*), is not rendered turbid by ammonia (*magnesium* or traces of *calcium*), yields a white precipitate with chloride of barium, which is completely soluble in nitric acid (absence of *sulphate*), and after having been acidulated with hydrochloric acid, is not colored or precipitated by sulphuretted hydrogen (absence of *arsenic*, *copper*, etc.).

Composition.—This officinal salt is disodic orthophosphate or disodium hydrophosphate, and represents in 100 parts, 19.9 parts of P_2O_5, 17.3 parts of Na_2O, 2.5 parts of basylous H_2O, and 60.3 parts of water of crystallization. When converted by heat into pyrophosphate, it loses 62.8 per cent. of its weight.

Pharmaceutical Uses.—For the preparation of Ferri phosphas, *U. S.*, *Br.*, Ferri pyrophosphas, *U. S.*, and Syrupus ferri phosphatis, *Br.*

Medical Action and Uses.—Phosphate of sodium in solution injected into the veins is almost entirely eliminated with the urine. Taken internally it is said to diminish the discharge of chloride of sodium by the kidneys. It has a cooling, saline, but not disagreeable taste, and has been used upon theoretical grounds as a remedy for *scrofula*, *rachitis*, *diabetes*, etc., but without encouraging results. It has been much recommended in the *bowel complaints* of children, for which its mild purgative action renders it peculiarly adapted, when the use of purgatives of any sort is indicated. It is said, however, to be most suitable for the *diarrhœas* which are apt to occur at the period of weaning. Its purgative *dose* for an adult is about an ounce; for children affected with diarrhœa the dose should be small, from three to ten grains, and it may conveniently be given in milk and water.

SODII SILICAS.—SILICATE OF SODIUM.

Soluble glass, E.; *Silicate de soude*, *Verre soluble*, Fr.; *Wasserglas*, G.

Preparation.—This compound is usually made by fusing together a mixture of 1 part of fine sand or powdered flint and 2 parts of exsiccated carbonate of sodium, dissolving the product in boiling water, filtering and evaporating to crystallization. The proportion of the ingredients is changed according to the use which is intended to be made of the compound, a more glass-like and less readily soluble mass being obtained by using 8 parts of exsiccated carbonate of sodium, 15 parts of fine sand, and 1 part of charcoal, the latter merely serving as a means for facilitating the decomposition of the carbonate, the gas evolved being partly carbonic oxide.

Properties.—Silicate of sodium is a transparent glass-like mass, which, on exposure, usually becomes superficially opaque, and is slowly soluble in boiling water; but the solution may be evaporated to a thick syrupy consistence without separating a deposit on cooling. The solution, as met with in commerce, usually contains about 10 per cent. of soda ($NaHO$), and 20 per cent. of silica (SiO_2). Some compounds may be obtained in crystalline masses. The solution of soluble glass, when acidulated with hydrochloric acid, remains transparent, and retains silicic acid dissolved; but when heated, evaporated, and boiled with acidulated water, an insoluble powder of silica, SiO_2, is left.

Other Silicates. SILICATE OF POTASSIUM.—Soluble glass was formerly obtained by fusing a mixture of 10 parts of carbonate of potassium, 15 parts of fine sand, and 1 part of charcoal. Sometimes a mixture of 10 parts of carbonate of potassium, 8 parts of carbonate of sodium, and 30 parts of sand is used, because it is more readily fusible than the other mixtures described.

SILICATE OF MAGNESIUM.—This is found native, and constitutes several well-known minerals, such as *soapstone* or *steatite*, which consists of silicate of magnesium and aluminium; *talc*, or *French chalk*, also called steatite, having the composition $4MgSiO_3.SiO_2 4H_2O$; *Meerschaum*, having the formula $2MgO.3SiO_2$, and several others. These minerals are insoluble, tasteless, and yield a soft, slippery powder. *Asbestos* is likewise a silicate of magnesium.

Physiological Action and Medical Uses.—Silicate of sodium is remarkable for its power of arresting the putrefaction of organic matter. When fifteen grains of it are added to six drachms of finely hashed meat, mixed with fifty cubic centimetres of water, putrefaction will not occur. Pus, blood, bile, and egg albumen are in like manner preserved by the addition of a 3 per cent. solution of the salt, which also prevents alcoholic fermentation. Given to dogs it soon renders the urine turbid with silicic acid, and the silicate, phosphate, and carbonate of sodium, but uric acid and its compounds disappear. On killing the animals, congestion of the kidneys and infarction of the renal tubules with silicic acid and its salts are found. Silicic acid is also detected in the muscles and the spleen, and the gastro-intestinal mucous membrane is inflamed or ecchymosed. Injected into the veins a solution of silicate of soda is fatal to life. Given to rabbits in the dose of fifteen grains it has produced alterations in the shape of the blood-corpuscles and fatty degeneration of the liver.

This salt has been applied to correcting the odor and preventing the consequences of putrefactive fermentation. Its solutions have been injected into the vagina in certain cases of *leucorrhœa* and *uterine ulceration;* into the urethra in *gonorrhœa;* into the bladder in chronic *cystitis;* and into the nostrils in *ozæna;* but for all these purposes it is inferior to other stimulant antiseptics and astringents. Solutions containing the salt in the proportion of one-half of one per cent. are employed. It has been applied in the same manner as collodion to the treatment of *erysipelas* of the face and other parts, care being taken that the solution is neutral in its reaction. It has also been used, like starch and other substances whose solutions harden in drying, to prepare the so-called immovable bandages used in treating *fractures* and other surgical injuries. Silicate of potassium has been employed for the same purpose; and the solutions of both have been known as soluble glass.

SODII SULPHAS, *U. S.*—SULPHATE OF SODIUM.

Sodæ sulphas, Br.; *Natrum sulfuricum*, P. G.; *Sulfas sodicus* (*natricus*), *Sal mirabile Glauberi.*—*Sulphate of soda, Glauber's salt*, E.; *Sulfate de soude, Sel de Glauber*, Fr.; *Glaubersalz*, G.

Formula $Na_2SO_4.10H_2O$. Molecular weight 322.

Origin and Preparation.—Sulphate of sodium is found native in the anhydrous state and crystallized, and also in combination with sulphate of calcium. It is present in the water of many mineral springs and of certain lakes in Russia, and in the western part of the United States. But for commercial purposes it is obtained as a secondary product in many chemical processes, as in the preparation of carbonate of magnesium; in the manufacture of hydrochloric and nitric acids from chloride and nitrate of sodium; in the preparation of table salt from many saline springs; in the manufacture of sal ammoniac from sulphate of ammonium and chloride of sodium; and in several other processes. Sulphate of sodium, as thus obtained, is purified by crystallizing it from water, if necessary, after neutralization with sodium carbonate.

Properties.—Sulphate of sodium crystallizes in large, transparent, oblique prisms, which do not alter the color of red and blue litmus paper, have a cooling, saline, and bitter taste, and effloresce on exposure to the air, leaving a white powder. At a temperature of 33° C. (91.4° F.) the salt melts, and a portion of it separates in the anhydrous state. It is insoluble in alcohol, but dissolves freely in water, requiring about three parts of cold, and one-fourth part of water of 34° C. (93.2° F.) for solution. At a higher temperature the salt is somewhat less soluble. On carefully cooling the solution, and keeping it free from dust, the liquid becomes supersaturated, but crystallizes on exposure.

When heated the salt parts with its water of crystallization, and at a full red heat melts, without being decomposed. It imparts a yellow color to flame, and its solution yields, with chloride of barium, a white precipitate which is completely insoluble in dilute nitric acid.

Tests.—An aqueous solution of sulphate of sodium does not effervesce on the addition of hydrochloric acid (absence of *carbonate*), is not precipitated by sulphuretted hydrogen (*heavy metals*), or a dilute solution of nitrate of silver (*chloride*), and does not give off ammoniacal vapors on being treated with a warm solution of caustic soda (absence of *ammonium salt*). One hundred grains of it dissolved in distilled water, and acidulated with hydrochloric acid, give, by the addition of chloride of barium, a white precipitate, which, after washing and drying, weighs 72.2 grains. (*Br.*)

Composition.—Crystallized sulphate of sodium contains 55.9 per cent. water of crystallization, 24.85 per cent. SO_3, and 19.25 per cent. Na_2O. Under certain circumstances the sulphate crystallizes with $7H_2O$, and then contains 47 per cent. of water of crystallization.

Sodii sulphas exsiccata, s. Natrum sulfuricum siccum, *P. G.*—It is obtained by exposing the crystallized salt to a moderate heat until it ceases to lose weight, and forms a white powder. Four parts of it represent nine parts of the crystallized salt. It contains 56.33 per cent. SO_3, and 43.67 per cent. Na_2O.

Physiological Action.—The mode of action of Glauber's salt does not differ essentially from that of other saline cathartics. Like them it does not purge unless given in solutions of a certain degree of dilution, nor even then unless the dose exceeds a certain variable limit. In the dose of a drachm, for example, dissolved in two or three ounces of water, it will not usually act as a purgative, but it will cause more or less increase of the sulphates in the urine. In doses of from half an ounce to an ounce, dissolved in half a pint of water, it causes some nausea, by its repulsive taste chiefly, and, later, colicky pain, intestinal gurgling, and copious watery stools. By the following day the evacuations are usually no longer liquid. If the salt is frequently taken in full doses, it disturbs the digestive functions, causing impaired appetite, flatulence, and constipation; but weak solutions may be repeated for a long time without such consequences.

Various views have been entertained of the mode of action of saline cathartics; but the one most generally accepted is founded upon the law governing the diffusion of liquids separated by a membrane or diaphragm. According to it a thinner liquid on one side of the membrane will pass through it to a denser liquid upon the opposite side, until an equilibrium in density is established between them. Therefore when a saline solution of greater density than the serum of the blood is introduced into the stomach and intestine, it will attract the water from the blood, and give rise to more or less liquid stools. This plausible explanation, which is generally regarded as sufficient, has been supported by the results of certain experiments in which a saline solution was injected into the veins, causing, not purgation, but constipation. But similar experiments by other hands have led to opposite conclusions.

There is good reason to believe that too strong or too weak a solution of a purgative salt equally tends to hinder its operation. If the solution is weak and not bulky, it will act by the kidneys rather than by the bowels. Many persons are affected by natural purgative mineral waters in this manner, whatever may be their dose. On the other hand, it is of daily observation that just in proportion to the dilution of a saline cathartic is its relative efficiency as a purgative. An ounce of Glauber's or Epsom salt if taken in just enough water to dissolve it will usually not purge at all; but a single drachm of either salt in a pint of water will produce liquid stools. This fact is abundantly illustrated by the familiar effects of the saline mineral waters just referred to; they are purgative in doses which contain only an inconsiderable proportion of the neutral salts.

Medical Uses.—Glauber's salt is almost entirely supplanted by Epsom salt in this country and in England, but in Germany the former is in more common use. It is employed to relieve *plethora*, overcome *constipation*, and to act as a depletory and sedative remedy in various febrile affections, inflammatory and other. It has been especially used in weak solution in *typhoid fever* and in *dysentery*, and probably with more benefit and less mischief than any other active treatment of those affections. Of late years it has been strongly recommended in the form of Carlsbad water (which contains also a little chloride and carbonate of sodium), natural or artificial, in cases of simple *ulcer of the stomach.* The water is taken to the extent of about a pint, in divided doses, early in the morning, and fasting; or half an ounce of Glauber's salt may be dissolved in a pint of water, and used in the same manner.

The *dose* of sulphate of sodium as a purgative is from half an ounce to an ounce, dissolved in from four to eight fluidounces of water. Its nauseous bitterness may be partially corrected by the addition of aromatic sulphuric acid, or by dissolving it in lemonade or in carbonated water flavored with syrup. Extract or fluid extract of liquorice may be used for the same purpose.

SODII SULPHIS, *U. S.*—SULPHITE OF SODIUM.

Natrum sulfurosum, Sulfis sodicus (natricus).—*Sulfite de soude*, Fr.; *Schwefligsaures Natron*, G.

Formula $Na_2SO_3.7H_2O$. Molecular weight 252.

Preparation.—This salt is formed on passing sulphurous acid gas into a solution of carbonate of sodium until the color of blue litmus paper is changed to red. Or the solution of a known quantity of carbonate of sodium is completely saturated with sulphurous acid gas, whereby *bisulphite of sodium* is produced; an equal weight of carbonate of sodium is dissolved in the liquid, and the solution evaporated to crystallization. The sulphurous acid decomposes the carbonate of sodium, replacing the carbonic acid which is evolved; $Na_2CO_3 + SO_2$ yields $Na_2SO_3 + CO_2$.

Properties.—Sulphite of sodium crystallizes in colorless transparent prisms, which effloresce on exposure, and have an alkaline reaction to test-paper, and a cooling, saline, and sulphurous taste. When heated the salt loses its water of crystallization, and yields a white powder without melting; but at a red heat fuses into an orange-red mixture of sulphide and sulphate of sodium. It requires about five parts of cold, and about its own weight of boiling water for solution. On adding sulphuric or hydrochloric acid to the solution, the odor of sulphurous acid is given off. In contact with air the salt, like other sulphites, is gradually oxidized to sulphate, the change taking place more rapidly when dissolved in water. Muspratt has obtained this sulphite in oblique prisms, containing $10H_2O = 58.8$ per cent. of water of crystallization.

Tests.—A diluted warm solution of this salt should not be precipitated by a solution of chloride of barium (absence of *sulphate*), nor should it yield a precipitate of sulphur on the addition of sulphuric acid (absence of *hyposulphite*).

Composition.—The salt contains 24.6 per cent. Na_2O, 25.4 per cent. SO_2, and 50 per cent. of water of crystallization.

Other Sulphites.—BISULPHITE OF SODIUM, $NaHSO_3$ (molecular weight 104), forms opaque crystals, and is precipitated by alcohol from its concentrated aqueous solution as a crystalline powder. It has a disagreeable sulphurous taste, gives off sulphurous acid on exposure, and when dissolved in water reddens litmus. It contains 61.5 per cent. of SO_2.

SULPHITE OF POTASSIUM, $K_2SO_3.2H_2O$ (see page 1139).

BISULPHITE OF POTASSIUM, $KHSO_3$ (see page 1140).

SULPHITE OF AMMONIUM, NH_4HSO_3, is precipitated in silky alkaline deliquescent needles on passing sulphurous acid into an alcoholic solution of ammonia.

SULPHITE OF CALCIUM is obtained as a white powder on mixing concentrated solutions of sulphite of sodium and chloride of calcium. It has an earthy and slightly sulphurous taste.

SULPHITE OF MAGNESIUM separates as a white powder on passing sulphurous acid gas into water containing magnesia in suspension. Its sulphurous taste is more marked than that of the calcium salt

Medical Action and Uses.—These are essentially the same as have been described in connection with sulphurous acid, sulphite of potassium, and hyposulphite of sodium; that is to say, sulphite of sodium checks putrefaction and other forms of fermentation, and thereby tends to arrest the exhalation of the fetid gases which are formed during these processes. This action, as in the case of sulphurous acid itself, is a purely chemical one, for it is neither more nor less certain in the laboratory than in the body. Like the other compounds of sulphurous acid with alkalies, sulphite of sodium has been vaunted as a remedy for the falsely called zymotic diseases, but clinical experience has condemned this groundless assumption.

The *dose* of sulphite of sodium is from twenty to sixty grains largely diluted and frequently repeated. The solution may be flavored to conceal its taste. One part of the salt dissolved in from two to ten parts of water may be applied externally, and solutions of half this strength, or less, may be injected into the bladder, vagina, etc.

SODII SULPHOCARBOLAS.—SULPHOCARBOLATE OF SODIUM.

Sulphophenate (*Phenolsulphonate*) *of sodium*, E.; *Sulphophénate de soude*, Fr.; *Phenylschwefelsaures Natron*, G.

Formula $NaC_6H_5SO_4.2H_2O$. Molecular weight 232.

Origin and Preparation.—If one part of crystallized carbolic acid is dissolved in an equal weight of strong sulphuric acid, there results a new acid, *sulphocarbolic* or *ortho-phenolsulphuric acid*, which was discovered by Laurent (1841); $C_6H_5HO+H_2SO_4$ yields $C_6H_5HSO_4+H_2O$. The mixture is digested for two or three days at a temperature of about 50° C. (122° F.), and then diluted with twenty parts of water. To the liquid are added in small quantities and with frequent stirring two parts of carbonate of barium until effervescence ceases, when a solution of *sulphocarbolate of barium* results, and a white deposit takes place, consisting of the excess of carbonate of barium employed, and of sulphate of barium produced by free sulphuric acid. On adding carbonate of sodium to the filtrate, double decomposition will take place, carbonate of barium being precipitated, while sulphocarbolate of sodium remains in solution, and is obtained crystallized on concentrating the clear liquid. Sulphate of sodium may be substituted for the carbonate with identical results, except that the precipitate consists of sulphate of barium; and carbonate of lead may be used in place of carbonate of barium, sulphocarbolate of lead being likewise soluble in water.

Properties.—Sulphocarbolate of sodium crystallizes in transparent rhombic prisms, which are permanent in the air, and are soluble in about five parts of water, and also soluble in alcohol and in glycerin. When fused together with caustic potassa, pyrocatechin is obtained. If during the preparation of sulphocarbolic acid the temperature is permitted to rise to near the boiling point of water, *paraphenolsulphonic acid* having the same composition as the acid described above is formed; it yields a sodium salt, which crystallizes in hexagonal tables without water of crystallization, is less freely soluble in water, and when fused with potassa yields resorcin.

Tests.—The aqueous solution of sulphocarbolate of sodium acquires a violet color on the addition of ferric chloride, and is not rendered turbid by chloride of barium.

Other Sulphocarbolates.—They may be obtained by accurately precipitating a solution of sulphocarbolate of barium or of lead by a solution of the corresponding carbonate or sulphate, filtering and crystallizing. They are all soluble in water, alcohol, and glycerin, and occasionally have a pinkish tint. The following have been employed:—

SULPHOCARBOLATE OF POTASSIUM, $2KC_6H_5SO_4.H_2O$, crystallizes in shining needles, like the ammonium salt.

SULPHOCARBOLATE OF CALCIUM, $Ca2C_6H_5SO_4.6H_2O$, forms scaly crystals.

SULPHOCARBOLATE OF MAGNESIUM, $Mg2C_6H_5SO_4.7H_2O$, crystallizes in rhombic prisms or needles.

SULPHOCARBOLATE OF ZINC, $Zn2C_6H_5SO_4.7H_2O$, resembles the preceding salt in appearance.

The following acids are likewise known, but have not been employed in medicine: *Metaphenolsulphonic acid*, having the same composition as the above; *phenoldisulphonic acid*, $C_6H_4O(HSO_3)_2$, and *phenoltrisulphonic acid*, $C_6H_3O(HSO_3)_3$.

Medical Action and Uses.—The bodies of animals that have taken largely of this salt are said to resist putrefaction for a long time. This result is ascribed to its decomposition in the body into carbolic and sulphuric acid; or rather the latter acid in combination with the sodium is eliminated along with the urine, while the carbolic acid exerts its characteristic influence in preventing organic decomposition. Given to man in doses of twenty or thirty grains it occasions no special symptoms; in twice or three times these doses it only causes some lightness of the head. It was at one time alleged to be a most efficient palliative in *phthisis* and to modify favorably the course of *typhoid fever* and the *eruptive fevers;* it was even vaunted as having a specific power in *scarlatina;* but it has, in reality, as little efficacy in these diseases as the numberless other medicines to which similar virtues have been attributed. Like all carbolates, it exerts a more or less favorable action upon parts affected with pseudomembranous exudation, especially when they tend to *gangrene* or become the seat of fetid decomposition, as in anginose *scarlatina* and *diphtheria;* and also upon the growth of *thrush.* It may be administered internally in *doses* of from ten to thirty grains, and applied topically in a saturated aqueous solution.

SODII SULPHOVINAS.—SULPHOVINATE OF SODIUM.

Ethylsulphate of sodium, E.; *Sulphovinate de soude*, Fr.; *Weinschwefelsaures Natron*, G.

Formula $NaC_2H_5SO_4.H_2O$. Molecular weight 166.

Preparation.—The preparation of sulphovinate of sodium requires the previous formation of *sulphovinic acid* from alcohol and sulphuric acid, of which equal parts by weight are usually employed. On adding the sulphuric acid gradually to the alcohol, the mixture becomes hot and forms sulphovinic acid, by ethyl C_2H_5 of the alcohol taking the place of one atom of hydrogen in the sulphuric acid, water being formed at the same time; $C_2H_5HO+H_2SO_4$ yields $C_2H_5HSO+H_2O$ (see page 104). The acid thus formed invariably contains free sulphuric acid, and if neutralized by caustic soda or carbonate of sodium the resulting solution requires to be mixed with an equal bulk of strong alcohol in which the sulphate of sodium is insoluble, leaving an alcoholic solution of sulphovinate of sodium, from which the salt is obtained by evaporation. The use of alcohol for removing sulphate of sodium is best avoided by neutralizing the crude sulphovinic acid with carbonate of barium or carbonate of lead, whereby insoluble sulphate of barium or of lead is precipitated, while the corresponding sulphovinate is retained in solution, and, on being decomposed by an aqueous solution of carbonate or sulphate of sodium, and filtered from the insoluble carbonate or sulphate of barium or lead, is converted into sulphovinate of sodium, which should be evaporated at a moderate heat and crystallized. Marchand prefers adding carbonate of calcium to the crude acid, and decomposing the sulphovinate of calcium by carbonate of sodium. The yield is usually about equal to the weight of alcohol or of sulphuric acid used.

Properties.—Sulphovinate of sodium crystallizes in shining, transparent, flat, six-sided tables, which effloresce on exposure to dry air. When obtained by spontaneous evaporation, the salt is granular and forms white opaque crystalline aggregations; and, if crystallized from an alcoholic solution, it contains alcohol in the place of water of crystallization. Heated to about 80° C. (176° F.) the crystals melt and rapidly part with their water, amounting to 10.8 per cent.; and if the heat is increased to 100° C. (212° F.), or a little above this point, the salt is decomposed with the formation of sulphate of sodium, charcoal, heavy oil of wine, and of sulphurous acid, ethylene, and other gases. The aqueous solution of the salt, when heated to boiling, is decomposed in the same manner as all sulphovinates, into alcohol which distils off, and acid sulphate of sodium; this decomposition takes place more rapidly in concentrated than in diluted solutions. Crystallized sulphovinate of sodium dissolves at ordinary temperatures in a little more than half its weight of water, and is soluble in glycerin and ordinary alcohol, sparingly soluble in absolute alcohol, and insoluble in ether. Its solution is neutral to test-paper, and has a slightly bitter, afterwards sweetish taste.

Tests.—Dissolved in water, the salt should not be precipitated by chloride of barium (absence of *sulphate*), or by carbonate of sodium (absence of *lead*, *barium*, and *calcium salts*).

Medical Action and Uses.—This salt was proposed as a laxative, on the ground of its being almost tasteless and having but little tendency to occasion colic; but, however real these advantages may be, they are outweighed by its liability to decomposition and to occasion unpleasant symptoms in consequence of its being imperfectly prepared. The *dose* is about half an ounce for an adult.

SODII VALERIANAS.—VALERIANATE OF SODIUM.

Sodæ valerianas, Br.; *Natrum valerianicum*, *Valerianas sodicus* (*natricus*).—*Valerianate of soda*, E.; *Valérianate de soude*, Fr.; *Baldriansaures Natron*, G.

Formula $NaC_5H_9O_2$. Molecular weight 124.

Preparation.—Take of Amylic Alcohol (Fousel Oil) four fluidounces; Bichromate of Potash nine ounces; Sulphuric Acid six and one-half fluidounces; Solution of Soda a sufficiency; Distilled Water one-half gallon. Dilute the sulphuric acid with ten fluidounces of the water, and dissolve the bichromate of potash in the remainder of the water with the aid of heat. When both liquids are cold, mix them with the fousel oil in a matrass, with occasional brisk agitation, until the temperature of the mixture has fallen to about 90° F. Connect the matrass with a condenser, and distil until about half a gallon of liquid has passed over. Saturate the distilled liquid accurately with the solution of soda, remove any oil which floats on the surface, evaporate till watery vapor ceases to escape, and then raise the heat cautiously so as to liquefy the salt. When the product has cooled and solidified, break it into pieces, and immediately put it into a stoppered bottle. *Br.*

This is a modification of Trautwein's process (1845). An excess of sulphuric acid liberates from bichromate of potassium chromic acid, which, in the presence of amylic alcohol, is deoxidized, and then combines with the sulphuric acid to form chromic sulphate, while the amylic alcohol is oxidized to valerianic acid. The reaction takes place according to the equation $3C_5H_{12}O+2K_2Cr_2O_7+8H_2SO_4=3C_5H_{10}O_2+2K_2SO_4+2Cr_23SO_4+11H_2O$. On subjecting the liquid to distillation, the residue in the retort will contain the sulphates of potassium and chromium, and in the distillate will be found the valerianic acid. A small portion of the fusel oil escapes oxidation, and is contained in the distillate combined with valerianic acid to *amylo-valerianic ether* or *amyl valerianate*, also known as *apple oil* from its odor when largely diluted; its composition is $C_5H_{11}C_5H_9O_2$. On the addition of caustic soda, the valerianic acid is neutralized to valerianate of sodium, and the amyl valerianate separates as an oily liquid, which may, however, be decomposed, by warming it with an additional quantity of soda, into valerianate of sodium and amylic alcohol. The latter separates as an oily stratum, which is removed, and the clear solution evaporated until all the water has been expelled.

Properties.—Thus prepared, valerianate of sodium forms a white crystalline mass which has a sweet and valerian-like taste, and melts at 140° C. (284° F.) to a colorless liquid. It is freely soluble in alcohol and water, and on exposure to the atmosphere liquefies from the absorption of water. On the addition of diluted sulphuric acid, a powerful odor of valerianic acid is given off.

Tests.—The solution of valerianate of sodium in water is not colored by sulphuretted hydrogen and sulphydrate of ammonium (absence of *metals*), and yields no precipitate with chloride of barium (absence of *sulphate*).

Pharmaceutical Uses.—For the preparation of Zinci valerianas, *Br.*, and of Acidum valerianicum.

Medical Action and Uses.—This preparation is active only through the valerianic acid it contains. The complaints in which it is used, slight functional derangements of the nervous system, are much more efficiently relieved by the valerianate of ammonium. The *dose* is from one to five grains.

SOLIDAGO, *U. S.*—GOLDEN ROD.

Verge d'or, Fr.; *Goldruthe*, G.

The leaves and tops of Solidago odora, *Ait.*

Nat. Ord.—Compositæ, Asteroideæ.

Description.—The *sweet-scented golden rod* is a native of the United States and Canada, and grows on the borders of woods and thickets and in dry or sandy fields. The stem is about three feet high, simple, slender, and nearly smooth, or somewhat pubescent in lines. The leaves are numerous, alternate, sessile, one or two inches long, linear-lanceolate, entire, acute, pellucid-punctate, smooth, and on the margin somewhat rough. The flowers are in a terminal pyramidal panicle, composed of spreading racemes, bearing the flower-heads on one side; these are small, have lance-linear appressed yellowish scales, and contain three or four oblong ray-florets, and several tubular disk-florets, all of a yellow color, and with terete akenes, and a simple bristly pappus. The leaves when bruised have an agreeable anise-like odor, and a sweetish aromatic taste. The flowers are likewise pleasantly aromatic; they appear in August and September.

Constituents.—The principal constituent is volatile oil; that obtained from the flowers differs from that contained in the leaves, which appears to be related to oil of anise.

Other Species.—SOLIDAGO VIRGA-AUREA, *Lin.*—This is a variable species indigenous to Europe, Northern Asia, and on this continent to Canada and the northern portion of the United States. It is from one to three feet high, branched above, has lanceolate or lance-oblong, petiolate, and more or less serrate leaves, and bears the flowers in erect simple wand-like racemes, forming a terminal panicle. The flower-heads contain eight or ten ligulate and several tubular disk-florets of a yellow color. The flowering herb has an aromatic odor, and a bitterish and somewhat astringent taste, and has been used in Europe as *herba virgaureæ.* The oblique thin rhizome has likewise been employed.

Medical Action and Uses.—This plant, which grows so profusely in the United States, owes its virtues to the volatile oil which it contains; that is to say, it is stimulant, irritant, rubefacient, anodyne, and carminative. Its infusion is much used in country practice to produce *diaphoresis*, allay *colic*, promote *menstruation*, and to cover the taste of nauseous medicines. For the last purpose the essential oil is to be preferred; it is also, like analogous products, sometimes used as a local anodyne in *neuralgia* and *rheumatism.*

The infusion may be prepared with an ounce of the herb and a pint of hot water, and given in *doses* of two or more fluidounces. The oil may be prescribed in *doses* of one or more drops.

SOPHORA.—SOPHORA.

Sophora speciosa, *Benth.* *Nat. Ord.*—Leguminosæ, Papilionaceæ.

Description.—An evergreen ornamental shrub or small tree indigenous to Western Texas. It has smooth, oddly pinnate leaves, with three to five pairs of leaflets, which are about an inch long, ovate in shape, obtuse or somewhat pointed, dark green and glossy above and pale green beneath. The flowers are in dense racemes, blue or tinged with white, very fragrant, and have a bell-shaped small calyx and ten nearly free stamens. The pod is indehiscent, two or three inches long, nearly terete, or more or less constricted between the seeds, tough, and covered with a pale brownish-gray pubescence. The seeds are globular-ovate, about one-half inch long, somewhat depressed on the hilum, and of a bright red color.

Constituents.—Dr. H. C. Wood (1877) isolated from the seeds an alkaloid *sophoria*, by macerating the powder for several hours in strong alcohol, exhausting it by water acidulated with hydrochloric acid, adding to the liquid an excess of carbonate of sodium, and agitating the mixture with chloroform. The chloroform solution is agitated with dilute hydrochloric acid, the aqueous liquid evaporated to a syrup, freed from gummy matter by strong alcohol, the alcohol evaporated, and the treatment with carbonate of sodium and chloroform repeated. Sophoria is nearly white, amorphous, yields with chromic and sulphuric acids a dirty deep-purple color, passing through bright green and bluish into yellowish-brown, and produces with tincture of chloride of iron a deep, almost blood-red, after a time acquiring an orange tint.

Physiological Action.—According to the experiments of Dr. H. C. Wood, its properties depend upon an alkaloid which in frogs produced a rapid loss of reflex activity and power of voluntary movement, due to its action upon the spinal marrow. In a cat a large dose of it speedily occasioned marked weakness in the limbs, disturbance of the respiration, and convulsive movements, with loss of consciousness. A smaller dose excited vomiting, great muscular weakness, profound quietude, and deep sleep lasting some hours and ending in recovery. It is stated that sophora beans are occasionally used by the Indians in Western Texas as an intoxicant; that half a bean will produce a delirious exhilaration followed by a sleep that lasts for several days; and it is asserted that a whole bean will kill a man. The evident peculiarities of sophora beans, as thus described, invite a fuller investigation.

SORBUS.—MOUNTAIN ASH.

Sorbes, Fr.; *Ebereschen*, *Vogelbeeren*, G.

The fruit of Sorbus (Pyrus, *Gærtn.;* Mespilus, *Scop.*) aucuparia, *Lin.* *Nat. Ord.*—Rosaceæ, Pomeæ.

Description.—This species of sorbus, which is also known as *rowan-tree*, is a medium-sized tree, indigenous to Europe and Western Asia, and cultivated for ornament in North America. It has oddly pinnate leaves, with obtuse, on the lower side, downy leaflets, and bears numerous small, globular, juicy, berry-like fruits, which are of a bright red color, are crowned by the calyx limb, contain three or four cells, each with two seeds, and have an acid taste.

The *American mountain ash*, Pyrus Americana, *D. C.*, and P. sambucifolia, *Cham. & Schlech.*, resemble the preceding species, and have similar but somewhat smaller fruits.

Constituents.—According to Liebig, mountain ash berries when unripe contain tartaric acid, but when ripe malic and citric acids. Byschl (1854) determined also the presence of tannin, acrid, bitter and coloring principles, fermentable sugar, and of an amorphous, non-fermentable sugar, which had previously been obtained by Pelouze (1852), by setting the juice aside for about a year, and then evaporating and crystallizing. This *sorbin* crystallizes in colorless hard prisms, separates cuprous oxide from an alkaline solution of copper, is not altered by boiling with dilute acids, and has the composition $C_{12}H_{24}O_{12}$. It is probably identical with *sorbite*, obtained by Boussingault (1872) from the fermented juice, and for which he gives the formula $2C_6H_{14}O_6.H_2O$; this is isomeric with mannite and dulcite, but melts at 102° C. (215.6° F.), and when anhydrous, at 110° C. (230° F.). On preparing malic acid from the juice of mountain ash berries, and distilling the mother liquor after the separation of bimalate of calcium, G. Merk obtained an oily liquid which A. W. Hofmann (1859) recognized as a new acid, *parasorbic acid.* This has an aromatic odor, does not displace carbonic acid from the carbonates, is slightly soluble in water, freely so in alcohol and ether, and when heated under pressure with caustic potassa, is converted into crystallizable *sorbic acid.* Both acids have the composition $C_6H_8O_2$. Wicke (1851) obtained *amygdalin* from the bark and buds of the mountain ash.

Medical Action and Uses.—The unripe fruit and the bark of the mountain ash and its European congeners are extremely astringent, and are used in infusions, decoctions, and poultices, to constringe relaxed parts, as the throat, anus, and vagina, and internally to check *diarrhœa*, etc.

SPIGELIA, *U. S.*—SPIGELIA.

Pinkroot, E.; *Spigélie du Maryland*, Fr.; *Marylandische Spigelie*, G.

The root of Spigelia Marilandica, *Lin.* *Nat. Ord.*—Loganiaceæ.

Origin.—This plant is variously known as *Maryland pink*, *Carolina pink*, and *wormgrass.* It grows in rich shady woods chiefly in the southern part of the United States, but is found northward to Pennsylvania and Wisconsin. The stem is from 6 to 12 or 18 inches high, simple, round below, quadrangular above, and has opposite sessile, acute, ovate-lanceolate leaves, and a terminal spike of 6 or 8 showy flowers with funnel-form or somewhat club-shaped corollas, which are nearly two inches long, externally scarlet red and internally yellow, and have the stamens exserted. The plant flowers in June and July, and produces two-celled and few-seeded capsules.

Description.—Pinkroot consists of a rhizome with numerous rootlets. The rhizome is from 2 to 4 or 6 inches long, simple or somewhat branched, bent in various directions, but generally horizontal, about one eighth inch thick, somewhat wrinkled longitudinally, frequently with a portion of the recent stem attached, and on the upper side with very short remnants of stems, which are from one-eighth to one-fourth inch apart and are terminated by cup-shaped scars. The numerous rootlets emanate chiefly from below and the sides of the rhizome, and are about 3 inches long, brittle, and angularly wrinkled longitudinally. The color is of a dark purplish-brown, the rootlets are somewhat lighter. Pinkroot has a faint aromatic odor and a sweetish, afterwards slightly bitter, not disagreeable taste. When the rhizome is cut transversely, there is seen a thin bark, with a dark outer layer and a light purplish-brown inner layer covering the pale-yellowish wood; the central pith is large, somewhat above the middle, and often discolored or decayed. The rootlets have a relatively thicker bark and no central pith.

Allied Species.—SPIGELIA ANTHELMIA, *Lin.*—This is an annual plant of the West Indies and South America, and has lance-ovate acute leaves and pale reddish or purplish flowers not over one-half inch long; its root is short and divided into numerous long, thin, blackish and internally whitish branches. The plant is employed like pinkroot.

Constituents.—Pinkroot was examined by Dr. R. H. Stabler (1857), who found in it a little volatile oil, tasteless resin, wax, tannin, and a bitter principle which was not obtained in the pure state, but was ascertained to be not precipitated by acetate of lead, to be soluble in water and alcohol, and to be insoluble in ether; it appears to be precipitated by tannin.

The West Indian plant was analyzed by Feneulle (1823) and Ricord-Madianna (1828), but the active principle was not isolated.

Adulteration.—Spigelia is sometimes met with as an admixture of serpentaria, and is not unfrequently found mixed with some few roots of several plants, doubtless from careless collection. A few years ago a very different root was seen in the market, which Dr. A. W. Miller (1875) ascertained to have been derived from Phlox carolina, *Lin.*, which plant is known in some parts as *Carolina pink.* This root is lighter in color, the rootlets are straight or but slightly curved, and their cortical portion is easily removed, exposing a straw-colored ligneous thread.

Off. Prep.—Extract. Spigeliæ fluid.; Infusum spigeliæ, *U. S.*

Physiological Action.—Spigelia was used as a medicine by the aboriginal inhabitants of this country, and was early employed by American physicians, who attributed to it both purgative and narcotic virtues. The latter were even said to have caused death. Its toxical effects include nervous excitement of an hysterical sort, a hot and dry skin, pain in the forehead and eyes, stiffness and swelling of the eyelids, strabismus, dilatation of the pupils, temporary loss of sight, some drowsiness but not narcotism, tremor of the tongue, general muscular trembling on making exertion, and even convulsions.

Medical Uses.—It is said that an infusion of spigelia is sometimes given as a substitute for ordinary tea to children liable to verminous disorders. It is so commonly associated with purgatives when used as an *anthelmintic*, that it may be concluded to act upon intestinal worms by benumbing, if not killing them, after which the associated medicine expels them from the bowels. In some states of chronic irritation simulating those which usually attend the presence of lumbricoid ascarides in the intestines, spigelia is of marked advantage; but its mode of action is obscure. The most usual, and the best form of the medicine is that known as "worm tea:" viz., ℞. Spigelia half an ounce; senna and fennel seed of each one hundred and twenty-grains; manna one ounce;

boiling water, one pint. Infuse. S. Half a wineglassful three times a day for a child two years old. The fluid extract of spigelia and senna represents this infusion sufficiently well. The proper remedies for the toxical effects of spigelia are wine, ammonia, and other diffusible stimulants.

SPILANTHES.—SPILANTHES.

Herba spilanthis, P. G.—*Para cress*, E.; *Cresson de Para*, Fr.; *Parakresse*, G.

Spilanthes oleracea, *Jacq.* *Nat. Ord.*—Compositæ, Senecionideæ.

Description.—This annual herb is indigenous to South America and India, and is sometimes cultivated in gardens. Its stem is six to eight inches high, and much branched. The leaves are opposite, petiolate, three-nerved, ovate, often subcordate, obtuse, or somewhat acute, repand-crenate, and rough on the margin, and two or three inches long. The flower-heads are on long axillary peduncles, hemispherical in shape, nearly one-half inch broad, have a chaffy receptacle, and contain numerous tubular florets, which are at first brown and afterwards yellow. The herb is collected while flowering; it has a peculiar, not agreeable odor, and when masticated a sharp and biting taste, followed by a copious flow of saliva.

Constituents.—Lassaigne (1825) determined the presence in Para cress of tannin, producing green precipitates with ferric salts, and believed the acrid taste to be due to the volatile oil. Buchner (1831), however, attributed the taste to a soft resin, resembling that contained in pellitory. Walz (1859) obtained from the alcoholic extract, by exhausting it with ether, a crystalline principle *spilanthin*, which is not precipitated by acetate of lead, is insoluble in water, and when its solutions are rapidly evaporated is converted into a resinous mass.

Allied Species.—SPILANTHES ACMELLA, *Lin.*, s. Acmella mauritiana, *Rich.*, is an annual East Indian herb with ovate or lance-ovate, serrate, pellucid-punctate, petiolate leaves, and small obconical flower-heads, having five or six ligulate ray-florets. It has a bitter balsamic, afterwards biting taste, and is used like the preceding species.

Medical Action and Uses.—Every part of this plant has an aromatic and acrid taste which excites free salivation. In its native country it is used in gout, rheumatism, and gravel, and also as a diuretic in dropsy, and as a vermifuge. In Europe it has been chiefly employed for the relief of toothache, and for many years a tincture made from the plant has been in popular use under the name of *Paraguay-Roux*. When the aching tooth is hollow, the tincture is applied to the carious cavity on cotton, otherwise it is painted or rubbed upon the adjacent gum. It does not act as an irritant upon the latter.

SPIRÆA, *U. S.*—HARDHACK.

The root of Spiræa tomentosa, *Lin.* *Nat. Ord.*—Rosaceæ, Roseæ.

Origin.—Hardhack, also known as *steeplebush*, *whitecap*, and, like other species of the same genus, as *meadow-sweet*, is a small North American shrub growing from Canada southward to South Carolina. It is three or four feet high, has a slender, red-brown, branching stem with hard brittle wood, and ovate-lanceolate, serrate, dark-green, and beneath rusty tomentose leaves. The small purplish-red flowers, with conspicuous stamens, are in short racemes crowded into a dense pyramidal panicle, and make their appearance in July and August.

Description.—The root is branching, covered with a thin brown bark, and contains a whitish, hard, and tasteless wood. The taste of the bark is bitterish and strongly astringent. The plant, collected while in bloom, is often employed in preference to the root; it has an agreeable though slight odor, and a very astringent, somewhat bitter taste.

Constituents.—Hardhack has not been analyzed; it evidently contains tannin.

Other Species.—SPIRÆA ARUNCUS, *Lin.;* Goat's beard, *E.;* Barbe de chèvre, *Fr.;* Bocksbart, *G.*—It grows in Europe and in North America westward from the Catskill and Allegheny Mountains. It is a perennial herb two or three feet high, has smooth thrice-pinnate leaves, with thin, lance-oblong, sharply serrate and pointed leaflets, and produces numerous small white flowers in slender racemes. It has an agreeable odor, and an aromatic, astringent, and bitterish taste.

SPIRÆA ULMARIA, *Lin.*, indigenous to Europe and cultivated in gardens, is an herbaceous perennial, with interruptedly pinnate leaves, the three to seven ovate or lance-oblong serrate leaflets being interposed with minute leaflets. The flowers are in long-peduncled corymbs, small, white, and in cultivation usually double. This, like other herbaceous species of spiræa, contains *salicylic aldehyd* or *salicylous acid*, $C_7H_6O_2$, which may also be obtained from salicin, and is a colorless strongly aromatic oil, which boils at 196° C. (385° F.), and in aqueous solution is colored dark violet by ferric chloride.

SPIRÆA FILIPENDULA, *Lin.*, likewise a European plant, has numerous long radicles, which near their lower end are enlarged to pear-shaped tuberous bodies, sometimes moniliform. These are one or one-and-a-half inch long, blackish-brown externally, internally pale red-brown, and have a sweetish, bitterish, and somewhat astringent taste.

Medical Action and Uses.—Of this plant the late Drs. Griffith and Ives remarked that the officinal portion of the root is the least valuable part of it, the bark and the leaves being more efficient. It is said to have been used by the aborigines of this country, but was first brought to the notice of physicians in 1810. Its action was compared with that of rhatany, and it was alleged not to disorder the stomach even when taken in large doses. It was used in various forms of *diarrhœa*, including that of typhoid fever, pulmonary consumption, and summer complaint; in passive *hemorrhages* and *menorrhagia;* in decoction as an injection in *leucorrhœa*, *gleet*, etc., and as a dressing for fungous *ulcers.* The extract has an agreeable odor, and an astringent, bitter taste, and may be prescribed in the *dose* of five grains or more. The decoction, made by boiling an ounce of the plant in a pint of water, may be given cold, in the *dose* of one or two fluidounces. Although S. tomentosa is somewhat aromatic, it is less so than some other species, and especially S. Almaria, which was formerly in vogue as a stimulant in *fevers*, as serpentaria is now used, as well as for its astringent action in the diseases mentioned above. It also appears to have displayed diuretic virtues in several forms of *dropsy.* In Europe an infusion, a decoction, and an extract of it are used.

SPIRITUS.—SPIRITS.

Alcoolats, Fr.; *Geiste*, G.

Spirits were formerly prepared almost exclusively by distilling odorous substances with alcohol; at present, however, both the United States and British Pharmacopœias direct most of them to be prepared simply by dissolving the volatile oils and other volatile compounds in alcohol. If made by distillation, a weak alcohol should be employed, and after distillation a portion of the water left in the still, since the odorous principles volatilize only sparingly with the vapors of alcohol, but more freely with the vapors of water. The German

Pharmacopœia usually directs alcohol and water in the proportion of three parts of the former to three or five parts of the latter; after due maceration with the bruised drug, four parts by weight of distillate are recovered. The alcoolats of the French Codex are generally made with 60 or 80 per cent. alcohol, the fresh drugs being used whenever practicable. In all cases the alcohol employed should be free from fusel oil, and the drugs should be well bruised and macerated with the alcohol for one or several days before distillation is commenced. In distilling spirits the same precautions should be adopted as in the distillation of medicated waters (see page 201), with this addition, that ample provision be made for the complete condensation of the vapors. Heat is best applied by means of steam, or on a small scale by means of a salt-water bath.

SPIRITUS ÆTHERIS, *Br.*—SPIRIT OF ETHER.

Spiritus æthereus s. Liquor anodynus mineralis Hoffmanni, P. G.; *Æther sulfuricus alcoolisatus*, F. P.—*Éther hydrique (sulfurique) alcoolisé; Liqueur anodine d'Hoffmann*, Fr.; *Hoffmannstropfen*, G.

Preparation.—Take of Ether ten fluidounces; Rectified Spirit twenty fluidounces. Mix. *Br.*

Its specific gravity is 0.809. The French Codex orders the two ingredients in equal parts by weight. The German Pharmacopœia directs one part of ether to three of alcohol. This preparation is used in Europe as a simplified form of *Hoffmann's anodyne*, and for similar purposes.

SPIRITUS ÆTHERIS COMPOSITUS, *U. S.*—COMPOUND SPIRIT OF ETHER.

Hoffmann's anodyne, E.; *Liqueur nervine de Bang*, Fr.; *Zusammengesetzter Ætherweingeist*, G.

Preparation.—Take of Ether half a pint; Alcohol a pint; Ethereal Oil six fluidrachms. Mix them. *U. S.*

The ethereal oil ordered in this formula is the heavy oil of wine preserved by an equal volume of stronger ether (see page 956).

Properties.—Compound spirit of ether has the density 0.815, and is a colorless inflammable liquid, entirely volatilized by heat, but, when ignited on glass or porcelain, it leaves an almost invisible residue, having an acid taste, and reddening blue litmus paper. The spirit is neutral to test-paper, or has only a very slight acid reaction. It has an aromatic ethereal odor, and a pungent, slightly sweetish taste. When mixed with water, a whitish turbidity is produced from the separation of oil of wine, and a slight opalescence is still observed if forty drops of the spirit are mixed with a pint of water. If adulterated with a fixed oil, this will separate from the water as a thin film, which, when absorbed by bibulous paper, produces a permanent greasy stain, not disappearing by heat. On adding a fluidounce of the spirit to an excess of aqueous solution of chloride of barium, and evaporating the cloudy mixture nearly to dryness, a white precipitate of sulphate of barium is produced, which, after washing and drying, weighs six and a quarter grains.

The commercial compound spirit of ether is rarely made by the officinal formula, but is obtained, as was ascertained by Procter (1852), in the rectification of ether, the last fraction of the distillate, which is contaminated with light and a little heavy oil of wine, being diluted with alcohol and water so as somewhat to resemble the officinal article; from this it differs in a higher specific gravity and in not producing the same amount of precipitate with chloride of barium.

Medical Action and Uses.—This preparation is stimulant, antispasmodic, and anodyne, as are all forms of alcohol; but in this the addition of ether and ethereal oil renders the action more prompt and lively. Hence it is universally employed to allay *restlessness*, *sleeplessness*, and *nervous disturbance* in general, especially in the absence of fever, and notably in the manifold manifestations of *hysteria*. It is also a convenient remedy for *flatulent*, and, so called, *uterine colic*. It may, indeed, be used in all the cases for which sulphuric ether is prescribed internally. The *dose* is from half a fluidrachm to one fluidrachm, properly diluted with sweetened water.

SPIRITUS ÆTHERIS NITROSI, *U.S.*—SPIRIT OF NITROUS ETHER.

Spiritus nitri dulcis, Spiritus nitrico-æthereus.—Sweet spirit of nitre, E.; *Éther azoteux alcoolisé, Liqueur anodine nitreuse*, Fr.; *Versüsster Salpetergeist*, G.

Preparation.—Take of Nitric Acid four troyounces and a half; Stronger Alcohol seven pints; Sulphuric Acid three troyounces and a half; Copper two troyounces. Add the sulphuric acid gradually to twenty ounces of the stronger alcohol. When the mixture has become cool, put it into a glass retort, connected with a Liebig's condenser, and add the copper and four troyounces of nitric acid. Then cautiously apply heat, and distil thirteen fluidounces at a temperature not exceeding 180° F. Remove the heat, let the contents of the retort cool to 90° F., add the remainder of the nitric acid, and distil two fluidounces as before. Mix the distillate with the remainder of the alcohol, and transfer the mixture immediately to half-pint bottles, which must be well stopped and protected from the light. *U. S.*

Take of Nitric Acid three fluidounces; Sulphuric Acid two fluidounces; Copper in fine wire (about No. 25) two ounces; Rectified Spirit a sufficiency. To one pint of the spirit add gradually the sulphuric acid, stirring them together; then add, in the same way, two and a half fluidounces of the nitric acid. Put the mixture into a retort or other suitable apparatus, into which the copper has been introduced, and to which a thermometer is fitted. Attach now an efficient condenser, and applying a gentle heat, let the spirit distil at a temperature commencing at 170° F. and rising to 175° F., but not exceeding 180° F., until twelve fluidounces have passed over and been collected in a bottle kept cool, if necessary, with ice-cold water; then withdraw the heat, and having allowed the contents of the retort to cool, introduce the remaining half ounce of nitric acid, and resume the distillation as before, until the distilled product has been increased to fifteen fluidounces. Mix this with two pints of the rectified spirit, or as much as will make the product correspond to the test of specific gravity and percentage of ether separated by chloride of calcium. Preserve it in well-closed vessels. *Br.*

Both formulas are modelled after the process of Prof. Redwood (1867), and yield good results if proper attention be paid to the strength of the acids and the alcohol and to the temperature. It seems, however, as if this process were best adapted for being worked on a small scale. The sulphuric acid, in the presence of nitric acid, dissolves the copper, forming sulphate of copper, and setting nitrous acid free, which, in its nascent state, acts upon the alcohol, producing nitrous ether and water. The reaction is explained by the equation $C_2H_5HO + HNO_3 + H_2SO_4 + Cu = C_2H_5NO_2 + CuSO_4 + 2H_2O$.

Older formulas differ from Redwood's either in acting upon alcohol directly by nitric acid, or in generating nitric acid from nitrate of potassium and sulphuric acid in the presence of alcohol. In either case the result is much influenced by the strength of the acid, and by the temperature, and a larger quantity of aldehyd is always thus produced than in the presence of copper. The action of nitric acid upon alcohol and the production of aldehyd are explained by the equation $2C_2H_5HO + HNO_3 = C_2H_4O + C_2H_5NO_2 + 2H_2O$. The German Pharmacopœia directs the distillation of a mixture of twelve parts of alcohol and three of nitric acid, until ten parts are obtained, the distillate being neutralized with magnesia and rectified. Other processes, which have been at various times recommended, require the previous preparation of nitrite of potassium or of sodium, and the decomposition of one of these salts by sulphuric acid in the presence of alcohol. It has likewise been suggested to prepare this spirit from pure nitrous ether by mixing it with alcohol in a definite proportion. This would doubtless be the most rational way of preparing the spirit; but the obstacles to it are the difficulty of obtaining the ether in the pure state, and, after it has been obtained, in the preservation of it.

Properties.—Prepared by either process, spirit of nitrous ether is a transparent nearly colorless liquid, with a slight yellowish or greenish-yellow tint, and has an agreeable apple-like odor, and a sweetish, cooling, and sharp taste. It does not alter the color of blue litmus paper or merely reddens it slightly, and should effervesce not at all, or but slightly, on the addition of bicarbonate of potassium. If agitated with a solution of ferrous sulphate and a little strong sulphuric acid, it acquires a dark olive-brown tint. If mixed with half its volume of officinal solution of potassa previously diluted with an equal measure of distilled water, it assumes a yellow color, which slightly deepens, but does not become brown in twelve hours, showing the absence of undue proportions of aldehyd. The spirit of the British Pharmacopœia contains about ten per cent. of nitrous ether, and has the specific gravity 0.845. The United States Pharmacopœia requires for its preparation about five per cent. of ether and a specific gravity of 0.837. Prof. Diehl (1877) in an elaborate paper proved that this is incorrect, and that a spirit containing five per cent. of ether, made with stronger alcohol, should have the density of 0.8235. On agitating the spirit of nitrous ether of the British Pharmacopœia with twice its volume of a saturated aqueous solution of chloride of calcium, two per cent. of the original volume will separate in the form of nitrous ether and rise to the surface of the mixture. A similar test cannot be applied to the preparation of the United States Pharmacopœia, since the whole of the ether will remain dissolved in the mixture. But Diehl ascertained that the test may be advantageously applied to the distillate of the Pharmacopœia after diluting it with alcohol to thirty-two fluidounces; after agitating a measured portion with twice its volume of a concentrated solution of calcium chloride, the crude nitrous ether is allowed to separate, and, for each volume indicated in excess of five per cent., nineteen volumes of stronger alcohol are added; that is, if two per cent. is separated, a strength of ten per cent. of ether is indicated, and a corresponding dilution is required. Diehl likewise showed that it is not absolutely necessary that the whole amount of distillate required by the Pharmacopœia should be obtained; but that, if the reaction takes place at a somewhat lower temperature, the yield is smaller, while the etherification is complete, and the distillate more concentrated than when obtained at a higher temperature.

Spirit of nitrous ether should be preserved in small well-filled and stoppered vials. The concentrated spirit obtained by distillation may be preserved in the same manner, and if assayed previously to being bottled, requires merely dilution with stronger alcohol to furnish an unexceptionable preparation.

Off. Prep.—Mistura glycyrrhizæ comp. *U. S.*

Medical Action and Uses.—The vapor of this liquid breathed by rabbits and cats rapidly occasions spasms followed by death, after which the blood is found liquid and dark, and the lungs and brain congested. When inhaled by man it causes giddiness, headache, throbbing of the arteries, and, in excessive quantities, confusion of mind, muscular relaxation, cyanosis, a thready pulse, and spasms. Prolonged immersion in its vapor has been fatal. In very large doses it irritates the stomach, especially if the preparation contain, as it often does, free acid, causing vomiting and colic. In medicinal doses it is decidedly diuretic or diaphoretic, according as the skin is cool or warm. In *febrile conditions* it is much used to promote critical sweating, which it probably does by abating the morbid activity of the heart and arteries. Its efficacy in this respect is very marked in slight and ephemeral febrile affections, especially such as are produced by an arrest of perspiration. It is usually associated with the neutral or the effervescing mixture and minute doses of some antimonial preparation.

As a *diuretic* it is commonly employed to relieve *strangury* produced by cantharides, and all painful affections of the *urinary apparatus*, whether occasioned by calculous or inflammatory disorders, and in the various affections of the *kidneys* in which congestion of those organs and diminished secretion of urine occur. In all of these cases the medicine should be associated with diluent drinks, weak saline solutions, or diuretic infusions. Of salines the most suitable are the acetate, tartrates, and carbonates of potassium, and of vegetable infusions, those of digitalis and juniper. In chronic renal dropsy it is less useful than when dropsy is of cardiac origin.

This medicine is often serviceable in relieving *flatulent* distension of the stomach and *nausea*, especially when it is associated with aromatic spirit of ammonia. It may be inhaled with advantage to allay *coughing* in diseases of the air passages. It is a soothing application to the forehead in neuralgic *headache;* but if frequently repeated it irritates the skin, especially if it is not freshly prepared. It is said to have cured certain hard swellings of the lip supposed to be cancerous (*papilloma*, *epithelioma*), but which are most generally non-malignant.

The *dose* of spirit of nitrous ether in febrile affections is from twenty to thirty drops repeated every half hour or hour, and given in sweetened water. As a diuretic from half a fluidrachm to one fluidrachm of it should be given every three or four hours in a diuretic mixture, solution, or infusion.

SPIRITUS AMMONIÆ, *U. S.*—SPIRIT OF AMMONIA.

Liquor ammonii caustici spirituosus, P. G.; *Spiritus ammoniaci caustici Dzondii.—Ammoniated alcohol*, E.; *Alcoolé d'ammoniaque*, *Liqueur d'ammoniaque vineuse*, Fr.; *Weingeistige Ammoniakflüssigkeit*, G.

Preparation.—Take of Chloride of Ammonium in small pieces, Lime, each twelve troyounces; Water six pints; Alcohol twenty fluidounces. Upon the lime, in a convenient vessel, pour a pint of the water, and stir the mixture so as to bring it to the consistence of a smooth paste. Then add the remainder of the water, and mix it well with the lime. Decant the milky liquid from the gritty sediment into a glass retort of the capacity of sixteen pints, and add the chloride of ammonium. Place the retort on a sand-bath, and adapt to it a receiver previously connected, by means of a glass tube reaching nearly to the bottom of the bottle, with a two-pint bottle containing the alcohol. Surround the bottle with ice-cold water; and apply a gradually increasing heat, until ammonia ceases to be given off. Lastly, remove the liquid from the bottle, and introduce it into small bottles, which must be well stopped. *U. S.*

Milk of lime is first prepared, and to this chloride of ammonium is added; on the application of heat, ammonia gas is given off and absorbed by the cold alcohol. At the same time water is vaporized and condensed in the alcohol, the quantity increasing towards the end of the process. The alcohol weighs a little over fifteen troyounces, and about four troyounces of ammonia gas are evolved. The preparation would therefore contain ten per cent. of ammonia, if the quantity of water distilling over with the gas should not exceed one ounce. In practice the quantity will be found larger, and it must vary with the manner in which the gradually increasing heat is applied; the preparation is therefore indefinite in strength of ammonia and in the degree of dilution with water.

The German Pharmacopœia directs ammonia gas to be conducted into alcohol of specific gravity 0.830 until the specific gravity has decreased to 0.808 or 0.810, when it will contain about ten per cent. of NH_3. In the pharmaceutical laboratory, ammonia gas is most conveniently obtained by heating stronger water of ammonia in a glass flask, when it will part with about one-half of the ammonia contained in it at a temperature not exceeding 40° or 45° C. (104° or 113° F.).

Properties.—Spirit of ammonia is a colorless liquid having an ammoniacal and, at the same time, spirituous odor. When diluted with water, it has the same behavior to reagents as ammonia water, and its purity may be determined in the same manner as for the latter. (See page 206.)

Medical Action and Uses.—The action and uses of this preparation have been described under Ammonia. It is seldom used internally; the aromatic spirit and the fetid spirit, being more appropriate for this purpose as a general rule. It has the advantage of not rendering turbid mixtures containing resins and other bodies which are precipitated by water; and hence it is a common ingredient in stimulating liniments, of which it should form not more than one-sixth part. Its *dose* is from ten to thirty drops in a wineglassful of water.

SPIRITUS AMMONIÆ AROMATICUS, *U.S.*, *Br.*—AROMATIC SPIRIT OF AMMONIA.

Alcoolat ammoniacal aromatique, Fr.; *Aromatischer Ammoniakgeist*, G.

Preparation.—Take of Carbonate of Ammonium a troyounce; Water of Ammonia three fluidounces; Oil of Lemon two fluidrachms and a half; Oil of Nutmeg forty minims; Oil of Lavender fifteen minims; Alcohol a pint and a half; Water a sufficient quantity. Dissolve the carbonate in the water of ammonia, previously mixed with four fluidounces of water. Dissolve the oils in the alcohol, mix the two solutions, and add sufficient water to make the whole measure two pints. *U. S.*

Take of Carbonate of Ammonia eight ounces; Strong Solution of Ammonia four fluidounces; Volatile Oil of Nutmeg four fluidrachms; Oil of Lemon six fluidrachms; Rectified Spirit six pints; Water three pints. Mix and distil seven pints. *Br.*

On adding ammonia water to officinal carbonate of ammonium, neutral carbonate of ammonium is formed, which is readily soluble in alcohol. This is the compound aimed at by both Pharmacopœias. If officinal carbonate of ammonium is treated with alcohol, neutral carbonate of ammonium will be dissolved, and bicarbonate of ammonium, being nearly insoluble in alcohol, will be left behind. An insoluble saline precipitate will therefore indicate either a deficiency in the strength of the ammonia water or a partial decomposition of the carbonate used. This salt should be employed only in translucent masses, and the effloresced portion, which contains variable proportions of bicarbonate of ammonium, should be rejected for this preparation. If good non-resinified oils are used in making this spirit, there appears to be no necessity for subsequent distillation.

Properties.—This spirit is colorless or yellowish, has an aromatic and, at the same time, ammoniacal odor, effervesces with acids, becomes milky on the addition of water, and, according to the British Pharmacopœia, has the specific gravity 0.870.

Medical Action and Uses.—This is a mild preparation of ammonia which is used almost exclusively for the relief of *headache*, and especially of that form of it which is attended with *acidity* of the stomach and *flatulent* eructations. It probably exerts a double action; upon the stomach, neutralizing its acidity and provoking the expulsion of its gaseous contents, and upon the nervous system, by a gentle stimulant action which allays nervous pain.

The *dose* of aromatic spirit of ammonia is from thirty minims to a fluidrachm properly diluted.

SPIRITUS AMMONIÆ FŒTIDUS, *Br.*—FETID SPIRIT OF AMMONIA.

Alcoolat ammoniacal fétide, *Essence antihystérique*, Fr.; *Ammoniakalischer Stinkasantgeist*, G.

Preparation.—Take of Asafœtida one and a half ounce; strong solution of Ammonia two fluidounces; Rectified Spirit a sufficiency. Break the asafœtida into small pieces and macerate it, in a closed vessel, in fifteen fluidounces of the spirit for twenty-four hours, then distil off the spirit, mix the product with the solution of ammonia, and add sufficient rectified spirit to make one pint (imperial). *Br.*

On distilling the tincture of asafœtida prepared as above directed, a portion of the volatile oil of asafœtida passes over; the finished preparation is therefore an alcoholic solution of this volatile oil, mixed with ammonia water. *Aqua fœtida antihysterica (s. Pragensis)*, P. G., is free from ammonia, but contains the volatile products of galbanum, myrrh, valerian, zedoary, angelica, peppermint, wild thyme, English chamomile, and castor, in addition to the oil of asafœtida.

Medical Action and Uses.—The purpose of this preparation is to associate a special nervous stimulant with ammonia. Asafœtida is often indicated where ammonia is appropriate, and especially in cases of *hysterical* derangement, whether exhibited in general nervous disorder or in that of a particular organ, as the larynx, the stomach, the bowels, or the uterus. It may be usefully associated with other antacids and with carminatives in *flatulent colic* from indigestion. The *dose* is from thirty minims to a fluidrachm.

SPIRITUS ANISI, *U. S.*—SPIRIT OF ANISE.

Alcoolat d'anis, Fr.; *Anisgeist*, G.

Preparation.—Take of Oil of Anise a fluidounce; Stronger Alcohol fifteen fluidounces. Dissolve the oil in the stronger alcohol. *U. S.*

The *essence of anise* of the British Pharmacopœia is about three times stronger in oil of anise than the foregoing (see page 544).

Medical Uses.—Spirit of anise is used for the relief of *flatulent colic*, and as a flavoring ingredient of mixtures, in the *dose* of one or two fluidrachms.

SPIRITUS ARMORACIÆ COMPOSITUS, *Br.*—COMPOUND SPIRIT OF HORSERADISH.

Esprit de raifort composé, Alcoolat antiscorbutique, Fr.; *Meerrettiggeist*, G.

Preparation.—Take of Horseradish Root scraped, Bitter Orange Peel cut small and bruised, of each twenty ounces; Nutmeg bruised half an ounce; Proof Spirit one gallon; Water two pints. Mix, and distil a gallon (imperial) with a moderate heat. *Br.*

This preparation is an alcoholic solution of the volatile oils of the drugs used.

Medical Uses.—This compound is appropriate in cases of atonic *dropsy*, especially of renal origin, but is more or less efficient in all forms of dropsy in which the use of diuretics is indicated. It may be added with advantage to various diuretic infusions, such as the compound infusion of juniper, the infusion of digitalis, etc. The *dose* is from one to two fluidrachms.

SPIRITUS CAJUPUTI, *Br.*—SPIRIT OF CAJUPUT.

Alcoolé de cajeput, Fr.; *Cajaputgeist*, G.

Preparation.—Take of Oil of Cajuput one fluidounce; Rectified Spirit forty-nine fluidounces. Dissolve. *Br.*

Medical Uses.—Being merely a solution of oil of cajuput in alcohol, it might be made by extemporaneous prescription. Each fluidrachm of the spirit contains one and a half minim of the oil; and the *dose* is from half a fluidrachm to a fluidrachm.

SPIRITUS CAMPHORÆ, *U. S.*, *Br.*—SPIRIT OF CAMPHOR.

Alcohol camphoratus, F. P.; *Spiritus camphoratus*, P. G.; *Tinctura camphoræ.—Tincture of camphor*, E.; *Esprit de camphre, Alcool camphré*, Fr.; *Kampferspiritus*, G.

Preparation.—Take of Camphor four troyounces; Alcohol two pints. Dissolve the camphor in the alcohol, and filter through paper. *U. S.*

Take of Camphor one ounce; Rectified Spirit nine fluidounces. Dissolve. *Br.*

One part of camphor is dissolved in nine parts of strong alcohol (*F. P.*) or in seven parts of strong alcohol and two parts of water (*P. G.*). Both formulas given above are stronger in camphor than the last two.

Medical Uses.—There are hardly any occasions on which the internal use of this preparation of camphor is appropriate, chiefly because the camphor is separated immediately on coming in contact with the moisture of the mouth, fauces, etc. Externally it is applied, as camphorated liniment is, for allaying pain in sprained, chafed, and contused parts; but it is preferable to the oily preparation whenever the local pain is *neuralgic*, or is attended with inflammation, inasmuch as the evaporation of the alcohol produces a sensation of coolness which is usually very grateful. This action is frequently invoked in bathing the mammæ in order to diminish the *secretion of milk* after parturition, or to assist in drying it up for weaning. Applied on cotton to an exposed nerve-pulp it mitigates, and may quite remove, the *toothache*. Like powdered camphor, it may be used advantageously in *hospital gangrene*, and in various *ulcers* of an indolent nature.

The *dose* of spirit of camphor is from five to thirty minims.

SPIRITUS CHLOROFORMI, *U. S.*, *Br.*—SPIRIT OF CHLOROFORM.

Alcoolé de chloroforme, Fr.; *Chloroformspiritus*, G.

Preparation.—Take of Purified Chloroform a troyounce; Alcohol twelve fluidounces. Dissolve the chloroform in the diluted alcohol. *U. S.*

Take of Chloroform one fluidounce; Rectified Spirit nineteen fluidounces. Dissolve. *Br.*

The two formulas yield nearly identical preparations. In a portion of the last edition of the United States Pharmacopœia, through an oversight, *diluted* alcohol was directed. The preparation was formerly known as *chloric ether.*

Medical Uses.—This is a convenient preparation for administering chloroform by the stomach. It may be prescribed in *colic*, whether flatulent, neuralgic, or biliary, and indeed in almost all painful abdominal disorders. *Dose*, from twenty to sixty minims of the U. S. spirit, and nearly twice as much of the British preparation.

SPIRITUS CINNAMOMI, *U. S.*—SPIRIT OF CINNAMON.

Alcoolé de cannelle, Fr.; *Zimmtspiritus*, G.

Preparation.—Take of Oil of Cinnamon a fluidounce; Stronger Alcohol fifteen fluidounces. Dissolve the oil in the stronger alcohol. *U. S.*

Oil of Ceylon cinnamon should be used in this preparation.

Medical Uses.—It may be prescribed pure, in the *dose* of from ten to twenty drops, in cases of *colic* with diarrhœa; and as a flavoring addition to various mixtures. But for the latter purpose cinnamon water is more commonly used.

SPIRITUS FRUMENTI, *U. S.*—WHISKY.

Whiskey, E.; *Eau de vie de grains*, Fr.; *Kornbranntwein*, G.

Spirit obtained from fermented grain by distillation, and containing from forty-eight to fifty-six per cent. by volume of absolute alcohol.

Origin and Preparation.—The term whiskey is supposed to be derived from *usque*, the first two syllables of *usquebaugh*, the original name in Ireland —itself from Irish *uisge* and *beatha*, "life," *Uisge beatha*, *Aqua vitæ*, "Water of life" (Dunglison's Dictionary). In Europe, whiskey is often made by fermenting potatoes, but likewise from different kinds of grain; in Great Britain principally from barley, oats, and rye. In the United States, rye, maize, and wheat are mostly employed for the manufacture of whiskey, either in the raw state, or after having been previously malted, when it furnishes a product of better flavor. The fermenting mixture is called the *wash*. During the fermentation the starch is converted into sugar, and finally into alcohol and carbonic acid gas (see page 120). The mixture is now subjected to distillation, and the weak spirit, called *low wine*, is rectified, and thus obtained stronger and less charged with fusel oil, which comes over chiefly in the last portions of the distillate. The *raw whiskey* is kept in barrels or tanks for several years, during which time it acquires mellowness and is improved in flavor, doubtless in consequence of the formation of various compound ethers.

Properties.—Whiskey is a spirituous liquid, usually of a yellowish or pale brownish color, due to coloring matter and to a trace of tannin derived from the tanks in which it has been kept, and to a trace of sugar which has probably been added in the form of caramel. The density of whiskey depends on the percentage of alcohol, and is to a slight extent influenced by the amount of the coloring and extractive matters; it should be near .935. The disagreeable odor of raw whiskey is mainly owing to a small quantity of amylic alcohol, which, on keeping, is changed into an ether and perhaps partly into valerianic acid; œnanthylic and other allied acids are likewise present to a slight extent. Old whiskey has a slight acid reaction due to the formation of a minute quantity of acetic, and, according to Kappel (1859), of valerianic acid. For neutralizing the acidity of good whiskey, 20 cubic centimeters require usually between 0.8 and 1.0 cubic centimeter of $\frac{1}{10}$ normal solution of alkali, indicating between 0.113 and 0.142 gram of acetic acid or its equivalent. The acidity slowly increases with age up to a certain degree; in one case 2.25 cubic centimeters of $\frac{1}{10}$ normal alkali were required for 20 cubic centimeters of whiskey. For medicinal use, whiskey should be free from disagreeable odor and be not less than two years old. *U. S.*

Tests.—On evaporating whiskey by a moderate heat nearly to dryness, the residue which is left should have a slightly aromatic and rather insipid, but not an acrid taste. The most convenient test for recognizing the origin of whiskey is that proposed by Molnar. A small quantity of it is heated with a slight excess of caustic potassa until the alcohol has been completely evaporated; the compound ethers are thereby decomposed, and, on adding an excess of sulphuric acid, the volatile acids are liberated, and from their odor the source is recognized. *Apple whiskey* distilled from cider gives off a decided fruit odor; the odors of whiskeys of different kinds of grain are sufficiently distinct from one another, but, to readily recognize them, considerable experience is required.

Medical Action and Uses.—Whiskey has probably been made officinal because genuine brandy of good quality is not readily procured. It is one of the unfounded claims of science that bodies of apparently the same composition are identical in their action; for experience daily shows that physiological effects cannot be predicted upon chemical grounds alone. The action of whiskey, both immediate and remote, differs in many respects from that of brandy; and the former liquor made from rye is not identical with that distilled from wheat; nor are potato brandy and grape brandy alike in their effects. Whiskey and also gin, besides being less palatable, to all but the coarsest tastes, than brandy, are much more apt than the latter to produce functional and then organic disease of the stomach, liver, and kidneys, and their immediate operation is less genial and exhilarating. In the absence of pure brandy, whiskey is probably the best of the alcoholic distilled liquors; since its comparative cheapness in a great measure removes the temptation of dealers to adulterate it. The proper occasions and indications for its medicinal use are described under Alcohol.

SPIRITUS JUNIPERI, *U. S.*, *Br.*—SPIRIT OF JUNIPER.

Alcoolat (Esprit) de genièvre, Fr.; *Wachholderspiritus*, G.

Preparation.—Take of Oil of Juniper a fluidounce; Stronger Alcohol three pints. Dissolve the oil in the stronger alcohol. *U. S.*

Take of Oil of Juniper one fluidounce; Rectified Spirit forty-nine fluidounces. Dissolve. *Br.*

The spirit of the German Pharmacopœia is made by macerating for 24 hours 5 parts of bruised juniper berries with 15 parts each of stronger alcohol and water, and distilling 20 parts.

Off. Prep.—Mistura creasoti, *Br.*

Medical Action and Uses.—This preparation is carminative and diuretic, and is useful as an addition to infusions and mixtures employed in the treatment of dropsy. Its *dose* is from thirty to sixty minims.

SPIRITUS JUNIPERI COMPOSITUS, *U. S.*—COMPOUND SPIRIT OF JUNIPER.

Preparation.—Take of Oil of Juniper a fluidrachm and a half; Oil of Caraway, Oil of Fennel, each ten minims; Alcohol five pints; Water three pints. Dissolve the oils in the alcohol, add the water, and mix them. *U. S.*

This spirit is an officinal substitute for *gin*, a spirit distilled in some parts of Europe from juniper berries, to which sometimes other aromatics are added. It has the advantage of uniformity of composition over the commercial article.

Medical Action and Uses.—The addition of caraway and fennel oils to that of juniper in this compound, increases its virtues derived from the last-named ingredient, and especially gives the medicine a carminative operation which is often called for in abdominal *dropsy*, owing to the loss of muscular power in the intestines occasioned by the pressure to which they are subjected. It is commonly added to diuretic infusions. The *dose* is from one to four fluidrachms.

SPIRITUS LAVANDULÆ, *U. S.*, *Br.*—SPIRIT OF LAVENDER.

Alcoolat (*Esprit*, *Eau*) *de lavande*, Fr.; *Lavendelspiritus*, G.

Preparation.—Take of Oil of Lavender a fluidounce; Stronger Alcohol three pints. Dissolve the oil in the stronger alcohol. *U. S.*

Take of Oil of Lavender one fluidounce; Rectified Spirit forty-nine fluidounces. Dissolve. *Br.*

The formula of the German Pharmacopœia agrees with that for Spiritus juniperi, lavender flowers being used in place of juniper berries. For use as a perfume, a small quantity of oil of bergamot, tincture of musk, or tincture of ambergris is sometimes added, the addition of the tinctures being made to the distilled spirit.

Off. Prep.—Mistura ferri comp., *U. S.*

Medical Action and Uses.—Spirit of lavender, or, as it is more commonly called, lavender water, is more generally used as an agreeable and refreshing perfume than as a medicine. It is popularly employed to bathe the forehead, etc., in cases of *headache*, *fever*, etc. It may be given internally in *doses* of from thirty to sixty minims.

SPIRITUS LAVANDULÆ COMPOSITUS, *U. S.*—COMPOUND SPIRIT OF LAVENDER.

Tinctura lavandulæ composita, Br.—*Compound tincture of lavender*, *Lavender drops*, E.; *Teinture de lavande composée*, Fr.; *Zusammengesetzte Lavendeltinktur*, G.

Preparation.—Take of Oil of Lavender a fluidounce; Oil of Rosemary two fluidrachms; Cinnamon in moderately fine powder two troyounces; Cloves in moderately fine powder half a troyounce; Nutmeg in moderately fine powder a troyounce; Red Saunders in moderately fine powder three hundred and sixty grains; Alcohol six pints; Water two pints; Diluted Alcohol a sufficient quantity. Dissolve the oils in the alcohol, and add the water. Then mix the powders, and, having moistened the mixture with a fluidounce of the alcoholic solution of the oils, pack it firmly in a conical percolator, and gradually pour upon it the remainder of the alcoholic solution, and afterwards diluted alcohol, until the filtered liquid measures eight pints. *U. S.*

Take of Oil of Lavender one and a half fluidrachm; Oil of Rosemary ten minims; Cinnamon Bark bruised, Nutmeg bruised, of each one hundred and fifty grains; Red Sandal-wood three hundred grains; Rectified Spirit two pints (imperial). Macerate the cinnamon, nutmeg, and red sandal-wood in the spirit for seven days in a closed vessel, with occasional agitation; then strain and press, dissolve the oils in the strained tincture, filter, and add sufficient rectified spirit to make two pints. *Br.*

This preparation, made by the first formula, is stronger in volatile oils and aromatics than that made by the second formula.

Off. Prep.—Liquor potassii arsenitis (Liq. arsenicalis), *U. S.*, *Br.*

Medical Action and Uses.—Of the numerous ingredients in this popular and useful compound, oil of lavender, except by its disproportionate quantity, is one of the least active and efficient. It is universally employed in this country as a domestic cordial remedy for *nausea*, *flatulent colic*, and gastric distress after food. It is most conveniently administered on a lump of sugar, or in a little hot and sweetened water. The *dose* is from half a fluidrachm to a fluidrachm.

SPIRITUS LIMONIS, *U. S.*—SPIRIT OF LEMON.

Essence of lemon, E.—*Alcoolat* (*Esprit*) *de citrons*, Fr.; *Citronenessenz*, G.

Preparation.—Take of Oil of Lemon two fluidounces; Lemon Peel freshly grated a troyounce; Stronger Alcohol two pints. Dissolve the oil in the stronger alcohol, add the lemon peel, macerate for twenty-four hours, and filter through paper. *U. S.*

The French Codex directs this spirit to be made by macerating for two days 500 parts of fresh rind of lemon with 3000 parts of 80 per cent. alcohol, and distilling until all the alcohol has passed over.

Medical Uses.—This preparation is only used for flavoring simple syrup and medicinal mixtures.

SPIRITUS MENTHÆ PIPERITÆ, *U. S.*, *Br.*—SPIRIT OF PEPPERMINT.

Spiritus menthæ piperitæ anglicus, P. G.—*Essence of peppermint*, E.; *Alcoolat* (*Essence*) *de menthe poivrée*, Fr.; *Englische Pfefferminzessenz*, G.

Preparation.—Take of Oil of Peppermint a fluidounce; Peppermint in coarse powder one hundred and twenty grains; Stronger Alcohol fifteen fluidounces. Dissolve the oil in the stronger alcohol, add the peppermint, macerate for twenty-four hours, and filter through paper. *U. S.*

Take of Oil of Peppermint one fluidounce; Rectified Spirit forty-nine fluidounces. Dissolve. *Br.*

The proportions of the German Pharmacopœia are one part of oil of peppermint to nine parts (by weight) of alcohol.

Medical Uses.—This preparation is the most convenient form for the ordinary administration of peppermint. The *dose* of the American preparation is from five to fifteen drops, taken on loaf sugar, or in sweetened water. The *dose* of the British spirit is from one-half to one fluidrachm.

SPIRITUS MENTHÆ VIRIDIS, *U. S.*—SPIRIT OF SPEARMINT.

Essence of spearmint, E.

Preparation.—Take of Oil of Spearmint a fluidounce; Spearmint in coarse powder one hundred and twenty grains; Stronger Alcohol fifteen fluidounces. Dissolve the oil in the stronger alcohol, add the spearmint, macerate for twenty-four hours, and filter through paper. *U. S.*

The analogous preparation used in France is distilled from fresh crisped mint, and that used in Germany as *Englische Krauseminzessenz* is made by dissolving 1 part of oil of crisped mint in 9 parts (by weight) of alcohol.

Medical Uses.—This preparation is less energetic than that of peppermint. It may be given in the *dose* of from twenty to forty minims.

SPIRITUS MYRCIÆ, *U. S.*—SPIRIT OF MYRCIA.

Bay-rum, E.

The spirit obtained by distilling rum with the leaves of Myrcia acris, *D. C.*, s. Myrtus (Eugenia, *W. & A.*, Pimenta, *Wight*, Amomis, *Bg.*) acris, *Swartz*. Bentley and Trimen, Med. Plants, 110.

Nat. Ord.—Myrtaceæ.

Origin.—This medium-sized tree is known as *wild clove, wild cinnamon*, and *bayberry*, and is indigenous to the West Indies and Venezuela. The quadrangular branches bear opposite, shortly petiolate, coriaceous, broadly oval, nearly obtuse, entire, strongly veined, and pellucid punctate leaves, which are about three inches long, and, when bruised, exhale an agreeable aromatic odor, somewhat similar to cloves. The flowers are small, reddish, and stalked; the fruit is a globular-ovoid smooth berry, resembling allspice.

Preparation.—We have no knowledge of the manner in which bay-rum is prepared in the West Indian Islands, except that the leaves, and probably the fruit of the above plant, are used in its manufacture. Perhaps the largest quantity of bay-rum at present consumed in the United States is made here, partly, we are informed, by distilling the leaves with deodorized spirit, partly by dissolving the volatile oil in alcohol. Of the formulas which have been recommended, we give the following: Oil of Myrcia one fluidounce; Jamaica Rum one pint; Stronger Alcohol four pints; Water three pints: Dissolve (Rother, 1876).

Properties.—Bay-rum is a colorless or pale-yellowish spirit, having a very refreshing and fragrant odor, somewhat like that of cloves.

Composition.—It is an alcoholic solution of the volatile oil of myrcia, which is known in the United States as *oil of bay*, and consists of a hydrocarbon having the specific gravity .870, and of a heavy oil of the density 1.056, and agreeing in its properties with the eugenic acid of oil of cloves. For accounts of this volatile oil see *American Journal of Pharmacy*, 1861, p. 297, and *Proceedings Amer. Pharm. Assoc.*, 1877, p. 435.

Medical Uses.—Bay-rum, like lavender-water, is used exclusively as a perfume, and as a refreshing application to the forehead in *headache*, and to other parts irritated by heat or chafing.

SPIRITUS MYRISTICÆ, *U. S.*, *Br.*—SPIRIT OF NUTMEG.

Alcoolé (Esprit) de muscade, Fr.; *Muskatspiritus*, G.

Preparation.—Take of Oil of Nutmeg a fluidounce; Stronger Alcohol three pints. Dissolve the oil in the stronger alcohol. *U. S.*

Take of Volatile Oil of Nutmeg one fluidounce; Rectified Spirit forty-nine fluidounces. Dissolve. *G.*

In France this spirit is prepared by macerating for four days five hundred parts of bruised nutmeg with four thousand parts (by weight) of 80 per cent. alcohol, and distilling as long as alcohol passes over.

Off. Prep.—Mistura ferri comp., *Br.*

Medical Uses.—Spirit of nutmeg is used almost exclusively as a flavoring ingredient, but less commonly than other aromatics. Its *dose* is from one-half to one fluidrachm.

SPIRITUS RECTIFICATUS, *Br.* See ALCOHOL (p. 122).

SPIRITUS ROSMARINI, *Br.*—SPIRIT OF ROSEMARY.

Spiritus anthos.—*Alcoolat* (*Esprit*) *de romarin*, Fr.; *Rosmarinspiritus*, G.

Preparation.—Take of Oil of Rosemary one fluidounce; Rectified Spirit forty-nine fluidounces. Dissolve. *Br.*

The preparation known in Europe, and formerly much employed, as *Aqua reginæ Hungariæ* (Eau de la reine de Hongrie, *Fr.*), is a compound spirit of rosemary, usually containing a little lavender, sage, or other aromatic oil.

Medical Action and Uses.—This preparation is but little used in the United States. It is worthy of being more generally employed, not only for its perfume, which is very grateful to most persons, but as a stimulant in nervous and *hysterical* conditions, and locally for the relief of muscular and neuralgic *pains*. Like the oil of rosemary, it may be added to stimulating and anodyne liniments. Each fluidrachm of the spirit contains nearly one minim of the oil.

SPIRITUS TENUIOR, *Br.*—PROOF SPIRIT.

Preparation.—Take of Rectified Spirit five pints; Distilled Water three pints. Mix. *Br.*

It has the specific gravity of 0.920 (see page 119).

Medical Uses.—This form of alcohol is employed in medicine only as a lotion for *contusions*, *rheumatic pains*, etc.

SPIRITUS VINI GALLICI, *U. S.*, *Br.*—BRANDY.

Spirit of French wine, E.; *Eau de vie*, *Cognac*, Fr.; *Franzbranntwein*, G.

The spirit obtained from fermented grapes by distillation, and containing from forty-eight to fifty-six per cent. by volume of absolute alcohol.

Origin and Preparation.—Brandy is made in France by distilling different kinds of wine. The colorless spirit (*white brandy*) thus obtained is kept for some time in new oak casks, where it gradually acquires a light amber tint (*pale brandy*). The darker colored varieties have their color deepened by the addition of caramel. The brandies obtained in different districts of France are not esteemed alike, those of Cognac and Armagnac being deemed the best, and next in order those from Bordeaux and Rochelle. The lees of wines and the marc of grapes are also distilled, and furnish a spirituous liquid called in France *eau de vie de marc*, which is highly charged with odorous principles, and is used as an addition to other brandies, and for imitating brandy by mixing the liquid with pure rectified spirit. The odorous constituents, separated from all or most of the alcohol, are sometimes met with in commerce as *oil of grapes.*

Considerable brandy is now made in the United States, and is usually distinguished as Catawba and California brandy. *Catawba brandy* is made in the vine-growing districts of the Ohio and Mississippi Valley, according to E. S. Wayne (1855), from the lees and from the marc. That made from the lees is the best, and has the flavor of Catawba wine. When distilled from the marc it has an unpleasant taste, and contains a large amount of fusel oil, but is mellowed down by age. *California brandy* is made from the lees and marc, which are thrown together with poor wines and distilled, the distillate being tinged by the addition of caramel. (*Proc. Amer. Phar. Assoc.*, 1866, p. 64.)

The British Pharmacopœia recognizes only the spirit of French wine, while the United States Pharmacopœia admits all spirits obtained from fermented grapes.

Properties.—Brandy is a spirituous, amber-colored liquid, having a peculiar flavor, which is improved by age. It has a slight acid reaction, due to the presence of acetic acid. We have found good brandy to require for the neutralization of 20 cubic centimeters from 1.3 to 1.7 cubic centimeters of one-tenth normal alkaline solution, indicating from .185 to .241 grams of free acetic acid in the pint. The odor is due to minute quantities of œnanthic, acetic, and perhaps propylic and allied ethers. Brandy assumes a dark-greenish color on the addition of ferric chloride, owing to the presence of tannin derived from the casks or from catechu, etc., purposely added. Sugar can usually be detected in the extract by Trommer's test, and is derived from the caramel. The density of brandy varies from about .925 to .935, but is frequently higher from being diluted with water.

Tests.—The addition of grains of paradise, Cayenne pepper, and similar substances, sometimes used for imparting artificial strength to brandy, is detected by the sharp or burning taste of the extract left on evaporation. With sufficient practical experience, the origin of brandy may be recognized by Molnar's method (see page 1310); but it is more difficult to distinguish, by their odors, the ethers and fusel oils of the French wines used for making brandy, than the fusel oils of different kinds of grain.

The United States Pharmacopœia requires brandy to be free from disagreeable odor, and to be not less than four years old.

Off. Prep.—Mistura spiritus vini gallici. *Br.*

Medical Action and Uses.—The virtues of brandy have been set forth in the article on Alcohol. It may be sufficient here to repeat that true brandy, that is, made from wine, has qualities peculiar to itself, and unlike those belonging to other distilled spirits. It is not only more palatable, but more cordial to the stomach, and produces a more grateful exhilaration.

SPONGIA.—SPONGE.

Éponge, Fr.; *Schwamm*, *Badeschwamm*, G.

Spongia officinalis, *Lin.* *Class*, Poriphera. *Ord.*, Ceratospongiæ.

Origin and Description.—Sponges belong to the lowest animals which live in water, and are attached to rocks or other substances. They consist of a framework arising from a broad base, and forming a ramifying and anastomosing tissue which is traversed by numerous canals and pores, and covered with a glairy or gelatinous substance. In some genera the skeleton is formed, to a greater or less extent, of siliceous or calcareous spicules; in others the whole body consists of a gelatinous substance. The sponges which are in common use belong to a few species, the skeleton of which is entirely or nearly free from spicules, and forms cup-shaped or convex, porous, and lacunose masses, with circular vents on the surface. They are collected by divers, who tear them from the rocks, or they are detached by means of a fork fastened to the end of a long pole. The gelatinous animal matter is removed by burying them for several days in sand, and afterwards soaking, squeezing, and washing them.

The best variety of sponge comes from the Mediterranean, and is chiefly collected in the neighborhood of Greece, and near the coast of Syria. It is known in commerce as *Mediterranean* and *Turkey sponge*, and comes in cup-shaped pieces of various sizes, having a soft, elastic, and compressible fibrous framework. The *Bahama* or *West Indian sponge* is collected near the Bahama Islands, and forms convex or oblong pieces, with somewhat projecting lobes, and of a coarser texture than the preceding. As met with in commerce sponge generally contains a large quantity of sand, from which it is freed by beating, and various calcareous matters, which are removed mechanically, or by dissolving them with the aid of dilute hydrochloric acid. After it has been cleaned it is sometimes *bleached*, either by means of solution of sulphurous acid prepared from hyposulphite of sodium and hydrochloric acid, or preferably by chlorine water. A still better process is dipping the sponge for five or ten minutes into a 2 per cent. solution of potassium permanganate, and subsequently immersing it in a 2 per cent. solution of oxalic acid, to which a little sulphuric acid has been added; the latter treatment removes the brown manganic oxide, and leaves the sponge white, without affecting its durability.

Composition.—The organic matter of sponge is a proteid called *spongin*, which was formerly supposed to be closely allied to, or identical with, *fibroin* or *sericin* of silk; but was proven by Schlossberger (1858) and Staedeler (1859) to be entirely distinct, in being insoluble or very slowly soluble in ammoniacal solutions of the oxides of nickel and copper, and in the behavior to hot diluted sulphuric acid, with which it yields *leucin* and *glycocoll*, while sericin yields, by this treatment, tyrosin and serin, and is readily dissolved by solutions of nickel and copper in ammonia. Spongin is soluble in hot solution of caustic potassa, and in hot mineral acids.

Pharmaceutical Uses.—SPONGIA USTA, *Burnt sponge*, is obtained by heating clean sponge, cut into small pieces, in a closed vessel, until vapors cease to be given off. The residue amounts to about one-third the weight of the sponge, and consists of about 40 per cent. of charcoal, 25 to 30 per cent. of sulphate of calcium, 10 per cent. of silica, 9 per cent. of ferrous oxide, the remainder being magnesium carbonate, potassium chloride, and calcium phosphate, and about one-half per cent. of sodium iodide. (Herberger.)

SPONGIÆ CERATÆ, *P. G.;* Sponge tent, *E.;* Éponge préparée à la cire, *Fr.;* Wachsschwämme, *G.*—Sponge is freed from foreign matters by beating and washing, then dried, cut into proper shape, dipped into yellow melted wax, pressed between hot iron plates, and, when cold, freed from the excess of wax.

SPONGIÆ COMPRESSÆ, *P. G.;* Compressed sponge, *E.;* Éponge préparé à la ficelle, *Fr.;* Presschwamm, *G.*—Perfectly clean, fine sponge is cut into elongated pieces, while moist, securely tied by means of twine into cylindrical pieces, and then dried.

Medical Action and Uses.—Before the discovery of iodine, roasted, or so-called "burnt" sponge, was generally used in the treatment of *goitre*, both internally and externally, and certainly with excellent results in appropriate cases; but it is now wholly superseded by the preparations of iodine. Sponge is familiarly employed for countless domestic purposes which require the use of a porous, compressible, and elastic substance, capable of holding liquids, and, amongst others, for partial or general baths, which are of such great hygienic importance. Its use in medicine and surgery for absorbing blood, pus, and other animal liquids, is equally familiar; and not less so are the dangers to which it exposes the patients in hospitals by carrying from one to another the germs of infectious disease. Sponges that have been used in surgical operations and dressings should never be dried before being thoroughly purified with boiling water. The elasticity of sponge renders it an efficient means of dilating wounds, sinuses, the natural apertures of the body, etc. For this purpose it should be introduced in a dry and compressed state, when, by absorbing the liquids of the part, it gradually expands with irresistible force. To facilitate its introduction into narrow canals, such as that of the neck of the uterus, compressed sponge, saturated, or merely coated, with wax, is of the greatest utility. It is used to dilate wounds, etc., in order to facilitate the extraction of foreign bodies or the discharge of secretions, as well as the introduction of probes, forceps, and other surgical instruments. In the cervix uteri it is employed to relieve dysmenorrhœa, and also to induce premature labor. Sometimes the sponge, before being compressed and coated with wax, is saturated with a solution adapted to stimulate or otherwise modify the condition of the part.

STANNUM.—TIN.

Étain, Fr.; *Zinn*, G.

Symbol Sn. Atomicity bivalent and quadrivalent. Atomic weight 118.

Origin and Preparation.—Tin is rarely found in the metallic state. Its most important ore is a binoxide, SnO_2, known as *tinstone*, which is usually imbedded in granite, quartz, or slate, and often associated with iron pyrites, and with tungstate of iron and manganese, known as the mineral *wolfram*. It is rarely met with as silicate, and is present in *columbite*, *tantalite*, and allied minerals, and in minute proportions in the mineral waters of Saidschütz and other places. The most important tin mines are in Devonshire and Cornwall in Great Britain, and in Malacca and Banca; but tin is likewise obtained in Australia, Bohemia, Saxony, and some parts of the United States. Australian tin sometimes contains gold.

The tinstone is stamped into a coarse powder, freed from lighter minerals by washing with a stream of water, roasted to expel arsenic and sulphur, again washed with water, mixed with powdered coal and a little lime or fluor spar for the purpose of forming a fusible slag, and then reduced on the hearth of a reverberatory furnace.

Properties.—Tin is a bluish-white metal, of the specific gravity 7.3, softer than gold, but harder than lead, and, when bent, emitting a crackling sound. It may be rolled or hammered into *foil*, and at 100° C. (212° F.) drawn into wire. It melts near 230° C. (446° F.), and at 200° C. (392° F.) it is so brittle that it may be readily reduced to powder. It is but superficially oxidized in moist air, and will effectually protect iron from rusting as long as the coating is perfect. Its alloy with lead forms *pewter*, *Britannia metal*, and *solder;* alloyed with copper it constitutes *gun metal* and *bronze;* and by combining four parts of tin with three of cadmium, eight of lead, and fifteen of bismuth, a fusible alloy is obtained, melting at 60° C. (140 F.)

Metallic tin dissolves in hot strong sulphuric acid to stannic sulphate, evolving sulphurous acid gas. Strong hydrochloric acid dissolves it to stannous chloride, and nitromuriatic acid yields with it stannic chloride. *Stannous salts* are precipitated brown by sulphuretted hydrogen, the precipitate being soluble in ammonium sulphydrate. Chloride of gold produces a deep purple precipitate (*Purple of Cassius*), and mercuric chloride is reduced either to calomel or to a gray powder of metallic mercury. This reaction explains the value of stannous chloride as a test for salts of mercury. *Stannic salts*, of which the chloride $SnCl_4$ is used by dyers, do not react with the chlorides of gold and mercury, but yield, with sulphuretted hydrogen, a yellow precipitate which is soluble in ammonium sulphydrate. Both stannous and stannic salts are precipitated white by caustic potassa; the precipitates are soluble in an excess of potassa, and the alkaline solution, when obtained from stannous salts, yields, on boiling, a black precipitate of stannous oxide.

Pharmaceutical Uses.—Stanni pulvis is readily obtained by fusing the metal, and afterwards triturating it in a hot iron mortar while it cools; the powder is afterwards separated by sifting.

Medical Action and Uses.—Since the time of Paracelsus, at least, tin filings have been used as a remedy for *tape-worms*, and a list of eminent physicians might be given, including some of the most distinguished helminthologists, who vaunted their efficacy, and recommended their use. Their testimony may certainly be taken to qualify the judgment of Küchenmeister when he writes: "Once for all, I protest against the administration of tin filings, and I believe that no one can have much pleasure in giving this remedy, who has seen the ecchymotic irritation of the intestine after its administration to living animals, and heard them whining, or seen them twisting about during life." Even if this criticism were admitted to be just, it would not affect the question of the efficacy of the powdered metal, or of tin prepared by precipitation from its chloride. The eminent authority above mentioned admits it to be real. When tin filings were employed they were supposed to act mechanically, subjecting the worms to such rude attrition as to destroy them; but since the salts of tin have sometimes proved to be tæniacide, and since precipitated tin has had a like effect, it is more probable that some inherent quality of the metal must be invoked to explain its operation. Moreover, it is stated upon good authority that in some rural districts of France, it is customary to use, as a vermifuge, sweetened wine that has been kept for twenty-four hours in a tin vessel.

Formerly tin filings were administered in the *dose* of twenty grains gradually increased to half an ounce. Powder of tin may be prescribed in the dose of about one drachm. These preparations should be given in a syrup or electuary, and when the bowels have been completely cleansed by a purgative. The bisulphuret of tin has also been used as a tæniafuge, in doses of from two to four drachms, in the same manner as the metal. Chloride of tin has also been employed for the same purpose; "as an antispasmodic in epilepsy, chorea, and other convulsive diseases; as a stimulant to paralyzed muscles in paraplegia; as an antidote in poisoning by corrosive sublimate; and as an internal application in chronic skin diseases." (Pereira.) It was administered internally in the *dose* of from one-sixteenth to one-half a grain, and in an aqueous solution prepared by dissolving one-sixth of a grain to one grain in an ounce of water. It acts topically as an astringent, irritant, and caustic, and in poisonous doses causes convulsions, and sometimes paralysis.

STATICE, *U. S.*—Marsh Rosemary.

Inkroot, Sea-lavender, E.; *Romarin des marais, Lavande triste*, Fr.; *Strandnelke*, G.

The root of Statice limonium, *Lin.;* variety caroliniana, *Gray* (Statice caroliniana, *Walt.*). Bentley and Trimen, Med. Plants, 166.

Nat. Ord.—Plumbaginaceæ.

Origin.—Marsh rosemary is a perennial acaulescent plant which grows near the seacoast and in inland salt marshes of Southern and Western Europe. The variety *Caroliniana* is an American plant, and grows in similar localities on the Atlantic coast. It has a tuft of spatulate-oblong or oblanceolate, bristly-pointed, one-ribbed leaves, and produces in August a much-branched, panicled scape, about one or two feet high, bearing numerous small lavender-colored or purplish-blue flowers; the fruit is a one-seeded utricle contained in the base of the calyx. The root should be collected in autumn.

Description.—The root of marsh rosemary is several headed, from one to two feet long and an inch or more thick. The upper part is closely annulate, and the stout branches, after drying, are longitudinally wrinkled. The root has a deep brownish-purple color externally, is somewhat paler internally, fleshy in the fresh state, and, after drying, tough and compact. It breaks with a short fracture, exhibiting a rather thick bark, and in the meditullium narrow pale-yellowish wood wedges. The root is without odor, and has a strongly astringent and slightly bitter taste.

Constituents.—Edward Parrish (1842) found in the root 12.4 per cent. of tannin, a trace of volatile oil, a little caoutchouc-like matter, gum, and other common vegetable principles; among the inorganic constituents the sulphates and the chlorides of sodium and magnesium were found. H. K. Bowman (1869) estimated the tannin by means of gelatin, and determined the amount to be from 14 to 18 per cent. of the air-dry root.

Medical Action and Uses.—This plant was anciently renowned as a remedy for pulmonary and uterine *hemorrhage*, and for *dysentery*, and other fluxes. In recent times it has been used, like kino and other vegetable astringents, for similar purposes, and still oftener in gargles for the cure of ulcerated, aphthous, and other forms of *sore throat*. The emetic action ascribed to it is probably developed only when its dose is excessively large. It may be used in decoction or infusion.

STILLINGIA, *U. S.*—STILLINGIA.

Queen's root, *Queen's delight*, *Silver leaf*, E.; *Stillingie*, Fr., G.

The root of Stillingia sylvatica, *Lin.*, s. Sapium sylvaticum, *Torr.* Bentley and Trimen, Med. Plants, 241. *Nat. Ord.*—Euphorbiaceæ.

Origin.—A perennial laticiferous herb, growing in dry and sandy soil in the Southern United States as far north as Eastern Virginia. The stems are erect, two or three feet high, and have nearly sessile, alternate, elliptic, or lance-oblong, finely serrate, smooth, and spreading leaves. The flowers are small, in dense catkin-like spikes, the upper ones with two stamens, the lower ones pistillate, fertile, and with three diverging stigmas on the thick style. The root should be collected late in autumn or early in spring.

Description.—Stillingia root is about a foot long, nearly two inches in diameter above, tapering downwards, little branched, but somewhat fibrous. It is crowned with the short remnants or scars of numerous stems, is fleshy when fresh, after drying compact and wrinkled longitudinally. Externally it is of a light brown-gray color, and internally of a pinkish tint. The root is tough and tenacious, and breaks with a fibrous fracture. On transverse section are seen a rather thick bark, the inner layer of which is pale pinkish-brown and dotted with numerous brown-yellow resin-cells, and a radially striate porous meditullium, containing resin-cells in the medullary rays. The odor of the fresh root is rather strong and disagreeable, but after drying is much weaker and less unpleasant; its taste is bitter and acrid, leaving a burning impression on the palate.

Constituents.—From some experiments made by Mr. Saunders (1868) it appears that, though the odor of the root may be diminished on drying and keeping, the pungency is scarcely lessened by exposure for a year to light and air. The pungency seems to be due to a resinous constituent which is readily soluble in alcohol. The root contains also starch. The so-called *oil of stillingia*, as found in the market, is intended to be the ethereal extract, but sometimes possesses scarcely any of the persistent acrimony of the root.

Allied Species. STILLINGIA SEBIFERA, *Mich.*—This is a medium-sized tree, indigenous to China, and somewhat cultivated in tropical countries. The ovate three-celled fruit contains three seeds imbedded in *vegetable tallow*, which consists principally of stearin. By pressure the seeds yield a liquid fixed oil.

Medical Action and Uses.—Stillingia was originally introduced as an emetic and alterative, and has been more or less used, especially in the Southern States, for the cure of *scrofula*, *syphilis*, and *cutaneous* and *hepatic* disorders. The evidences of its power do not appear to be very convincing. Thus it is credited with curing phagedenic chancres which nothing else could arrest. But it appears that with each dose of a decoction of stillingia four drops of nitric acid were given. Now, nitric acid is reputed to cure syphilis. Stillingia is best given in a decoction made with an ounce of the bruised root in a pint and a half of water, gradually reduced to a pint. *Dose*, a wineglassful two or three times a day. The *dose* of the powder is from fifteen to thirty grains.

STRAMONII FOLIA, *U. S.*, *Br.*—STRAMONIUM LEAVES.

Thornapple leaves, E.; *Feuilles de stramoine*, Fr.; *Stechapfelblätter*, G.

The leaves of Datura stramonium, *Lin.* Woodville, t. 74; Bentley and Trimen, Med. Plants, 192.

STRAMONII SEMEN, *U. S.*—STRAMONIUM SEED.

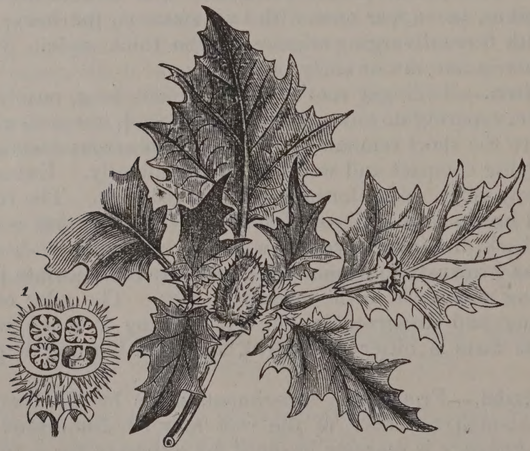
Stramonii semina, Br.—*Stramonium seeds*, E.; *Semences (graines) de stramoine*, Fr.; *Stechapfelsamen*, G.

The seeds of Datura stramonium, *Lin.*

Nat. Ord.—Solanaceæ.

Origin.—Stramonium is known in the United States as *Jamestown weed* and *Jimson weed.* It is very unequally distributed, being quite common in some localities and rare in others, and grows in waste places and along roadsides throughout the greater part of the world, with the exception of the colder countries. Its native country is not certainly known: but it is now by most botanists believed to be indigenous to Asia. DeCandolle refers it to the countries

Fig. 185.



Datura stramonium, *Lin.* 1. Transverse section of capsule.

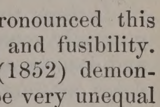
bordering on the Caspian Sea; others regard it as coming from Northern India. It is a coarse-looking annual weed, with a white, conical, branching root, and an erect, nearly smooth, pale green, and succulent stem, attaining, with its repeatedly forking branches, a height varying from 2 to 5 feet. The flowers are on short stalks singly in the forks, have a long tubular five-angled calyx with a short 5-toothed limb, and a white, tubular funnel-shaped, five-plaited, and five-pointed corolla, about 4 inches long. The capsule is 2 to 3 inches long, surrounded below by the spreading base of the calyx, ovate in shape, obtusely quadrangular, covered with spines, in the lower portion 4-celled, but only 2-celled above, and contains numerous seeds.

DATURA TATULA, *Lin.*, resembles the officinal plant very closely, is found in similar localities, and is distinguished by its purple-colored stem, the darker green foliage with occasionally purplish petioles and nerves, and by the purple color of the flowers and anthers. Many botanists regard it merely as a variety of stramonium; but there are evident hybrids between the two forms; and, according to Naudin (1862), the seedlings from these are again either D. stramonium or D. tatula. DeCandolle considers this species to be indigenous to South America; but it has spread over the greater part of the world.

Description. 1. THE LEAVES.—These should be collected while the plant is in bloom, which commences early in summer. They are situated on the forks, on long petioles, vary in length from 3 to 8 or 9 inches and in width from 2 to 5 inches, are ovate in shape, and have an unequal base, one side being decurrent on the petiole. The apex is pointed, and the margin coarsely and unequally sinuate-toothed. The leaves are rather fleshy when fresh, and have a disagreeable narcotic odor, but, after drying, are thin, brittle, and nearly inodorous. Young leaves are downy; older ones are smooth or slightly downy on the nerves beneath, and frequently perforated with nearly circular holes. Their taste is unpleasant, saline, and bitter.

2. THE SEEDS.—When ripe the seeds are of a dull brownish-black color, about $\frac{1}{6}$ inch long, $\frac{1}{10}$ inch broad, and about $\frac{1}{25}$ inch thick; they are reniform, flattened, finely pitted, and somewhat coarsely reticulate, and have the hilum on the sinus. The testa is hard, and incloses a white oily albumen in which is imbedded the cylindrical embryo, curving parallel with the edges of the seed. The seeds are inodorous or nearly so, except after being bruised, when they emit a heavy unpleasant odor; their taste is oily and bitter.

Fig. 186.



Stramonium seed and section, magnified 3 diam.

Constituents.—The alkaloid *daturia* was discovered in the seeds by Geiger and Hesse (1833), and subsequently found in other parts of the plant. According to Brandes, the seeds contain it combined with malic acid. Von Planta (1850) pronounced this alkaloid to be identical with atropia in composition, solubility, and fusibility. But the physiological experiments performed by Von Schroff (1852) demonstrated the two alkaloids, though acting qualitatively alike, to be very unequal in their effects, daturia being about twice as strong as atropia. Subsequently Erhard (1866) observed also some of their salts to differ in their crystalline forms. The other constituents of the seeds are about 25 per cent. of a bland fixed oil, mucilaginous, resinous, and other common principles. Trommsdorff isolated *stramonin* as a white tasteless powder, insoluble in water, readily soluble in fixed and volatile oils, soluble in ether, and sparingly soluble in alcohol; it does not appear to have been further investigated. The leaves contain only about .02 per cent. of daturia, besides mucilage, albumen, nitrate of potassium, etc.; they yield about 17 per cent. of ash.

Allied Drugs.—DATURA ALBA, *Nees*, of India, has triangular yellowish-brown seeds, which are used like those of the preceding species.

Off. Prep.—Of the leaves. Extract. stramonii foliorum, *U. S.* *Of the seeds.* Extract. stramonii seminis (stramonii), Tinct. stramonii, *U. S., Br.*

History.—It is almost certain that stramonium was unknown to the ancients; it was described by Gerarde in the sixteenth century; but it was first introduced into medical practice by Stoerck in 1762. The dried leaves and seeds are said to have been brought from Asia into Europe in the middle ages, by the gypsies, who employed their smoke to intoxicate and delude their dupes.

Physiological Action. *On Animals.*—Insects of the caterpillar tribe feed upon stramonium, and goats devour it without injury. A decoction of the leaves applied to the skin of a young rat caused alternate debility and convulsive movements. Very large doses given to the horse have induced gaping, drowsiness, and even death.

On Man.—The action of stramonium and belladonna, and of their respective alkaloids, daturia and atropia, upon man are almost identical. The powdered leaves of stramonium in two-grain doses slightly increase the fulness and frequency of the pulse, occasion a little giddiness, and render the skin warm, and the hands and face moist. Five-grain doses cause dilatation of the pupils, difficulty of speech, nausea, thirst, dryness of the throat, relaxation of the bowels, an increased flow of urine, and some feverishness. Poisonous doses produce a condition like that of high fever with delirium; the patient may talk volubly and laugh, or become violent, biting and striking furiously; and usually there is evidence of various, and sometimes grotesque, hallucinations; the movements may resemble those in chorea or in alcoholic intoxication; the head is dizzy, heavy or light, and there is a tendency to faint; the face is flushed, occasionally swollen, the eye bright, the conjunctiva injected, the pupil dilated, and the sight confused; the skin is sometimes covered with a bright red eruption which may be followed by a crop of minute vesicles, or the eruption may resemble erysipelas at first and measles afterwards. In some cases hydrophobic phenomena occur, the sight of water or the attempt to drink producing a convulsive paroxysm. In rare fatal cases the phenomena of excitement sooner or later are succeeded by stupor, insensibility and relaxation, and even paralysis; the pupils are inordinately dilated, the pulse is rapid and thready, and the skin hot and perspiring. In no case is there any tendency to sleep, but, on the contrary, persistent insomnia. When recovery takes place there is no distinct recollection of what has occurred. Among the perversions of the senses it has been noticed that all black objects appear green. Daturia occasions phenomena essentially identical with the above and with those caused by atropia, but with more depression, failure of the pulse, and insensibility; according to some observers, it dilates the pupils more rapidly, although less persistently, than atropia. Other reporters, however, furnish a different result, asserting that as a mydriatic daturia is three times as strong as atropia, and its action more prolonged. It is generally accepted as being proved by the above phenomena that stramonium and daturia expend their power mainly upon the vaso-motor nerves, in small doses contracting, but in large doses paralyzing the capillaries. These actions are identical with those which experiment and observation have shown to be exerted by hyoscyamia.

Medical Uses.—At one time stramonium was believed to be a valuable remedy in various forms of *insanity*, in *mania* as well as in *melancholia;* but experience has not confirmed the favorable judgment. Yet there are isolated cases in which phantasmal delirium appears to have been removed by this medicine. A similar statement may be made respecting its use in *epilepsy*, and there is at least every reason to regard it as not less efficacious than belladonna in that disease. The utility of stramonium in *spasmodic asthma* cannot rationally be called in question; the evidence in its favor is drawn from too many and too widely different sources to be gainsaid. The scepticism upon this point expressed by certain writers may fairly be attributed to their having failed to discriminate between pure asthma, and asthma or dyspnœa connected with pulmonary or cardiac disease. In the latter category the medicine must usually fail, either partially or wholly, and may even aggravate the symptoms; while in pure nervous asthma there can be no doubt of its power to relieve the paroxysms. It should be used as follows: About fifteen grains of dried stramonium leaves, or half that quantity of the fibres of the dried root, may be smoked at once, mixed with sage leaves or tobacco in a pipe or a cigarette. Or else tobacco steeped in a strong decoction of stramonium may be smoked in a pipe, or cigars impregnated with the same liquid may be used. If possible, the smoke should be drawn into the lungs. An atomized decoction of stramonium has been used, but is less efficient. Of other spasmodic affections more or less benefited by this medicine, may be mentioned *whooping-cough*, *dysmenorrhœa*, and *retention of urine* caused by spasm of the neck of the bladder. In the latter case bruised fresh stramonium leaves may be used, or stramonium ointment may be rubbed upon the perineum. The rectal tenesmus, burning pain, etc., due to *hemorrhoids*, *fissure*, and other affections of the anus and rectum, may be greatly palliated by stramonium. A convenient formula for this purpose is the following: ℞. Ung. stramon., Ung. gallæ, Cerat. plumbi subacet., āā q. s.—M. S.—Apply within the anus after defecation and washing.

It might have been expected that the apparent identity of the physiological actions of stramonium and belladonna and of their respective alkaloids, would indicate an identity in their therapeutic powers. But it does not really exist. Their differences are most conspicuous in the treatment of *neuralgic* affections. In these belladonna is much more efficient than stramonium; indeed while the former and atropia are among the most reliable of anti-neuralgic medicines, stramonium is comparatively inefficacious, and daturia has been but little used. Moreover, stramonium is much more useful as a local anodyne in superficial neuralgia, while belladonna is even more active as an internal than as a topical remedy for these as well as the deeper-seated neuralgic affections. If stramonium is prescribed for them internally, it should be given in such repeated doses as will develop the specific action of the medicine.

In subacute and chronic articular, and in muscular, *rheumatism*, bruised fresh stramonium leaves produce an anodyne effect, and the ointment may be applied with some benefit; but the action of either is inferior to that of belladonna or of opium. There is some authority for attributing to stramonium in full and repeated doses a certain control over the course of acute articular rheumatism; but the evidence is too scanty and ambiguous to inspire much confidence.

In the absence of belladonna stramonium may be used to produce *dilatation of the pupil*. Daturia has been employed for this purpose, and, as before stated, by some is held to be less irritating to the eye than atropia, while others make the opposite statement.

The average *dose* of the leaves or the root of stramonium is about two grains, and of the seeds about one grain, repeated at intervals of several hours, and until it begins to dilate the pupil. The *dose* of daturia, hypodermically, is from one-sixtieth to one-twentieth of a grain.

The physiological and clinical antidote to stramonium is opium. Numerous cases are reported in which opium, or its liquid preparations, and especially morphia hypodermically, have apparently saved the lives of persons poisoned by stramonium. In the case of an adult no less than fifteen grains of muriate of morphia were administered by the mouth before the safety of the patient was secured.

STRYCHNIA, *U. S.*, *Br.*—STRYCHNIA.

Strychninum, P. G.—*Strychnine*, Fr.; *Strychnin*, G.
Formula $C_{21}H_{22}N_2O_2$. Molecular weight 334.

Preparation.—Take of Nux Vomica rasped forty-eight troyounces; Lime in fine powder six troyounces; Muriatic Acid three troyounces and a half; Alcohol, Diluted Alcohol, Diluted Sulphuric Acid, Water of Ammonia, Purified Animal Charcoal, Water, each a sufficient quantity. Macerate the nux vomica for twenty-four hours in sixteen pints of water, acidulated with one-third of the muriatic acid; then boil for two hours, and strain with expression through a strong muslin bag. Boil the residue twice successively in the same quantity of acidulated water, each time straining as before. Mix the decoctions, and evaporate to the consistence of thin syrup; then add the lime previously mixed with a pint of water, and boil for ten minutes, frequently stirring. Pour the whole into a double muslin bag, and, having thoroughly washed the precipitate, press, dry, and powder it. Treat the powder repeatedly with diluted alcohol, in order to remove the brucia, until the washings are but faintly reddened by nitric acid. Then boil it repeatedly with alcohol until deprived of bitterness, mix the several tinctures, and distil off the alcohol by means of a water-bath. Having washed the residue, mix it with a pint of water, and, applying a gentle heat, drop in enough diluted sulphuric acid to neutralize and dissolve the alkaloid. Then add purified animal charcoal, and, having boiled the mixture for a few minutes, filter, evaporate, and set aside to crystallize. Dissolve the crystals in water, and add enough water of ammonia to precipitate the strychnia. Lastly, dry this on bibulous paper, and keep it in a well-stopped bottle. *U. S.*

Take of Nux Vomica one pound; Acetate of Lead one hundred and eighty grains; Solution of Ammonia a sufficiency; Rectified Spirit a sufficiency; Distilled Water a sufficiency. Subject the nux vomica for two hours to steam in any convenient vessel; chop or slice it; dry it in a water-bath or hot-air chamber, and immediately grind it in a coffee-mill. Digest the powder at a gentle heat for twelve hours with two pints of the spirit and one of the water; strain through linen, express strongly, and repeat the process twice. Distil off the spirit from the mixed fluid, evaporate the watery residue to about sixteen ounces, and filter when cold. Add now the acetate of lead, previously dissolved in distilled water, so long as it occasions any precipitate; filter; wash the precipitate with ten ounces of cold water, adding the washings to the filtrate; evaporate the clear fluid to eight ounces, and, when it has cooled, add the ammonia in slight excess, stirring thoroughly. Let the mixture stand at the ordinary temperature for twelve hours; collect the precipitate on a filter, wash it once with a few ounces of cold distilled water, dry it in a water-bath or hot-air chamber, and boil it with successive portions of rectified spirit till the fluid scarcely tastes bitter. Distil off most of the spirit, evaporate the residue to the bulk of about half an ounce, and set it aside to cool. Cautiously pour off the yellowish mother liquor (which contains the brucia of the seeds) from the white crust of strychnia which adheres to the vessel. Throw the crust on a paper filter, wash it with a mixture of two parts of rectified spirit and one of water till the washings cease to become red on the addition of nitric acid; finally, dissolve it by boiling it with an ounce of rectified spirit, and set it aside to crystallize. More crystals may be obtained by evaporating the mother liquor. *Br.*

In the process adopted by the U. S. Pharmacopœia, the comminuted nux vomica seeds are exhausted by boiling with very dilute hydrochloric acid; the decoction contains the alkaloids as hydrochlorates, together with the liberated igasuric acid, mucilaginous compounds, coloring matter, and other principles. On the addition of slaked lime the hydrochlorates of the alkaloids are decomposed, chloride of calcium is formed, and remains in solution, while strychnia and brucia are precipitated together with the excess of lime employed. On washing this precipitate with water, the igasuria and other foreign principles are removed; and by treatment with cold diluted alcohol the brucia is dissolved. The residue now consists essentially of lime and strychnia, the latter of which is taken up by boiling alcohol, and further purified by converting it into sulphate soluble in water, decolorizing with animal charcoal, and precipitating with an alkali. Manufacturers of strychnia following this process sometimes modify it as follows: the nux vomica is softened by steam, crushed, while soft, between iron rollers, and then exhausted by boiling with very dilute sulphuric acid. On adding lime to the decoction, the precipitate will also contain sulphate of calcium. The washed precipitate is at once exhausted with boiling alcohol, and the mixed strychnia and brucia are purified by treatment with sulphuric acid, animal charcoal, and ammonia, and separated by dissolving in hot alcohol, when, on cooling, strychnia will crystallize, and brucia remain in the mother liquor.

The process of the British Pharmacopœia is a modification of the one proposed by Wittstein. The tincture, prepared with about 55 per cent. alcohol, is concentrated, and the resinous and other insoluble matter separated by filtration. Acetate of lead precipitates from the filtrate igasuric acid and coloring matter, and leaves the alkaloids in solution as acetates. These are decomposed by ammonia, and the precipitated alkaloids treated with hot alcohol, from the concentrated solution of which strychnia crystallizes, and is entirely purified from brucia and coloring matter by washing with alcohol of about 55 per cent., and by recrystallization from strong alcohol.

Various other processes have been proposed, differing mainly in the manner in which the alkaloids are liberated, and afterwards separated from each other. Magnesia or carbonate of sodium may be substituted for the lime and ammonia in the above processes; and benzol was suggested by Boiraux and Léger (1875) for dissolving strychnia from the mixed alkaloids, brucia, it is stated, being completely insoluble in that menstruum.

Properties.—Strychnia is seen in commerce as a white powder, or crystallized in short, quadrangular prisms. It is inodorous, has a very persistent bitter taste, and is sublimable only when very minute quantities are carefully heated. Pelletier and Caventou, who discovered this alkaloid in 1818, found it soluble in about 6700 parts of cold, and 2500 parts of boiling water, and to be insoluble in ether. It requires 120 parts of cold, and 10 parts of boiling 80 per cent. alcohol for solution (Wittstein); but it is very sparingly soluble in absolute and in dilute alcohol. It dissolves in about 5 parts of chloroform (Pettenkofer); in 300 parts of glycerin (Cass and Garot); and is also soluble to some extent in volatile and fixed oils, in creasote, benzol, and amylic alcohol. Its solubility in water is not increased by ammonia or caustic potassa; but dilute acids render it much more soluble, with the formation of neutral salts, which are mostly crystallizable, and are precipitated by alkalies, alkaline carbonates, and, after some time, by soluble bicarbonates.

The composition of strychnia is expressed by the formula $C_{21}H_{22}N_2O_2$ (Regnault).

Tests.—Strychnia and its salts dissolve in concentrated sulphuric acid without color; but on the addition of a little peroxide of lead a beautiful blue color is produced, passing into violet, red, and finally into yellow (Marchand). If bichromate of potassium is used instead of the lead oxide, a deep violet color is produced, or a blue color if strychnia is in excess (Otto). A similar color is obtained with sulphuric acid and ferridcyanide of potassium (Davy); it passes like the preceding, though more slowly, through red into yellow. The solution of strychnia in sulphuric acid containing some nitric acid yields on the addition of binoxide of manganese a purplish-violet color (Mack, Erdmann); and a similar color, but rapidly fading to yellow, is produced with chloric, chlorous, and iodic acids and their salts, with manganic sulphate and potassium permanganate (Lefort). If much contaminated with organic matter, the alkaloid is best purified by dissolving it in a dilute acid so as to free it from fatty and resinous matters, liberating it by ammonia, and dissolving it by agitation with chloroform; if necessary, the process is repeated, and the residue from the evaporation of chloroform is tested as above. If the above tests are carefully applied, a very minute quantity may be detected, according to Wenzell (1870), in a solution containing the $\frac{1}{900000}$ part of strychnia.

The freedom from inorganic matters is readily proven by the absence of ash on incinerating a portion. Concentrated nitric acid should not produce a red color, showing the absence of brucia.

Off. Prep.—Liquor strychniæ, *Br.;* Strychniæ sulphas, *U. S.*

STRYCHNIÆ SULPHAS, *U. S.*—SULPHATE OF STRYCHNIA.

Strychninum sulfuricum.—*Sulfate de strychnine,* Fr.; *Schwefelsaures Strychnin,* G.

Formula $2C_{21}H_{22}N_2O_2.H_2SO_4.7H_2O$. Molecular weight 892.

Preparation.—Take of Strychnia a troyounce; Diluted Sulphuric Acid nine fluidrachms, or a sufficient quantity; Distilled Water a pint. Mix the strychnia with the distilled water, heat the mixture gently, and gradually add diluted sulphuric acid until the alkaloid is neutralized and dissolved. Filter the solution, and evaporate with a moderate heat, so that crystals may form on cooling. Lastly, having drained the crystals, dry them rapidly on bibulous paper, and keep them in a well-stopped bottle. *U. S.*

In preparing this salt it is best to use the strychnia in the form of powder, and add it in slight excess to warm dilute sulphuric acid; the filtrate from the undissolved strychnia will yield the salt on being evaporated spontaneously to dryness.

Properties.—Sulphate of strychnia crystallizes in small, neutral, transparent cubes or prisms, which become superficially opaque on exposure, and when heated to about 135° C. (275° F.) melt, and lose 14.1 per cent. of water of crystallization. The salt dissolves in 48 parts of water (Abl), is also soluble in alcohol, but insoluble in ether. Like other salts of strychnia, it gives the same color reactions as strychnia, and on being ignited leaves no residue.

Other Salts of Strychnia. STRYCHNIÆ NITRAS; Strychninum nitricum, *P. G.*—On dissolving strychnia in warm very dilute nitric acid, the solution yields on cooling colorless needles of a silky lustre and very bitter taste. The salt is soluble in sixty parts of cold and in three parts of boiling water, and in about the same proportion in 80 per cent. alcohol. It is less freely soluble in absolute alcohol and fixed oils, is insoluble in ether, but dissolves in twenty-six parts of glycerin. Its composition is $C_{21}H_{22}N_2O_2.HNO_3$; molecular weight 432.

STRYCHNIÆ HYDROBROMAS, $C_{21}H_{22}N_2O_2.HBr$; molecular weight 415.—Bullock (1875) recommended its preparation from forty-five grains of sulphate of strychnia dissolved in a mixture of one fluidounce of water and two fluidrachms of alcohol. To this solution is added a solution of 11.7 grains of potassium bromide in one fluidrachm of water and one fluidounce of alcohol. The precipitated potassium sulphate is filtered off, the filtrate is mixed with a fluidounce of water, concentrated and crystallized. It forms prismatic needles, which are sparingly soluble in alcohol, readily soluble in dilute alcohol, and require about thirty-two parts of cold water for solution.

History.—It is singular that the history of an agent whose effects are so powerful and peculiar should be so obscure as that of nux vomica, the original source of strychnia. The very name that it bears, nux vomica, is a misnomer, since vomiting is not a symptom which is often produced by it in any dose. It is, however, more apt to be caused by nux vomica than by strychnia. It was known to the Hindoos as a poison, and seems to have been introduced into Europe in the sixteenth century. It is very curious that during the sixteenth, seventeenth, and a part of the eighteenth centuries, although it was well known to be poisonous to animals, it was affirmed not to be so to man. So delusive is negative testimony!

Physiological Action. *On Plants.*—Very minute portions of strychnia in the soil will destroy the life of growing plants. The same effect follows its inoculation into their branches.

On Animals.—It acts poisonously upon all animals, but in different degrees. Flies die in convulsions, and intestinal worms are destroyed by it. Fishes placed in water containing the $\frac{1}{2500}$ part of muriate of strychnia or of brucia, die within ten minutes; and in a solution containing about one part of strychnia to 150,000 parts of water a minnow died within twenty minutes, in a state of lateral rigidity (Gray). It is alleged, on the other hand (Falck), that serpents and fish experience no tetanic phenomena, but disturbance of the breathing, trembling, and jerking of the muscles, exhaustion, insensibility, and death. The frog is generally considered to be so exceptionally sensitive to the action of strychnia as to be employed as a test of the presence of this alkaloid in solution; for if $\frac{1}{1000}$ of a grain be dissolved in a drop of water and applied to the skin of the animal's back, previously dried, tetanoid spasms occur in from a quarter of an hour to one hour. The same effect is produced by the subcutaneous injection of the $\frac{1}{2000}$ of a grain of the acetate of strychnia under the skin of a healthy frog, or by that of $\frac{1}{20000}$ of a grain in the case of a frog exhausted by drying its skin, so as to impede the natural elimination of the poison through the animal's integument. It is claimed by some experimenters that, in proportion to its weight, the frog is really less susceptible to strychnia than various mammals, and that it requires four times the dose needed by dogs, cats, rabbits, etc., to produce an equal effect on frogs (Falck). Birds appear to be comparatively insusceptible to the poisonous action of this substance. Thus in one experiment nux vomica was given to a hen in progressively increasing doses, until it took two and a half drachms of the poison every day. Ruminating animals are less easily affected than other quadrupeds, at least when the poison is given by the mouth; for while ten grains thus administered may fail to kill a sheep, a quarter or half a grain of strychnia will be fatal if introduced hypodermically or injected into the pleural cavity, or into the veins. A similar result of experiment on the goat has been observed. Dogs very readily manifest the power of this substance; but cats resist it singularly, whether it be administered by the mouth, or veins, or subcutaneously. When strychnia has been employed in fulminating balls to kill whales, it has been observed that these mammals perish in spasms. Guinea-pigs and monkeys are said to be comparatively insusceptible to it. The phenomena in these various cases in which its specific operation is developed, consist of tremors, twitchings, and startings of the voluntary muscles, followed by tetanoid spasms, during which the heart's action is accelerated, and the respiration and consciousness suspended. Between the spasms the circulation generally becomes normal, the consciousness returns, and cutaneous hyperæsthesia is observed. Death may occur through asphyxia from tonic spasm of the respiratory muscles, by syncope, or by exhaustion. Of these modes of death that during spasm is by far the most frequent in cases of strychnia poisoning. No lesion is uniformly found after death; the heart may be distended with black blood, or empty; and although congestion and serous effusion within the meninges of the brain and spinal cord are usual, they are not uniformly met with, and in the substance of these organs no alterations have been found.

It may reasonably be believed, 1, that strychnia does not act upon the muscles, the nervous extremities, or the nerve trunks; 2, that it does act upon the nerve centres in the medulla oblongata, and m. spinalis; and, 3, that it acts upon those centres first by stimulating them, when given in small doses, and by exhausting them and thereby exaggerating their reflex irritability when poisonous doses are used. The latter effect is probably dependent, in part at least, upon the power of strychnia to contract the arteries, and to slow the pulse. It is essentially through spasm, in so far as it throws the respiratory muscles into tonic contraction, and by rendering the chest immovable, that it tends to produce asphyxia. This explanation renders clear the agency of artificial respiration in saving the life of animals in strychnia poisoning, and the effect of keeping the frog's skin moist in preventing or delaying the fatal action of the poison upon this animal. In both cases the blood continues to be oxygenized until the poisonous excess of strychnia has been eliminated.

The antagonisms presented by strychnia relate chiefly to chloral hydrate, aconite, hydrocyanic acid, and nicotin, or the special heart poisons. In regard to the first, it has been shown by J. Hughes Bennett: 1. That after a fatal dose of strychnia life may be saved by bringing the animal under the influence of chloral hydrate; 2. That chloral hydrate is more likely to save life after a fatal dose of strychnia than strychnia is to save life after a fatal dose of chloral hydrate; 3. That, after a dose of strychnia producing severe tetanic convulsions, these convulsions may be much reduced, both in force and frequency, by the use of chloral hydrate; 4. That the extent of physiological antagonism between the two substances is so far limited, that (1) a very large fatal dose of strychnia may kill before the chloral hydrate has had time to act; or (2) so large must the dose of chloral hydrate be to antagonize an excessive dose of strychnia, that there is danger of death from the effects of the chloral hydrate; 5. Chloral hydrate mitigates the effects of a fatal dose of strychnia by depressing the excess of reflex activity excited by that substance, while strychnia may mitigate the effects of a fatal dose of chloral hydrate by rousing the activity of the spinal cord; but it does not appear capable of removing the coma produced by the action of chloral hydrate on the brain. The experiments of Dr. J. Milner Fothergill appear to show that the antagonism of strychnia and aconitia is very marked so far as the influence of the former upon lethal doses of the latter is concerned; those of Brunton and others give equivocal evidence of the antidotal power of hydrocyanic acid in poisoning with strychnia. The experiments of Dr. Francis L. Haynes led him to these conclusions: 1, strychnia and nicotin are in no degree antagonistic poisons; 2, strychnia increases the convulsive action, and does not diminish the motor paralysis of nicotin; 3, nicotin (even in paralyzing doses) increases the convulsive action of strychnia; 4, both poisons cause death by paralyzing the respiratory apparatus; they may affect respiration in different ways, but the result is the same; 5, animals may be killed by injecting together doses of the two drugs, which, singly, are not fatal.

On Man.—Powdered nux vomica and also strychnia rubbed upon the skin persistently act as local irritants; this action is greatly intensified if they are applied to the raw cutis. In small doses, internally, they are tonics, increasing the appetite and the urinary secretion, and the fecal discharges also when these are unfrequent, but diminishing the latter when their frequency is due to atony of the bowels. Like other bitter tonics, their prolonged and excessive use deranges the digestion. They appear to augment the biliary and pancreatic secretions. Strychnia is excreted with the urine, and occasions an increased frequency of urination, but in excess produces spasm of the neck of the bladder, and ultimately impaired contractile power in this organ. It probably excites uterine contraction, promotes menstruation, disposes to venery, and provokes erections of the penis. It exerts no perceptible action upon the brain, but seems to increase the functional activity of the special senses. In medicinal doses it usually produces no definite and direct effects upon healthy persons, or only a slight formication of the skin and a transient rigidity of the lower jaw and limbs; but in recently paralyzed parts the same doses may excite spasm.

As experiments upon animals demonstrate, strychnia is absorbed by the veins and the lymphatics, and when introduced into the connective tissue or the serous cavities; it is said to be more readily absorbed from the rectum than from the stomach, and but little from the urinary bladder. By the stomach it is, like other soluble substances, much more readily absorbed when in solution than in the solid state. If taken mixed with the food, or immediately after a meal, and especially a meal of fatty substances, its action may be greatly retarded, and hence even excessive doses may, under such circumstances, fail to act poisonously. In like manner, if the food contain a large proportion of tannin, an insoluble tannate of strychnia will be formed, and the action of the poison mitigated or prevented. As a general rule the more rudimentary or the more feeble the nervous system is, the more readily it is acted upon by strychnia; thus females and children are disproportionately affected by it, notwithstanding the rapidity with which it is eliminated with the urine in the latter. On the other hand, old persons are very susceptible to the action of small doses, perhaps because the medicine is in them slowly excreted by the kidneys. It would appear that sleep retards the poisonous action of the medicine; it, at all events, restrains an open manifestation of it by spasm, etc., just as perfect repose in man or animals under the toxical operations of the drug tends to prevent spasm, while excitement is apt to develop or to aggravate it. Active disease of the central portions of the brain or of the spinal cord induces an exaggerated morbid action under the administration of strychnia; but old paralytic disorders are not affected by it. It aggravates the functional disturbances of tetanus.

When strychnia acts gradually, owing to the moderate dose taken, or to its slow absorption from the stomach, the patient complains first of general uneasiness, restlessness, soreness and heaviness of the limbs, and stiffness of the joints and muscles, particularly of those of the chest and lower jaw, and these effects are succeeded by spasmodic symptoms. When the dose has been large and the conditions are favorable to its rapid absorption, the first phenomena may be clonic convulsions, or violent muscular twitchings, which, with the accompanying sensation, have been compared to the effects of an electric shock. Whether rapid or slow in their access, these phenomena are excited and intensified by all external stimuli. They are succeeded by tetanic muscular spasms, during which the arms are rigidly bent and the legs extended, the hands being clenched and the feet extended and arched, the lower jaw firmly fixed against the upper, and the body arched forwards. The rigid contraction of the respiratory muscles renders breathing laborious, or even temporarily suspends it, and, as a consequence of the immobility of the chest, the blood accumulates in the veins and gives a livid color to the skin. The pulse is rapid, and unequal both in volume and force, and the heart-beat is also rapid and fluttering. The retracted corners of the mouth disclose the set teeth and foam issues from between them, while the staring eyes and contracted brow give to the countenance an expression of anguish mingled with fright. The mind generally remains unaffected, and pain is not often complained of. The convulsions may be altogether tonic, continuing without interruption until death; but more usually they are clonic also, and are interrupted by intervals of calm, or, rather, of exhaustion. But, during such intervals the slightest stimulus may renew them with the suddenness of an electric shock. Generally the spasms grow less violent, but not so the disorder of the circulation and the exhaustion of muscular power; they become more and more marked until death, and may be due immediately to asyhyxia or to asthenia, according as life terminates during a paroxysm or not.

In fatal poisoning by strychnia death may take place within five minutes, and is hardly ever delayed more than five or six hours. Even when poisonous doses are not followed by death, their effects may continue to be observed in extreme fatigue and exhaustion, paralysis of the bladder, and sometimes muscular stiffness and neuralgic pains of several days' duration.

The smallest fatal dose of nux vomica on record is said to have been three grains of the alcoholic extract, and of strychnia taken by an adult, half a grain. A child between two and three years of age died in four hours from taking one-sixteenth of a grain of strychnia. On the other hand, recovery has taken place after the ingestion of three, four, and even seven or eight grains, and in one case eight grains of nitrate of strychnia and twelve grains of the pure alkaloid were taken without fatal effect. In the last instance, the poison was suspended in bitter almond water, holding in solution ten grains of acetate of morphia, and swallowed after a meal consisting of porridge and cranberries; chloroform also was inhaled. The natural effects of the strychnia seem to have been prevented by the mass of food in the stomach, by the precipitation of the strychnia as an insoluble tannate formed with it by the tannic acid of the cranberries, and finally by the antagonistic action of the hydrocyanic acid and the morphia. The mode of access or the course of the symptoms is not always the same, *e. g.*, the sense of muscular rigidity may first be felt in the spine and attended with neuralgic pains of the trunk or limbs; or the attack may commence abruptly with shrieks as of pain or alarm; or it may set in with giddiness, insensibility, or clonic convulsions; or, again, among the earliest symptoms vomiting may occur.

After death caused by strychnia, cadaveric rigidity is usually marked, with opisthotonos, clenching of the hands, and flexion of the arms across the chest. The face is usually pale, but sometimes livid. The muscles are rigid, and all the internal organs are gorged with dark blood, the cerebral and spinal membranes, not more so, nor more uniformly, than the rest; they may contain a serous effusion; the heart may be either contracted, dilated, or natural. These lesions indicate the effects, rather than the mechanism, of strychnia poisoning. But they agree with the symptoms in showing that the cause of death by this poison is primarily asphyxia produced by rigidity of the muscles of respiration. This view does not exclude, as possible factors in producing the result, exhaustion of the heart or spasm of that organ.

Medical Uses.—Strychnia was first employed medicinally in the treatment of *paralysis*, and continues to be used for this affection more than for any other. But it is not equally beneficial in all forms of the disease. As already stated, it is apt to aggravate those paralyses which depend upon a recent central lesion, but is appropriate in the same cases, when the acute stage has passed, and the symptoms remain stationary. In such cases the paralyzed muscles are the first to exhibit the specific action of the medicine. It is now demonstrated, as it was long ago observed, that the medicine is most efficient in the cure of functional paralysis, whether depending directly upon anæmia of the spinal cord, or upon general exhaustion. Such are cases due to venereal excesses, hysteria, intense mental emotion, concussion of the spinal marrow, abuse of opium or alcohol, lead poisoning, gout, rheumatism, etc. *Diphtherial paralysis* is, more than any other form, benefited by strychnia, whose special stimulus co-operates with that of electricity, mechanical excitants, tonics, nutrients, etc. It is less necessary, yet of very great utility, in *paralysis from lead.*

Although physiological experiments do not lead to the suggestion that strychnia acts upon the peripheral ends of nerves, clinical observation, as in so many other cases, is supposed to have demonstrated what the former method has failed to show. For more than forty years strychnia has been well known to be efficacious in cases of *amaurosis* when applied endermically around the orbit; more recently it has been used by friction and hypodermically, by the instillation of dissolved strychnia into the eye, and also internally. These methods have greatly ameliorated and often cured the disease, not only in cases of purely functional disorder, but of a greater or less alteration of the retina as revealed by the ophthalmoscope. Inflammatory affections of the eye in their active stage are unsuitable for this medication, and so is impairment of vision depending upon intra-cranial causes. The greater number of ophthalmic surgeons insist upon the application of the medicine to the neighborhood of the eye; but others admit that it is equally efficacious wherever introduced. The latter are probably right. It has been employed with marked success in *night-blindness.*

Nux vomica and also strychnia have been used, with unquestionably good results, for the cure of *prolapsus of the rectum,* by enema, by hypodermic injection, and by their application to the blistered skin. *Paralysis of the bladder* occasioning either retention or incontinence of urine, and the latter affection in the form of *nocturnal incontinence* in children, has frequently been cured by the use of strychnia by the mouth, and sometimes by injecting a solution of it into the bladder. *Sexual impotence* is often diminished or even cured by this medicine, when it depends upon asthenia of the spinal cord or upon general debility. Generally, however, it should form only one element of a complex treatment adapted to the peculiarities of each case.

Among spasmodic diseases *tetanus* has been cured by strychnia, contrary to all expectations founded upon the accepted mode of action of the medicine; nevertheless, the method has found few imitators. The same remark is nearly as applicable to *chorea,* and also to *epilepsy;* but in regard to both diseases it may be observed that where the patients are extremely feeble, excitable, and timid, this medicine may well form part of the general plan of tonic treatment which is then indicated. A like statement may also be made respecting various local *spasms,* as that of the *œsophagus, facial tic,* etc. It is said that *writer's cramp* has been cured by the hypodermic use of strychnia, and the *vomiting of pregnancy* by its internal use. It is alleged that the medicine has the power of arresting the development and preventing the usual effects of *alcoholic intoxication.* It is one of the numerous remedies which have seemed to moderate *hay-fever.* It has been known to cure facial *neuralgia, lead-colic, dysmenorrhœa,* etc., but its efficacy is too inconstant to inspire confidence. There is one form of neuralgia, *gastralgia,* in which it is often of signal benefit, doubtless more by its power as a bitter tonic than as a nervine. The cases in which it is most useful are those in which the gastralgia is associated with gastrodynia produced by flatulent dyspepsia, eructations, and sometimes vomiting of food, along with habitual constipation. In some of these cases strychnia, or, still better, nux vomica, should be combined with antacids and stimulant carminatives. It is, on the whole, best suited to combat the element gastric debility, with whatever symptoms that condition may be associated. Its tonic action upon the intestine renders nux vomica and strychnia appropriate remedies for *constipation* depending upon atony of the bowel. But for this purpose it should be prescribed in small doses taken immediately after meals, or should be associated with aloes, rhubarb, and soap, or with the first only, in a pill, which is most conveniently taken at bedtime. A similar mode of action makes it one of the best remedies for the so-called *spasmodic obstruction* of the bowel, which is really, in most cases, constipation with fecal accumulations at one part of the intestine and flatulent distension at another. *Tympanites* from intestinal debility is favorably influenced by this medicine, especially if associated with lime-water, or some antifermentative, as salicylic acid. On the other hand, *chronic diarrhœa* and *dysentery,* affections in which the discharges are apt to be prolonged by the exhausted state of the bowel, are often benefited by nux vomica or strychnia. The latter is alleged to have been found useful in *epidemic cholera.* Finally, it is reported to have cured *diabetes,* and to act as a *vermifuge.*

Administration.—The first dose of strychnia should not be greater than from one-twentieth to one-twelfth of a grain; as a general rule it is better to begin with one-thirtieth of a grain, and cautiously increase the dose until a slight manifestation of its specific effects occurs, or until the object of its administration is attained. It is usually prescribed in pills of bread-crumb or of confection of roses, care being taken to mix the mass thoroughly and divide it accurately. A convenient form, which its bitterness alone renders objectionable, is to dissolve one grain of strychnia in two fluidrachms of rectified spirit with the aid of two minims of sulphuric, acetic, or muriatic acid, so that every ten minims of the solution shall contain one-twelfth of the salt of strychnia. For hypodermic injection a solution of four grains of sulphate or muriate of strychnia in a fluidounce of water is used. Each minim contains the one hundred and twentieth of a grain of the salt. Two minims or one-sixtieth of a grain ot strychnia may be used as a primary dose. In all cases in which strychnia is used, the modifying operation of idiosyncrasies and the existing disease must be regarded.

Treatment of Poisoning by Strychnia.—As in the case of other poisons taken into the stomach, so in poisoning by strychnia, free vomiting should be produced by mustard and warm water, or, as has been found successful in one case, the hypodermic injection of one-third of a grain of apomorphia, after which the bowels should be purged with castor oil or a saline laxative. When asphyxia threatens, artificial respiration should be resorted to. As mechanical antidotes which retard the absorption of the poison, lard, sweet oil, and milk have been used with apparent success, immediately after the poison was taken, and before its spasmodic action had been developed. Animal charcoal and also tannin have been used with the same view. Of the other alleged antidotes all are more or less sedatives of the nervous system, and therefore antagonists of the spasm produced by the poison. The first of these is the medicine which has been so much employed in the treatment of tetanus, *opium*, or *morphia*, and from which *a priori* so much was to be expected. But experimentally and clinically the expectation has proved to be unfounded. Opium and its salts are useless in strychnia poisoning, however efficient they may be in relieving those symptoms produced by the alkaloid when its medicinal operation is but slightly exceeded. *Aconitia* and *woorara* are also regarded as physiological antidotes to strychnia; but we are unacquainted with any instances of their use as such in human poisoning. Moreover, the physiological antagonism of woorara and strychnia has been denied by Vulpian, Brown-Séquard, and others. *Camphor*, internally, is said to have arrested the toxical symptoms. There is more evidence in favor of *chloroform*, which unquestionably has in several cases controlled the spasm and apparently prevented death; while in others it has rendered the phenomena of death less distressing. The antagonism shown by experiments upon animals to exist between *chloral* and strychnia is more or less exhibited in cases of poisoning by the latter. Chloral counteracts the spasmodic effects of strychnia, and thus conserves force, while it gains time for the elimination of the poison. When bromide of potassium has been associated with chloral, the effects have been better, and with smaller doses, than if either medicine had been employed alone. *Nitrite of amyl*, which appears to be more or less antidotal to strychnia in dogs and frogs, does not seem to have been sufficiently tested in poisoning by this substance in man. *Bromide of potassium* is credited with several striking cures of strychnia poisoning. In three of them the doses of strychnia were very large, and the effects characteristic; but repeated doses of the bromide, varying in their totality from eighty grains to half an ounce, saved the patients. Experiments on animals demonstrate the power of the bromide to prevent or mitigate the strychnia spasms. *Calabar bean* and strychnia appear to be truly antagonistic, in that the one counteracts the operation of the other, provided that their doses and the time of their administration be duly adjusted. But there is great danger that death by asphyxia may be escaped only by encountering the risk of death from exhaustion. In two cases which terminated favorably, this untoward result was prevented by the use of stimulants internally and externally. In one of these cases three-quarters of a grain of the extract of physostigma was exhibited three times within an hour; and in the other case one grain in a single dose. *Tobacco* and *nicotia* have been employed experimentally as antidotes to strychnia, and, on the whole, with not unfavorable results. Whether or not they may be so regarded in a physiological sense, matters little, provided that they save lives which would otherwise be lost. That tobacco has done so is proved by at least four recorded cases. Very possibly it may have acted by hastening the elimination of the poison with the urine. *Belladonna* and *atropia* have also been suggested as antidotes to strychnia; and a case is recorded in which, atropia having been injected subcutaneously, the patient recovered. One-sixth of a grain was thus used three times, at intervals of ten minutes.

STYRAX, *U. S.*—STORAX.

Styrax præparatus, Br.; *Styrax liquidus*, P. G.; *Balsamum styracis.*—*Liquid storax*, E.; *Styrax liquide*, Fr.; *Flüssiger Storax*, G.

A balsam prepared from the bark of Liquidambar orientale, *Miller*, s. L. imberbe, *Aiton*. Bentley and Trimen, Med. Plants, 107.

Nat. Ord.—Hamamelaceæ, Balsamifluæ.

Origin. — The tree yielding liquid storax closely resembles the sweet gum tree of North America (see p. 818), from which it differs in having smooth leaves with obtuse, often three-lobed and finely serrulate lobes, and in producing smaller heads of fruit. It has been found only in the southwestern part of Asia Minor, where it forms forests.

Production.—The extraction of liquid storax was described by Hanbury (1857) from accounts received from S. H. Maltass and Lieut. Robert Campbell. The outer bark is stripped off on one side of the tree, made into bundles, and reserved for the purpose of fumigation. The inner bark is then scraped off with a semicircular or sickle-shaped knife, and thrown into pits until a sufficient quantity has been collected. It is then boiled in water, upon which the resinous matter comes to the surface, and is skimmed off. The boiled bark is next put into hair-sacks and pressed, boiling water being added to assist in the extraction of the resin, or, as it is termed, *yagh*, i. e. *oil*. According to Maltass, the fresh bark is pressed in strong horsehair bags by means of a wooden lever press, hot water being afterwards thrown over the bags, and these subjected to pressure a second time. Dr. McGrath states that the storax is chiefly collected by a tribe of wandering Turcomans, called *Yuruks*, and that the liquid resin, separated from the bark by boiling and pressure, is run into barrels.

Description. — Liquid storax has the consistence of thick honey, and is opaque and of a gray color, caused by the water which is diffused through it. By long standing it separates a heavier dark brown, in thin layers transparent stratum. When heated, it becomes thinner and more transparent, the water separating slowly; and when ignited it burns with a bright sooty flame. It becomes harder by age and on exposure, is heavier than water, and has a strong agreeable odor somewhat resembling that of vanilla. Its taste is pungently balsamic. With the exception of the water and the impurities contained in it, storax dissolves in alcohol, ether, chloroform, and most of the volatile oils. It is insoluble in cold petroleum benzin, but dissolves partly in it while hot, the solution depositing crystals on cooling. Examined under the microscope storax is seen to consist of minute globules, intermixed with larger drops of water and with tabular crystals of cinnamic acid; and, when left on the object glass, feathery crystals of styracin make their appearance.

STYRAX PRÆPARATUS, *Br.*, is storax purified by melting it together with rectified spirit, straining to remove fragments of bark and other impurities, and evaporating the alcohol. It has a brownish-yellow color, is semi-transparent, and otherwise resembles the crude balsam.

Constituents.—E. Simon (1839) obtained from this balsam styrol, cinnamic acid, styracin, and two resins. *Styrol* or *cinnamene* has the composition C_8H_8, and is obtained by distilling storax with water. The yield is very variable. It is a colorless thin liquid, very refractive to light, and of a very fragrant odor and burning taste. It has been artificially obtained by heating acetylene gas, and from ethyl-benzol bromide by heating it with baryta. Its specific gravity is 0.924, and it boils at 146° C. (294.8° F.); but when heated to 200° C. (392° F.) it is rapidly converted into a polymeric compound, *metacinnamene*, which is a colorless amorphous tough solid, of the specific gravity 1.054, insoluble in alcohol and ether, and reconverted into styrol when distilled. *Cinnamic acid* (see page 969) may be obtained by treating storax with a solution of sodium carbonate, and precipitating the acid by means of hydrochloric acid. *Styracin* is best obtained from storax previously deprived of cinnamic acid, by treating it with hot petroleum benzin, on the cooling of which the styracin crystallizes in white or colorless needles. These melt at 38° C. (100.4° F.), and after prolonged heating congeal to a transparent mass, in which crystals are formed very slowly. Styracin is *styryl* (s. *cinnamyl*) *cinnamate*, $C_9H_9.C_9H_7O_2$, and when in alcoholic solution treated with caustic soda, or when heated with an aqueous solution of soda, is converted into cinnamate of sodium and *cinnam-alcohol*, also known as *styryl alcohol* and *styron*, $C_9H_{10}O$. This crystallizes in colorless silky needles, has an agreeable hyacinthine odor, melts at 33° C. (91.4° F.), and boils at 250° C. (482° F.). Styracin, and cinnamic acid, yield, with oxidizing agents, oil of bitter almonds and benzoic acid; and, when styrol is treated with chromic acid and then boiled with water, benzoic acid is obtained. After saponifying storax with an alkali, and subjecting the alcohols to fractional distillation, Laubenheimer (1872) obtained a distillate having the properties of *benzyl alcohol;* this is a colorless liquid of a weak but fragrant odor, having the specific gravity 1.06, and the composition C_7H_8O.

Commercial storax contains from 10 to 20 per cent. of water, and from 13 to 18 per cent. of fragments of bark and inorganic impurities. (Pharmacographia.)

Adulterations.—Storax is said to be sometimes adulterated with turpentine. Hager (1874) proposed to detect the adulteration by dissolving the storax in a little warm alcohol, and exhausting it with petroleum benzin by agitation. On evaporating the benzin solution, the residue should have a bluish opalescence and an agreeable odor, while, if turpentine be present, the color will be yellowish and the odor of turpentine will be apparent.

Allied Products. CORTEX THYMIAMATIS.—This is the bark from which storax has been obtained. It is in brown foliaceous cakes, consisting of thin pieces of bark, and having the odor of storax.

STYRAX CALAMITA.—As now found in the market, it consists of sawdust mixed with liquid storax, and contains numerous minute crystals of styracin. The drug known by this name in ancient times and during the last century was a solid balsamic resin, most likely obtained from Styrax officinale, *Lin.*, which is indigenous to Western Asia and Southeastern Europe. This is no longer an article of commerce.

Off. Prep.—Tinct. benzoini comp., *U. S.*, *Br.*

History.—The tree from which storax is derived being indigenous to the countries bordering on the Levant, its juice attracted attention from an early period. The storax of Celsus, Pliny, Galen, and Paulus Ægineta is taken to be a solid resin; it was classed by them with the aromatics and balsams, particularly with myrrh, frankincense, and galbanum, and they attributed to it stimulant, cleansing, astringent, and discutient properties, and stated that it was used medicinally in the treatment of coughs, catarrhs, defluxions, and menstrual disorders. But Dioscorides, who was a contemporary of Celsus, states expressly that one variety of storax was liquid, although it is not clear that it was so in its natural condition. The true styrax, or liquidambar, is said to have been first described by Aëtius and by Paulus Ægineta in the sixth and seventh centuries respectively. In the thirteenth century Ebn Baithar states, on the authority of Hobaisch, that storax is useful for pains in the chest and coughs, and for catarrhs; that it controls diarrhœa and flatulence; that externally it is of especial service in the treatment of ulcers, and that when mixed with oil it cures the itch and both moist and dry eruptions of the skin.

Medical Action and Uses.—The medicinal action and uses of this substance are almost identical with those of copaiba, like which it was formerly employed in the treatment of chronic catarrhs, particularly of the lungs, but also to some extent in similar affections of the digestive and the urinary organs, and especially in *gonorrhœa.* It has been highly recommended as a dressing for ulcers following *frost-bite.* Within a few years its use as a remedy for *scabies* has been revived. As of old, it is mixed with olive oil for this purpose; a mixture of one part of storax with two or three parts of oil is rubbed diligently into the affected parts, and in the course of twelve hours a warm bath with soap is used, after which the skin is again covered with the liniment. This treatment generally suffices for a cure in nearly all of the cases. It is convenient for its cheapness, as well as for its acceptableness, particularly when balsam of Peru is added to the storax in the proportion of about one-fourth. The latter ingredient improves the odor of the mixture. The following formula is recommended as more efficient than the mixture described above: ℞. Liquid storax, ℥j; alcohol, f℥ij; olive oil, f℥j.—M. S.—For two frictions. The *dose* of storax internally is from ten to twenty grains.

SUCCI.—Juices.

Sucs végétaux, Fr.; *Pflanzensäfte*, G.

These preparations are made by bruising the fresh drugs, expressing them forcibly, and mixing the expressed juices with a definite proportion of alcohol for preservation. These liquids must necessarily vary in the amount of their active constituents, and perhaps more so than the dried and carefully preserved drugs.

SUCCUS BELLADONNÆ, *Br. Add.*—Juice of Belladonna.

Suc de belladonne, Fr.; *Belladonnasaft*, G.

Preparation.—Take of Fresh Leaves and Young Branches of Belladonna seven pounds; Rectified Spirit a sufficiency. Bruise the belladonna in a stone mortar, press out the juice, and to every three measures of juice add one of the spirit. Set aside for seven days and filter. Keep it in a cool place. *Br.*

Medical Uses.—The *dose* of this preparation is from five to fifteen minims.

SUCCUS CONII, *U. S.*, *Br.*—JUICE OF CONIUM.

Juice of hemlock, E.; *Suc de grande ciguë*, Fr.; *Schierlingsaft*, G.

Preparation.—Take of Fresh Conium Leaves a convenient quantity; Alcohol a sufficient quantity. Bruise the leaves thoroughly in a mortar, press out the juice, and to every five measures of juice add one of alcohol. Set aside the liquid for seven days, and filter. Keep it in a cool place. *U. S.*

According to the British Pharmacopœia three measures of the expressed juice are mixed with one measure of rectified spirit.

Medical Uses.—The officinal *dose* of juice of hemlock is stated at from one-half to one fluidrachm; but the characteristic effects of the drug are not manifested in the slightest degree by doses of less than two drachms; and, ordinarily, they are not well marked by less doses than half an ounce. Doses of one, two, or even four ounces have been given without occasioning alarming symptoms. But in whatever dose the medicine is given, it should not be increased beyond the point at which it begins to render deglutition and voluntary movement imperfect. This preparation is relatively less powerful in children than in adults.

SUCCUS HYOSCYAMI, *Br. Add.*—JUICE OF HYOSCYAMUS.

Suc de jusquiame, Fr.; *Bilsensaft*, G.

Preparation.—Take of Fresh Leaves and Young Branches of Hyoscyamus seven pounds; Rectified Spirit a sufficiency. Bruise the hyoscyamus in a stone mortar, press out the juice, and to every three measures of juice add one of the spirit. Set aside for seven days and filter. Keep it in a cool place. *Br.*

Medical Uses.—The *dose* is from half a fluidrachm to one fluidrachm.

SUCCUS SCOPARII, *Br.*—JUICE OF BROOM.

Suc de genêt à balais, Fr.; *Besenginstersaft*, G.

Preparation.—Take of Fresh Broom Tops seven pounds; Rectified Spirit a sufficiency. Bruise the broom tops in a stone mortar, press out the juice, and to every three measures of juice add one of the spirit. Set aside for seven days, and filter. Keep in a cool place. *Br.*

Medical Uses.—This juice may be prescribed in *doses* of one or two fluidrachms.

SUCCUS TARAXACI, *U. S.*, *Br.*—JUICE OF DANDELION.

Suc de pissenlit, Fr.; *Löwenzahnwurzelsaft*, G.

Preparation.—Take of Fresh Dandelion a convenient quantity; Alcohol a sufficient quantity. Bruise the dandelion thoroughly in a mortar, press out the juice, and to every five measures of juice add one of alcohol. Set aside the liquid for seven days, and filter. Keep it in a cool place. *U. S.*

The British Pharmacopœia directs three measures of the expressed juice to be mixed with one measure of rectified spirit.

Medical Uses.—This preparation is a convenient form for the administration of dandelion; but it may be surmised that even the small proportion of alcohol which it contains may impair its virtues in those hepatic derangements for which dandelion is a reputed remedy. The *dose* is from two to four fluidrachms.

SULPHUR LOTUM, *U. S.*—WASHED SULPHUR.

Sulphur depuratum, s. Flores sulphuris loti, P. G.—*Soufre lavé*, Fr.; *Gereinigte Schwefelblumen*, G.

Sublimed sulphur thoroughly washed with water.

SULPHUR SUBLIMATUM, *U. S., Br.*—SUBLIMED SULPHUR.

Flores sulphuris.—Flowers of sulphur, E.; *Fleurs (Crême) de soufre*, Fr.; *Schwefelblumen, Schwefelblüthe*, G.

SULPHUR PRÆCIPITATUM, *U. S., Br.*—PRECIPITATED SULPHUR.

Lac (s. Magisterium) sulphuris.—Milk of sulphur, E.; *Soufre précipité, Lait de soufre*, Fr.; *Schwefelmilch*, G.

Symbol S. Atomicity bivalent, quadrivalent, and sexivalent. Atomic weight 32.

Origin.—Sulphur is a constituent of the volatile oils of mustard, garlic, and asafœtida, and of albumen and other proteids. It is found in many mineral waters as sulphuretted hydrogen and in the form of sulphates, and is widely distributed in the mineral kingdom in combination with metals, forming iron pyrites FeS_2, galena PbS, blende ZnS, black antimony Sb_2S_3, cinnabar HgS, and other sulphides; and as sulphate in gyspum, heavy spar, and many other minerals. But sulphur is most abundantly obtained from *native sulphur*, which is found in volcanic countries. Beds of native sulphur have been discovered in California and other parts of the Western United States, in Mexico, the West Indies, etc.; the chief supply of sulphur, however, comes from Italy, where extensive beds are worked near Latera and Scrofano, and from the provinces of Girgenti, Caltanisetta, Catania, and Palermo, in the Island of Sicily. Sulphur beds on the surface of the earth are called *solfatare*, and when they are found under-ground are known as *solfare.* The latter are the most important, and yield nearly the whole of the commercial sulphur.

Extraction and Purification.—Sulphur is obtained in Sicily by melting it from the mineral in semicircular pits called *calcaroni*, which have a diameter of about thirty feet and a depth of about eight feet, and are internally covered with a layer of gypsum. The bottom is inclined towards one side, which has an opening, closed during the operation with a thin wall of gypsum. The pit is filled with the mineral, and this is heaped up above so as to form an obtuse cone, the whole being covered first with a layer of powdered sulphur ore, and finally with a stratum of spent ore in powder. Fire is now applied to the heap, and after an hour all openings are closed until after about nine days the melted sulphur begins to collect on the floor of the pit. Through a small opening made into the gypsum wall, the melted sulphur is removed two or three times a day and run into moistened moulds made of poplar wood, where it solidifies in the form of blunt pyramids, in which condition it enters commerce.

The *rough sulphur* thus obtained contains from three to four parts of earthy impurities, which are removed by distilling the sulphur from iron retorts and conducting the vapors into large brick chambers, where they condense in the form of a fine powder, which is from time to time removed, before the condensing chamber becomes too hot, and constitutes *sublimed sulphur.* If, however, the operation is not interrupted, the brick walls of the chamber become hot enough to melt the sulphur, which is run into wooden moulds. The cylindrical pieces thus obtained enter commerce as *brimstone* or *roll sulphur.*

Some sulphur is also obtained from pyrites by a process of roasting in heaps or in suitable furnaces built for the purpose, a portion of the sulphur being burned in the operation.

Preparation. SUBLIMED SULPHUR.—The process by which this is procured has been described above. The other officinal forms of sulphur are prepared as follows:—

WASHED SULPHUR.—Sublimed sulphur is washed with water as long as it changes the color of blue litmus paper to red, and is then dried (*U. S.*). Or twelve parts of sublimed sulphur are mixed with eight parts of distilled water and one part of ammonia water; the pasty mixture is transferred to a strainer, well washed with distilled water, and afterwards dried and sifted (*P. G.*).

PRECIPITATED SULPHUR.—Take of Sublimed Sulphur twelve ounces; Lime eighteen troyounces; Muriatic Acid, Water, each, a sufficient quantity. Pour sufficient water on the lime to slake it, and, having mixed the sulphur with it, add fifteen pints of water to the mixture; then boil for two hours, occasionally adding water to preserve the measure, and filter. Dilute the filtered liquid with an equal bulk of water, and drop into it muriatic acid as long as a precipitate is produced. Lastly, wash the precipitated sulphur repeatedly with water until the washings are nearly tasteless, and dry it. *U. S.*

Take of Sublimed Sulphur five ounces; Slaked Lime three ounces; Hydrochloric Acid eight fluidounces, or a sufficiency; Distilled Water a sufficiency. Heat the sulphur and lime, previously well mixed, in a pint of the water, stirring diligently with a wooden spatula; boil for fifteen minutes and filter. Boil the residue again in a half pint of the water, and filter. Let the united filtrates cool, dilute with two pints of the water, and, in an open place or under a chimney, add in successive quantities the hydrochloric acid previously diluted with a pint of the water, until effervescence ceases and the mixture acquires an acid reaction. Allow the precipitate to settle, decant off the supernatant liquid, pour on fresh distilled water, and continue the purification by affusion of distilled water and subsidence, until the fluid ceases to have an acid reaction and to precipitate with oxalate of ammonia. Collect the precipitated sulphur on a calico filter, wash it once with distilled water, and dry it at a temperature not exceeding 120° F. *Br.*

In the processes described, hyposulphite and sulphide of calcium are first produced, from which, on the addition of an acid, sulphur is precipitated. The first formula directs too large a quantity of lime, resulting in a corresponding waste of hydrochloric acid. The second formula, on the contrary, employs an excess of sulphur, but this is not lost, since the undissolved portion may be utilized in a subsequent process. In order to obtain good results, it is advisable to dissolve in the lime as much sulphur as can be taken up, and this is accomplished by the British formula, the reaction taking place as follows: $3CaH_2O_2 + 6S_2$ yields $2CaS_5 + CaS_2O_3 + 3H_2O$. On the addition of hydrochloric acid, both the pentasulphide and hyposulphite of calcium are decomposed with the liberation of sulphur, and, in addition thereto, of sulphuretted hydrogen from the former and sulphurous acid from the latter compound, the newly-formed compounds again reacting with each other and producing sulphur and water. The result of this complicated reaction is expressed by the equation $2CaS_5 + CaS_2O_3 + 6HCl = 6S_2 + 3CaCl_2 + 3H_2O$.

Properties.—Sulphur exists in several modifications, and is either *crystalline* and soluble in carbon bisulphide, *amorphous* and insoluble in the same liquid, or *soft* or *oily* at common temperatures, and either soluble or insoluble in carbon bisulphide. When sulphur is fused and kept near the temperature of 90° C. (194° F.), octahedral or rhombic crystals are formed, fusing at 115° C. (239° F.); but if the crust which forms on cooling is broken and the liquid sulphur poured out, the vessel will afterwards be filled with long oblique prisms, which melt to a yellowish liquid at 120° C. (248° F.). On gradually increasing the heat to near 180° C. (356° F.), sulphur becomes brown and ultimately black, opaque, and very viscid. If the heat be continued, the mass liquefies again at 260° C. (500° F.), and at about 450° C. (842° F.) is converted into orange-brown vapors. On agitating sublimed sulphur with carbon bisulphide, about two-thirds of it are dissolved, while the remainder is amorphous and remains undissolved. The different varieties of sulphur differ also in specific gravity, that of amorphous and soft sulphur being 1.96, of prismatic sulphur 1.98, and of octahedral sulphur 2.05; this last variety is more stable than the other two, which are under various circumstances converted into it. Heated in the air, sulphur ignites at about 150° C. (302° F.), and burns with a blue flame to sulphurous acid gas, SO_2. In addition to this only one other oxygen compound of sulphur has been obtained in the isolated state, sulphuric anhydrid, SO_3, though several others are known in combination, of which the most important is hyposulphurous acid. (See page 1284.) The other oxygen compounds of sulphur are as yet only of scientific interest; they are *dithionic*, *trithionic*, *tetrathionic*, and *pentathionic acid*, and contain, in combination with a bivalent basylous radical, six atoms of oxygen, and respectively two, three, four, and five atoms of sulphur. These four acids, when liberated from their salts, are readily decomposed into sulphuric and sulphurous acids; the last three separating also sulphur.

Sulphur combines also with most of the non-metallic and metallic elements, forming sulphides, the most important of which to the pharmacist are the sulphides of antimony, mercury, iron, potassium, ammonium, and hydrogen. When treated at an elevated temperature with volatile and fixed oils, it dissolves and forms with the fats compounds which were formerly known as *balsams of sulphur*. Sulphur is insoluble in water, but dissolves somewhat in hot absolute alcohol, ether, chloroform, and benzol, and is deposited on cooling in crystals.

SUBLIMED SULPHUR is a yellow or somewhat greenish-yellow slightly gritty powder, which is free from odor and taste, and has a slight acid reaction to litmus. To heat and solvents it shows the behavior described above.

WASHED SULPHUR has the same appearance and behavior as the preceding, except that it does not change the color of litmus paper.

PRECIPITATED SULPHUR is a yellowish-white or grayish, very fine powder, free from grittiness and from the odor of sulphuretted hydrogen. When examined under the microscope, it is seen to consist of opaque globules which are free from crystalline matter. It is not altered on exposure to air when kept dry, and on fusion it is converted into ordinary sulphur.

Tests.—Sulphur should completely evaporate by heat; clay, gypsum, and similar impurities are left behind as fixed residues. The milk of sulphur, frequently demanded in Great Britain, is prepared by precipitating the solution of sulphur in lime-water by means of sulphuric acid, and the resulting precipitate is therefore contaminated with calcium sulphide; it is more readily miscible with water than pure precipitated sulphur. When obtained from pyrites, sulphur usually contains arsenic, which is most conveniently detected, unless present in very minute quantities, by digesting it with ammonia water, filtering, and adding hydrochloric acid, when yellow sulphide of arsenic will be precipitated. Very minute quantities of arsenic are best detected by Marsh's test. Selenium, which is sometimes present in sulphur, is detected by heating a sample with nitro-muriatic acid, diluting with water, filtering, and concentrating the filtrate, which contains selenious acid, and yields, on the addition of sulphite of sodium, a bright red or reddish-black precipitate of selenium. Precipitated sulphur frequently has a slight odor of sulphuretted hydrogen, which is more apparent on being warmed; such sulphur acquires a more or less black color when agitated with a solution of acetate of lead.

Off. Prep.—Sublimed sulphur is used in preparing Confectio sulphuris, *Br.;* Emplast. ammoniaci cum hydrargyro, *U. S.*, *Br.;* Empl. hydrargyri, *Br.;* Hydrarg. sulphuretum rubrum, *U. S.;* Potass. sulphuretum (sulphurata), Sulphur præcip., Sulphuris iodidum, Ung. sulphuris, *U. S.*, *Br.*

History.—The word sulphur is derived, according to some, from *sal*, salt, and *πυρ*, fire; and, according to others, from *solum*, earth, and *πυρ*, fire. Brimstone is from A. S. *byrne*, burning, and *stoan*, stone. Its fumes were very anciently employed to purify bodies, clothing, and dwellings: Hippocrates refers to it in his treatise on the diseases of females: Pliny attributed to it a heating and restorative quality, states that it discusses swellings, and for that purpose may be used in plasters and poultices; that it relieves lumbago when rubbed upon the loins in an ointment; that in combination with resins it removes lichenous and leprous eruptions, and as an electuary relieves dyspnœa and cough with purulent expectoration. Dioscorides, and, later, Paulus Ægineta, spoke of its virtues in itch. The value of sulphurous mineral waters was well known.

Physiological Action. *On Vegetables and Animals.*—The use of powdered sulphur for limiting fermentation has come down from a remote period; and it has also long been used for destroying parasitic fungi upon plants, as well as parasitic insects upon plants and animals. Recent experiments appear to show that these effects, as well as others which are usually attributed to sulphur, are in reality due to the sulphurous and sulphuric acids with which it is nearly always impregnated, or which form by the action of the oxygen of the air upon it. If this view be correct, the therapeutic applications of sulphur will need revision. More than a century ago (1745) Langrish showed that when the body of a dog was exposed to the fumes of burning sulphur the animal suffered no inconvenience, but all the fleas that infested it were killed. Powdered sulphur given to animals in moderate but repeated doses, impregnates the perspiration, the eructations, the feces, and sometimes the expired breath with sulphuretted hydrogen. Larger doses operate as laxatives, and, if continued, occasion diarrhœa, but do not materially affect the intestinal membranes. The flesh of sheep that have eaten food mixed with sulphur tastes and smells of sulphuretted hydrogen.

On Man.—In doses of from twenty to forty grains, sulphur occasions soft stools, generally without colic, and the flatus discharged has the odor of sulphuretted hydrogen. The greater part of the sulphur passes unchanged. When small doses are repeated day after day, the exhalations of the lungs and skin have a sulphurous smell, the linen is sometimes stained yellow by the perspiration, and silver articles worn near the skin are blackened by the formation of sulphide of silver. The expired air, also, the urine, and the milk contain combinations of sulphur. It has happened, when a course of mercury has followed the administration of sulphur, that parts of the skin have been discolored by sulphide of mercury. Sulphur may continue to be used for a long time and in full doses without any untoward effects; but, on the other hand, such a case has been recorded as that of a person who took 120 grains of sulphur in wine four or five times a day, and who, on the sixth day, was seized with nausea, bloody diarrhœa, cramps in the legs, fever, dysury, etc., and for several years his stomach remained irritable. There can be little doubt that these peculiar symptoms were occasioned by a great excess of free acids in the sulphur, for those acids have been found to be present in the proportion of from ten to thirty parts in ten thousand parts of ordinary sublimed sulphur. They are the chief source of the increased proportion of sulphates found in the urine of those who use sulphur medicinally. The proportion of uric acid and of urea in this secretion is also said to be increased.

So long as the stomach contains only its normal acid secretions, sulphur undergoes no changes in that organ; but if the gastric liquids are rendered alkaline by disease, sulphuretted hydrogen may be evolved, as it normally is, in the intestinal canal by a reaction between a portion of the sulphur and the alkaline secretions of the liver and pancreas. That such is the case is proved by the odor of the dejections, and, when the medicine has been for some time employed, by that of the cutaneous and pulmonary exhalations also. Even the skin appears to absorb it in some degree, since those who are subjected to frictions with sulphur ointment discharge fetid gas from the bowels. This may, however, possibly arise from the inhalation of the sulphur which is volatilized at the temperature of the body. The laxative action of the medicine can only be explained by its forming compounds with the aforesaid alkaline secretions. Indeed, its irritant and laxative operation is doubtless hindered by the undissolved coating of sulphur which lines the bowel. The alkaline compounds of sulphur in the blood appear to be partially converted into sulphates, and to be discharged with the urine. The remainder are secreted chiefly in the form of sulphuretted hydrogen by the lungs and the skin. The extreme depression of the circulatory and nervous systems that have occasionally followed the use of sulphur may be attributed to the same compound absorbed from the digestive canal.

Medical Uses.—The most important therapeutic application of sulphur is to the cure of *scabies*. As already stated, it was used for this purpose in ancient times. Within the last generation its efficacy has been greatly enhanced by softening the patient's skin by means of warm baths before the sulphur is applied, and by associating the latter with some substance which, with the aid of friction, mechanically breaks up the burrows of the acari, and brings the insects under the poisonous influence of the sulphur. Some writers, even among the most recent, distinctly assert that sulphur is not efficient, *per se*, and can cure the itch only when the presence of a free or carbonated alkali permits the formation of a sulphide which is the true agent of the cure, and hence that all sulphurous itch ointments should contain such an alkaline ingredient. Others affirm that the sulphur in an ointment only acts mechanically, by breaking up the burrows of the itch insect, while the sulphides destroy its life. These writers appear to have overlooked the presence and potency of sulphurous acid in sulphur ointment, as well as to have forgotten the long period in which simple sulphur ointment continued to be an efficient cure for the itch. The greatest dermatologist of the age is not, apparently, of their opinion. Hebra, after referring to the comparative value of several insecticide agents, says of sulphur: "It was found to be equally effectual whether it was used alone, or in combination with potassa, soda, or lime." He also distinctly points out the advantage of there being mixed with the sulphur some coarse and insoluble substance to mechanically rupture the burrows of the acarus, and permit the true insecticide to reach at once the insect and its eggs. But as many of the substances used for that purpose irritate the skin, causing artificial vesicular and pustular eruptions, those remedies only should be employed which, without irritating the skin, will destroy the itch insect and its ova. In hospitals this precaution may be less imperative than in private practice; but in all cases ointments which irritate the skin should be applied to those parts only, and especially the hands and the feet, which are distinctly the seat of the parasitic eruption.

The first compound sulphur ointment was that of Helmerich (1812–13), and consisted of two parts of sulphur, one of carbonate of potash, and eight of lard, which was said to cure the itch in eighteen hours when applied by vigorous and repeated friction, aided by warm baths. The method was revived in 1844 by Hebra, whose perfected formula was as follows: ℞. Flor. sulphuris, Ol. fagi vel cadini, āā ℥vj; Saponis viridis, Adipis, āā Oj; Cretæ, ℥iv.—M. He, however, employed successfully a much simpler preparation, made of equal parts of flowers of sulphur and powdered soap, reduced to a semi-fluid mass with water. These agents effect a cure in two or three days, when duly supplemented by warm baths. Hardy reduced the time of treatment to two hours. The patient was first rubbed for half an hour with soft soap, and placed in a warm bath for half an hour, the skin being again thoroughly rubbed, after which he was vigorously anointed with Helmerich's ointment, or with one composed of one part of carbonate of potassium, two parts of sublimed sulphur, and twelve parts of lard. The method, variously ascribed to Bourguignon and to Vlemingkx, consisted in the use of the following lotion: ℞. Calcis vivæ, lb. j; Sulphuris citrini, lb. ij. Boil with twenty pints of water until reduction to twelve pints. When cold, filter. The patient is immersed in a warm bath, and for half an hour rubbed with flannel cloths and potash soap, and is allowed to remain for another half hour in the bath. During the third half hour he is again rubbed vigorously with flannel dipped in the solution of sulphuret of calcium, and passes the fourth half hour in the bath. Any particles of sulphur adhering to the skin may be washed off with cold water. This completes the cure. The objection to these methods consists in the harshness of their application and the artificial eruptions they excite,

Sulphur is useful in other diseases of the skin, and especially in *acne rosacea*, *sycosis*, and *chloasma*, and in certain cases of *psoriasis*. In the last-named affection, unless very circumscribed, all sulphurous applications are painful, and often aggravate the disease. In chloasma, sulphur baths and the internal use of sulphur waters should be conjoined. In the different forms of acne the seat of the eruption should every night be bathed with warm water, to soften the skin, after which a paste made with flowers of sulphur and water, or an ointment prepared with equal parts of sulphur, carbonate of potassium, and simple ointment, should be smeared over the affected part and allowed to remain all night. In the morning it should be thoroughly washed off with soft water, with the addition, if necessary, of bran or Indian corn meal, but without soap. Chloasma is sometimes cured by drinking sulphurous mineral waters and by baths of the same; but whether by their local or their indirect action is not easily determined.

The fumes of burning sulphur, conveyed into a wooden chest inclosing all of the patient but his head, have sometimes been used in the treatment, especially of inveterate cases, of cutaneous diseases, such as *eczema*, *psoriasis*, *impetigo*, and *prurigo;* and also for the cure of *rheumatic* and *scrofulous* affections, *paralysis*, *amenorrhœa*, etc. The method, however, sometimes gave rise to great cutaneous irritation, syncope, etc., and is now seldom if ever employed. Sulphurous baths both natural and artificial have always enjoyed a great vogue, especially in the treatment of *rheumatism* and *gout* and of some *cutaneous affections*. For the former thermal waters are to be preferred; and for the latter partial douche baths are more efficacious than general baths, and are more useful in limited than in extensive eruptions. Sulphurous mineral waters generally contain earthy and alkaline sulphates which render them, when taken internally, more or less laxative and diuretic, and therefore depurative, while the sulphurous acid disengaged from them in the body promotes diaphoresis. (See Aquæ Minerales.) Probably by the latter operation sulphur is useful as an internal remedy for chronic rheumatism, especially of the muscles and tendons, but not of the joints. It forms an ingredient of the laxative compound known as the "Chelsea pensioner," thus: ℞. Flowers of sulphur, ℥ij; Cream of tartar, ℥j; Powdered rhubarb, ʒij; Guaiacum, ʒj; Clarified honey, lb.j; one Nutmeg finely powdered. M. S.—Two large teaspoonfuls to be taken night and morning, and at bedtime a hot alcoholic draught.

In *chronic coughs* with profuse expectoration the virtues of sulphur are sometimes conspicuous. Its reputation in such affections at one time was so great as to obtain for it the title of *balsamum pulmonum*. It was often used for this purpose in the form of the compound liquorice powder which is now more generally employed as a mild and efficient laxative. The mildness of the laxative operation of sulphur renders it appropriate in *piles;* for this and similar purposes it is often administered with cream of tartar, of each one drachm, mixed with molasses.

Nebulized sulphurous waters are useful as a local application in *granular pharyngitis* and *laryngitis;* and powdered sulphur itself was long ago recommended to be applied by insufflation to the same parts in *diphtheria* and *croup*, but of its efficacy there is not sufficient proof.

Administration.—Sulphur is given as a laxative in the *dose* of from 60 to 240 grains. For other purposes the dose is about 30 grains. It may be administered in milk, or molasses or other syrup.

SULPHURIS IODIDUM, *U. S.*, *Br.*—IODIDE OF SULPHUR.

Sulfur iodatum, P. G.; *Ioduretum sulfuris*, F. P.—*Iodure de soufre*, Fr.; *Jodschwefel*, G.

Preparation.—Take of Iodine four troyounces; Sublimed Sulphur a troyounce. Rub them together until they are thoroughly mixed. Introduce the mixture into a flask, close the orifice loosely, and apply a gentle heat so as to darken the mass without melting it. When the color has become uniformly dark throughout, increase the heat so as to produce liquefaction, and incline the flask in different directions, in order to return into the liquid any portions of iodine which may have been condensed on the inner surface of the vessel. Then withdraw the heat, and, after the liquid has become solid, remove the mass by breaking the flask, reduce it to pieces, and keep them in a well-stopped bottle. *U. S.*

Essentially the same formula has been adopted by all the Pharmacopœias. On warming a mixture of iodine and sulphur, the two elements unite, and at a somewhat higher heat melt together. The operation is readily performed in an ordinary vial, if this is carefully heated by means of a sand-bath.

Properties.—Thus prepared, iodide of sulphur is a grayish-black mass of a radiated crystalline appearance and with a metallic lustre. It resembles iodine in smell, and on exposure to the air gives off vapors of iodine. If exposed to a gradually increased heat, it sublimes, the first portion of the sublimate consisting of iodine, and the portion subsequently obtained containing sulphur. Iodide of sulphur dissolves in about sixty parts of glycerin, and is soluble in carbon bisulphide, on the spontaneous evaporation of which at a low temperature iodine crystallizes first, and afterwards rhombic pyramids of *sulphuric iodide* are obtained, having the formula SI_6 (Vom Rath, 1860), and on exposure to the air leaving sulphur in the form of a delicate crystalline skeleton (Lamers, 1861). Alcohol, ether, volatile oils, and solutions of potassa and of potassium iodide decompose iodide of sulphur, by dissolving the iodine. A similar decomposition is effected by boiling the iodide of sulphur with water, with the vapors of which the iodine passes off, leaving a residue of sulphur, amounting to 20 per cent. of the weight of the iodide of sulphur employed.

Composition.—Sulphur and iodine are employed in the proportion of their atomic weights, the compound being regarded as *subiodide of sulphur*, S_2I_2. Guthrie (1861) obtained this compound in tabular crystals by acting with subchloride of sulphur, S_2Cl_2, upon iodide of ethyl, C_2H_5I.

Off. Prep.—Ungu. sulphuris iodidi, *U. S.*, *Br.*

Medical Action and Uses.—This preparation was originally employed in the treatment of tuberculated *diseases of the skin*, in an ointment which contained from one part of the iodide in twelve, to one part in three, of lard.

It acts as a stimulant or caustic according to the strength of the preparation applied. It is seldom used, chiefly on account of its tendency to become decomposed.

SUMBUL RADIX, *Br.*—SUMBUL ROOT.

Racine de sumbul, Fr.; *Sumbulwurzel, Moschuswurzel*, G.

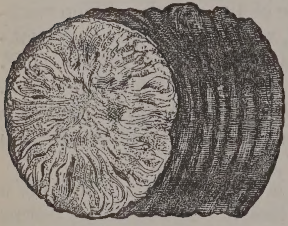
The root of Ferula (Euryangium, *Kauffmann*) sumbul, Hook. fil. Bentley and Trimen, Med. Plants, 131.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The sumbul plant is indigenous to Turkestan, Bucharia, Eastern Siberia, and probably to other parts of Central Asia, and was discovered by Fedschenko (1869) in the mountains of Maghian, southeastward of Samarkand. It is a perennial growing to the height of eight feet, and has large, triangular, tripinnate radical leaves, and a few small cauline leaves, the upper ones being reduced to sheathing bracts. The flowers are polygamous, and the fruit is about one-half inch long, oblong-oval, dorsally compressed, and when ripe, is free from oil tubes, but in the unripe state has in each mericarp four large dorsal and two small commissural vittæ.

Description.—Sumbul root enters commerce by way of Russia, and is met with in transverse segments, varying in diameter from one inch to four or five inches, and in thickness from three-quarters of an inch to two inches, occasionally intermixed with pieces scarcely one-quarter of an inch in diameter. The root is light, of a spongy texture, annulate or with longitudinal wrinkles, covered with a thin brown bark, is internally whitish, sprinkled with yellowish-brown resinous dots, and consists of white parenchyma and pale-brownish fibro-vascular bundles, which are irregular-wavy, and more numerous near the bark than in the centre. Sumbul root breaks with an irregular, farinaceous and fibrous fracture, and has a strong persistent musk-like odor and a bitter aromatic taste.

Fig. 187.



Sumbul root.

Constituents.—The ethereal tincture of sumbul root, on being evaporated and treated with alcohol, leaves waxy matter behind, and on evaporating the alcoholic solution Reinsch's (1848) *sumbul balsam* is obtained, which on being heated in a narrow tube acquires a green, afterwards blue color, and subsequently yields oily distillates of a yellow, green, and blue color, and containing umbelliferon. When added to sulphuric acid, the balsam acquires a purple color, and after having been heated with potassa, it yields to a small quantity of water angelicate of potassium, the potassium salt of *sumbulamic acid* remaining undissolved. Valerianic acid is probably likewise contained in the resinous extract. Murawjeff (1853) reported having obtained from sumbul root an alkaloid, *sumbulina*, yielding crystallizable salts. The chemistry of sumbul root requires further researches.

Allied Root.—In India a root is said to be employed as sumbul root which, according to Pereira, differs from the Russian root, in being of a closer texture, firmer, denser, and of a more reddish tint. It does not appear to be met with in European or American commerce.

Off. Prep.—Tinctura sumbul, *Br.*

Medical Uses.—This root was first employed in Russia, about 1840, as a specific for cholera, how uselessly the history of that disease demonstrates. Afterwards its strong musky odor led to its being used in various functional nervous disorders, including *hysteria* and *delirium tremens.* Its combined resin and essential oil caused it to be employed in mucous profluvia such as chronic *bronchitis*, *leucorrhœa*, and *gleet.* It is now but little used. The *dose* of the root in powder is from ten to twenty grains. The tincture is officinal in Great Britain.

SUPPOSITORIA.—SUPPOSITORIES.

Suppositoires, Fr.; *Stuhlzäpfchen*, G.

Suppositories are solid medicinal preparations intended to be introduced into the rectum or vagina, and of such a consistence that they will slowly melt at the temperature of the body or liquefy in the presence of moisture. The material best adapted for the vehicle is undoubtedly butter of cacao, since at ordinary temperatures it is sufficiently firm to be handled, and at the same time has such a low fusing point that it will slowly but completely liquefy after introduction into the rectum. In addition to this, it is not prone to become rancid, and may be mixed with most medicinal substances commonly employed in this form of medication without having its fusing point lowered. The volatile oils, camphor, carbolic acid, creasote, and chloral hydrate, exert a marked influence upon the consistence of cacao butter, and liquefy with it at a temperature lower than its fusing point. But even these substances may be added in small quantities without occasioning unusual trouble in preparing the suppositories; if, however, added in full medicinal doses, the cacao butter may be replaced by about 10 per cent. of spermaceti.

In the selection of the base for suppositories, the United States Pharmacopœia very properly follows the French Codex, while the British Pharmacopœia employs a mixture of cacao butter and wax, or curd soap with powdered starch, or with starch and glycerite of starch. Another vehicle, which is more particularly adapted for vaginal suppositories, is a combination of three parts of gelatin, seven of glycerin, and one of alcohol, as proposed by H. B. Brady.

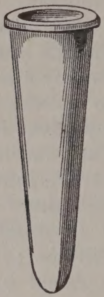
The size of suppositories adopted by the different pharmacopœias varies very much; their weight, according to the British Pharmacopœia, being 15 grains; according to the United States Pharmacopœia, 30 grains; and according to the French Codex, 5, or sometimes 10 grams (75 or 150 grains).

Preparation.—Suppositories are prepared by the following general formula: Mix the medicinal portion with a small quantity of Oil of Theobroma, by rubbing them together, and add the mixture to the remainder of the oil of theobroma previously melted and cooled to the temperature of 95° F. Then mix thoroughly without applying more heat, and immediately pour the mixture into suitable moulds, having the capacity of thirty grains each. The moulds, previously made cold, must be kept so by immersion in iced-water. All difficulty in removing suppositories from the moulds may be obviated by having the moulds previously dusted with lycopodium. In the absence of suitable moulds, suppositories may be formed by allowing the mixture, prepared as above, to cool, care being taken to keep the ingredients well mixed, and dividing it into parts, each of which shall weigh thirty grains, and may be made into a conical or other convenient form for a suppository. *U. S.*

These directions are sufficiently minute for the proper preparation of suppositories having cacao butter for their base. The directions of the British Pharmacopœia, when other vehicles are used, are given below. In making suppositories with gelatin, this material is well soaked in water, and when thoroughly saturated and softened, is melted together with the requisite quantity of glycerin, and the fused mass is mixed with the alcohol containing the medicinal substance in solution or suspension. Since tannin forms an insoluble compound with gelatin, drugs owing their virtues to tannin cannot be combined with this vehicle, which is likewise not well adapted for various salts unless the amount of gelatin be somewhat increased.

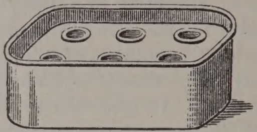
To obtain suppositories of a uniform shape, they are generally moulded. The simplest mould is made of thin writing paper, folded into the shape of a cone, and having the edge secured with a little sealing wax or paste; after the material has solidified, the paper is unrolled. Or the moulds are made of pewter or other suitable metal, and suspended in a tray, which is filled with cold water or fragments of ice to thoroughly chill the moulds before the melted mass is poured out. The suppositories will readily congeal, and may be removed by inverting the mould and striking it suddenly on a slab. Moulds have also been made of brass with a number of conical cavities of the desired size and shape, and arranged in such a manner that after the suppositories have congealed, the mould may be taken apart either by removing the top portion or the sides, when the suppositories are easily lifted or pushed out by slight pressure. Serviceable suppository moulds may be made by the pharmacist from plaster of Paris, as was suggested by Chas. E. Dwight (1872), by pouring the plaster mixed with water to the consistence of thick cream into a suitable vessel, and inserting into the soft mass a suitable number of wax suppositories in such a manner that the broad end is near one side, and the suppositories are immersed only to one-half their diameter. When the plaster has set, the wax is removed, the surface is smoothed with a knife, taking care that the edges of each mould be sharp, and small cavities are dug between the depressions. This represents one-half of the mould, the surface of which is well greased, and after replacing the wax, the other half is obtained by pouring mixed plaster upon the greased surface to the depth of an inch or more. When hard the two parts can be easily separated, the edges trimmed off, and each part boiled for about an hour in linseed oil, which will prevent the adhesion of the substance to be moulded. The adhesion of suppositories to metallic moulds sometimes causes inconvenience; it is frequently due to the imperfect cleaning or to insufficient chilling of the moulds, and may be prevented by dusting them lightly with lycopodium.

Fig. 188.



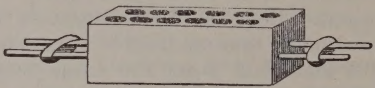
Suppository mould.

Fig. 189.



Tray for suppository moulds.

Fig. 190.



Suppository mould.

In making suppositories it is of importance that the medicinal ingredients are uniformly mixed with the vehicle, and if not soluble in the latter, the rapid congelation of the mixture after it has been poured into the moulds is absolutely necessary. The difficulty thus experienced has led many pharmacists to abandon this method, and to prepare suppositories by a process rendering fusion of the cacao butter unnecessary. This vehicle is either grated or by means of a sharp knife cut into very thin slices, and mixed by trituration, either in a mortar or on a slab, with the other ingredients; in this condition the mass may be easily rolled out in the same manner as a pill mass, and cut into the requisite number of pieces, each of which is then shaped into a cone by means of a spatula. Several apparatuses have been constructed by means of which the mass, as obtained by mixing the cold ingredients, may be compressed into conical moulds. The simplest machine for this purpose has been constructed by Prof. Emlen Painter (1878), and is very similar to Remington's machine for compressed pills, figured on page 1066, from which it differs in the greater thickness of the cylinder, and in the conical shape of the cavity used for compressing the material.

Urethral suppositories are made in precisely the same manner as those intended for use in the rectum or vagina, the chief difference being in the shape, which should be cylindrical and slender, and in the greater stiffness of the vehicle. J. L. Lemberger (1871) made use of the well-known candle-mould, modified merely by making the tubes much smaller; and others have forced the mixture of cacao butter, wax, and medicinal substances through a narrow tube, and cut the cylinders thus obtained into pieces of a suitable length.

SUPPOSITORIA ACIDI CARBOLICI, *U. S.*—
SUPPOSITORIES OF CARBOLIC ACID.

Suppositoires d'acide phénique, Fr.; *Carbolsäure-Stuhlzäpfchen*, G.

Preparation.—Take of Carbolic Acid twelve grains; Oil of Theobroma three hundred and forty-eight grains; Water a sufficient quantity. Mix the carbolic acid previously dissolved in a few drops of water thoroughly with sixty grains of the oil of theobroma, and then, having melted the remainder of the oil of theobroma, proceed according to directions given in the general formula at page 1345. *U. S.*

These suppositories, as adopted by the British Pharmacopœia, have a different vehicle, and are recognized under the name *Suppositoria acidi carbolici cum sapone.* The following is the formula:—

Take of Carbolic acid twelve grains; Curd Soap in powder one hundred and eighty grains; Starch in powder a sufficiency. Mix the carbolic acid with the soap, and add sufficient starch to form a paste of suitable consistence. Divide the mass into twelve equal parts, each of which is to be made into a conical or other convenient form for a suppository.

Medical Uses.—The American differs from the English preparation in being of rather firmer consistence. This suppository is disinfectant and stimulant, and may be used in chronic *dysentery*, *hemorrhoids*, *cancer*, and other diseases of the *rectum*, attended with mucous, purulent, or bloody secretions, or with fetor.

SUPPOSITORIA ACIDI TANNICI, *U. S.*, *Br.*—
SUPPOSITORIES OF TANNIC ACID.

Suppositoires de tannin, Fr.; *Tannin-Stuhlzäpfchen*, G.

Preparation.—Take of Tannic Acid sixty grains; Oil of Theobroma three hundred grains. Mix the tannic acid thoroughly with sixty grains of the oil of theobroma, and then, having melted the remainder of the oil of theobroma, proceed according to the directions given in the general formula at page 1345. *U. S.*

Take of Tannic Acid thirty-six grains; Benzoated Lard forty-four grains; White Wax ten grains; Oil of Theobroma ninety grains. Melt the wax and oil of theobroma with a gentle heat, then add the tannic acid and benzoated lard previously rubbed together in a mortar, and mix all the ingredients thoroughly. Pour the mixture while it is fluid into suitable moulds of the capacity of fifteen grains; or the fluid mixture may be allowed to cool, and then be divided into twelve equal parts, each of which shall be made into a conical or other convenient form for a suppository. *Br.*

The British Pharmacopœia has adopted another formula as follows, under the designation of

Suppositoria acidi tannici cum sapone.—Take of Tannic Acid thirty-six grains; Glycerin of Starch fifty grains; Curd Soap in powder one hundred grains; Starch in powder a sufficiency. Mix the tannic acid with the glycerin of starch and soap, and add sufficient starch to form a paste of suitable consistence. Divide the mass into twelve equal parts, each of which is to be made into a conical or other convenient form for a suppository. *Br.*

Medical Uses.—Tannic acid suppositories are chiefly used to allay rectal or vaginal irritation, diminish local discharges, and constringe the flabby mucous membrane of these parts.

SUPPOSITORIA ALOES, *U. S.*—SUPPOSITORIES OF ALOES.

Suppositoires d'aloès, Fr.; *Aloe-Stuhlzäpfchen*, G.

Preparation.—Take of Purified Aloes in very fine powder sixty grains; Oil of Theobroma three hundred grains. Mix the aloes thoroughly with sixty grains of the oil of theobroma, and then, having melted the remainder of the oil of theobroma, proceed according to directions given in the general formula at page 1345. *U. S.*

The corresponding suppositories of the French Codex weigh 5 grams and contain 0.5 grams (7½ grains) of powdered aloes.

Medical Uses.—It may very well be doubted whether this suppository operates as a laxative otherwise than by its mechanical irritation of the rectum, just as soap, or molasses candy acts. No sufficient reason for it exists.

SUPPOSITORIA ASSAFŒTIDÆ, *U. S.*—SUPPOSITORIES OF ASAFETIDA.

Suppositoires d'asa fœtida, Fr.; *Asafœtida-Stuhlzäpfchen*, G.

Preparation.—Take of Tincture of Asafetida a fluidounce; Oil of Theobroma three hundred and twenty grains. Expose the tincture of asafetida to the air, in a capsule, in a moderately warm place, and allow it to evaporate spontaneously until reduced to the consistence of a thick syrup. Mix this thoroughly with sixty grains of the oil of theobroma, and then, having melted the remainder of the oil of theobroma, proceed according to directions given in the general formula at page 1345. *U. S.*

Medical Uses.—This suppository is an extremely convenient means of administering asafetida to persons who are unable or unwilling to swallow, as frequently happens in *hysterical* attacks. It is an appropriate agent for relieving *tympany* and overcoming *constipation*, and also for allaying irritation in the pelvic organs.

SUPPOSITORIA BELLADONNÆ, *U. S.*—SUPPOSITORIES OF BELLADONNA.

Suppositoires calmants (de belladone), Fr.; *Belladonna-Stuhlzäpfchen*, G.

Preparation.—Take of Alcoholic Extract of Belladonna six grains; Oil of Theobroma three hundred and fifty-four grains; Water a sufficient quantity. Having rubbed the extract of belladonna into a smooth paste, with the addition of a drop or two of water, mix it thoroughly with sixty grains of the oil of theobroma, and then, having melted the remainder of the oil of theobroma, proceed according to directions given in the general formula at page 1345. *U. S.*

Medical Uses.—Belladonna suppositories form one of the most efficient means of allaying or removing pain in the pelvic viscera, and have the advantage over opium suppositories that they do not tend to constipate. They are especially adapted to relieve *irritation* in the *bladder*, *urethra*, *ovaries*, *uterus*, *vagina*, or *rectum*, and *neuralgia* of these parts and even of the sciatic nerve.

SUPPOSITORIA HYDRARGYRI, *Br.*—MERCURIAL SUPPOSITORIES.

Suppositoires mercuriels, Fr.; *Mercurial-Stuhlzäpfchen*, G.

Preparation.—Take of Ointment of Mercury sixty grains; Benzoated Lard and White Wax, each twenty grains; Oil of Theobroma eighty grains. Melt the benzoated lard, wax, and oil of theobroma with a gentle heat, then add the ointment of mercury, and, having mixed all the ingredients thoroughly, without applying more heat, immediately pour the mixture, before it has congealed, into suitable moulds of the capacity of fifteen grains; or the fluid mixture may be allowed to cool, and then be divided into twelve equal parts, each of which shall be made into a conical or other convenient form for a suppository. *Br.*

Medical Uses.—These suppositories appear to have been contrived for the purpose of affecting the system with mercury when for any reason it cannot be administered by the mouth.

SUPPOSITORIA MORPHIÆ, *U. S.*, *Br.*—SUPPOSITORIES OF MORPHIA.

Suppositoires morphinés, Fr.; *Morphin-Stuhlzäpfchen*, G.

Preparation.—Take of Sulphate of Morphia six grains; Oil of Theobroma three hundred and fifty-four grains. Mix the sulphate of morphia thoroughly with sixty grains of the oil of theobroma, and then, having melted the remainder of the oil of theobroma, proceed according to directions given in the general formula at page 1345. *U. S.*

Take of Hydrochlorate of Morphia six grains; Benzoated Lard sixty-four grains; White Wax twenty grains; Oil of Theobroma ninety grains. Melt the wax and oil of theobroma with a gentle heat, then add the hydrochlorate of morphia and benzoated lard previously rubbed together in a mortar, and mix all the ingredients thoroughly. Pour the mixture while it is fluid into suitable moulds of the capacity of fifteen grains; or the fluid mixture may be allowed to cool, and then divided into twelve equal parts, each of which shall be made into a conical or other convenient form for a suppository, which will contain half a grain of hydrochlorate of morphia. *Br.*

The British Pharmacopœia has adopted another formula, the product being of the same strength as the preceding :—

Suppositoria morphiæ cum sapone.—Take of Hydrochlorate of Morphia six grains; Glycerin of Starch fifty grains; Curd Soap in powder one hundred grains; Starch in powder a sufficiency. Mix the hydrochlorate of morphia with the glycerin of starch and soap, and add sufficient starch to form a paste of suitable consistence. Divide the mass into twelve equal parts, each of which is to be made into a conical or other convenient form for a suppository. *Br.*

Medical Uses.—Each of these suppositories contains half a grain of sulphate or hydrochlorate of morphia, which is quite too large a dose for ordinary use.

SUPPOSITORIA OPII, *U. S.*—SUPPOSITORIES OF OPIUM.

Suppositoires d'opium, Fr.; *Opium-Stuhlzäpfchen*, G.

Preparation.—Take of Extract of Opium twelve grains; Oil of Theobroma three hundred and forty-eight grains; Water a sufficient quantity. Having rubbed the extract of opium into a smooth paste, with the addition of a few drops of water, mix it thoroughly with sixty grains of the oil of theobroma, and then, having melted the remainder of the oil of theobroma, proceed according to directions given in the general formula at page 1345. *U. S.*

Medical Uses.—Each suppository contains one grain of extract of opium. This proportion is too small, if that of morphia in the suppositories containing it is correct. Evidently the one or the other formula is erroneous. One-fifth of a grain of morphia is regarded as the equivalent of a grain of extract of opium; and, as morphia is more absorbable than opium from the rectum, the relative dose of the former should be less than that of the latter. We believe that the error consists in the proportion of morphia in the suppositories containing it being about twice too large. It would be more convenient for the practitioner if the officinal directions for making suppositories corresponded to the general custom, which is to keep them on hand containing the various appropriate constituents in different proportions.

Opium suppositories are very convenient in all cases requiring a local anodyne or inhibitory impression upon the rectum, and also when the administration of opium by the mouth is contraindicated.

SUPPOSITORIA PLUMBI, *U. S.*—SUPPOSITORIES OF LEAD.

Suppositoires d'acétate de plomb, Fr.; *Bleizucker-Stuhlzäpfchen*, G.

Preparation.—Take of Acetate of Lead, in very fine powder, thirty-six grains; Oil of Theobroma three hundred and twenty-four grains. Mix the acetate of lead thoroughly with sixty grains of the oil of theobroma, and then, having melted the remainder of the oil of theobroma, proceed according to directions given in the general formula at page 1345. *U. S.*

Medical Uses.—These suppositories are more frequently required for the *vagina* than for the *rectum*, and especially in the ulcerative and catarrhal disorders affecting the former organ or the vaginal portion of the uterus. Diseases of the rectum in which they would be appropriate are more favorably influenced by suppositories of lead and opium.

SUPPOSITORIA PLUMBI ET OPII, *U. S.*—SUPPOSITORIES OF LEAD AND OPIUM.

Suppositoria plumbi composita, Br.—*Compound lead suppositories*, E.; *Suppositoires de plomb opiacés*, Fr.; *Stuhlzäpfchen von Opium und Bleizucker*, G.

Preparation.—Take of Acetate of Lead, in very fine powder, thirty-six grains; Extract of Opium six grains; Water a sufficient quantity. Having rubbed the acetate of lead and extract of opium into a smooth paste, with the addition of a few drops of water, mix it thoroughly with sixty grains of the oil of theobroma, and then, having melted the remainder of the oil of theobroma, proceed according to directions given in the general formula at page 1345. *U. S.*

Take of Acetate of Lead thirty-six grains; Opium in powder twelve grains; Benzoated Lard forty-two grains; White Wax ten grains; Oil of Theobroma eighty grains. Melt the wax and oil of theobroma with a gentle heat, then add the other ingredients previously rubbed together in a mortar, and, having mixed them thoroughly, pour the mixture while it is fluid into suitable moulds of the capacity of fifteen grains, or the fluid mixture may be allowed to cool, and then be divided into twelve equal parts, each of which shall be made into a conical or other convenient form for a suppository. *Br.*

Medical Uses.—The combined astringent, soporific, and anodyne qualities of these suppositories render them appropriate in many affections of the *rectum*, *vagina*, and *uterus*, attended with altered secretion and pain, such as *leucorrhœa*, *diarrhœa*, *dysentery*, *cancer*, &c.

SYMPHYTUM.—COMFREY ROOT.

Radix symphyti, *Radix consolidæ majoris*.—*Consoude*, Fr.; *Schwarzwurz*, *Beinwurz*, G.

The root of Symphytum officinale, *Lin.* *Nat. Ord.*—Borraginaceæ.

Origin.—Comfrey is a European perennial growing on the banks of streams and in meadows, and now found in similar places in the United States, where it has escaped from gardens. It is a coarse-looking plant with a bristly stem a foot or two in height, and with lance-ovate or lanceolate alternate and rough leaves, which are narrowed into a winged petiole. The flowers are in racemose cymes, have a five-toothed calyx and a tubular bell-shaped yellowish-white or purplish corolla, with spreading teeth and linear scales closing the throat, and produce four smooth, glossy, brown-black akenes. The flowers appear in June. The root is collected in autumn or early in spring.

Description.—Comfrey root is fleshy, six or eight inches long, nearly an inch thick above, several-headed, tapering, and with few branches. After drying it is deeply wrinkled longitudinally, often bent, of a purplish-black color externally, and breaks readily with an even somewhat waxy fracture, or in damp weather is rather tough. The bark is about one-eighth the diameter of the root, and has a thick black corky layer, the inner bark being whitish. The meditullium consists of broad medullary rays and narrow wood-wedges, and is of a whitish color, or, when old, brownish. Comfrey root is inodorous, and has a mucilaginous, sweetish, and faintly astringent taste.

Constituents.—The most important principle contained in comfrey root appears to be the large quantity of *mucilage*. The root contains also sugar, a little tannin, and a few starch granules, but acquires with iodine only a brown, not a blue color. Plisson (1829) isolated from the root a small quantity of *asparagin*.

Medical Action and Uses.—This plant, which is both demulcent and astringent, was esteemed in ancient times for hastening the cure of bruises and the cicatrization of wounds; hence its name *consolida.* A popular method in France of treating *fissures of the nipple* is to apply a hollow section of the fresh root over the sore organ. A decoction of it is prescribed in *hæmoptysis, hæmaturia, metrorrhagia, diarrhœa,* and *dysentery.*

SYRUPI.—SYRUPS.

Sirops, Fr.; *Syrupe,* G.

Syrups are concentrated solutions of sugar in water, or in aqueous or very slightly alcoholic solutions of medicinal substances. In a few instances vinegar or dilute acetic acid is the solvent, and in Europe certain syrups are made with wine. Syrup made of sugar and water is called *simple syrup;* all others are distinguished as *medicated syrups,* and these may be again classified into *simple* and *compound medicated syrups,* in accordance with the number of drugs represented by them.

Preparation.—In preparing syrups only the best refined sugar should be employed, which is free from impurities, and when dissolved in water less prone to fermentation than partially refined sugar. All pharmacopœias direct most of the syrups to be prepared with the aid of heat. The necessary quantity of sugar is mixed with the liquid, and heat is applied to the mixture until the boiling point is reached, when the sugar will be dissolved, and the syrup is strained for the purpose of removing dust and other accidental impurities that may have been contained in the sugar, and albumen which is coagulated by heat from some aqueous infusions of drugs. A few syrups are directed to be made by dissolving the sugar in the proper liquid without heat, exclusively with the view of avoiding the evaporation of volatile ingredients. But L. Orynski (1871) proposed to extend this process to all syrups, and the method has been found by R. Hunstock (1875) and others not only much easier and more economical than the officinal process, but likewise to yield syrups, which, as a rule, are less liable to ferment. This latter quality may probably be directly referred to the avoidance of heat, since the continued application of heat is known to produce changes in the sugar, resulting in the formation of glucose. Simple syrup made by dissolving the sugar at the boiling point, very soon after it has been prepared, reduces alkaline solutions of copper, showing the formation of grape sugar, while simple syrup made from the same sugar, but without heat, appears to form grape sugar more slowly. This so-called *cold process* for preparing syrups, therefore, deserves the attention of pharmacists. The menstruum is in all cases prepared as directed by the Pharmacopœia; the requisite quantity of sugar is then introduced into a conical percolator, the lower orifice of which is closed with a cork, and into the neck of which a piece of loose sponge, or cotton, previously moistened, is introduced. The liquid is now poured into the percolator and the whole set aside in a moderate temperature until the sugar has been partially dissolved and melted down to about one-half of its original volume, when the cork may be removed and the syrup allowed to drop; it should be perfectly clear and transparent, or the turbid portion returned to the percolator. If the sugar is not all dissolved when the liquid has passed, this is to be again percolated through the sugar. With proper management a repetition of the process will be rarely required. Syrups prepared in this manner, with perfect emulsions, will be opaque.

If heat is employed, as directed by the pharmacopœias for most syrups, the loss occasioned by evaporation should be rectified by the addition of water. This is easily accomplished by taking the weight of the vessel with its contents before and after boiling, and adding enough water to compensate for the loss occasioned by heating. If clarification by means of white of egg should be necessary, this is best added to the cold aqueous liquid. Paper pulp may be used for the same purpose.

The preparation of the aqueous liquid, used for dissolving the sugar, is of great importance. The pharmacopœias have very properly discarded the exhaustion of the crude drugs by boiling them with water, since thereby starch and other principles are dissolved which easily undergo chemical changes and interfere with the stability of the syrups. The United States Pharmacopœia has, for the same reasons, abandoned the employment of hot water in exhausting the drugs. The most stable medicated syrups are obtained if the drug is treated with cold water, diluted alcohol, or alcohol, as the case may be, either by maceration or preferably by percolation. For this part of the process all the precautions are required which have been pointed out in another place (see page 585). The percolate is concentrated, and, if necessary, deprived of alcohol, particular care being required to prevent the evaporation of volatile principles and the change of others by the influence of an elevated temperature (see Extracta and Extracta fluida). Filtration of the concentrated liquid is usually required, and it should be borne in mind that it is much easier to pass a concentrated aqueous infusion of a drug, or an aqueous solution of an alcoholic extract, through a filter, than to perform the same operation with a syrup.

The proper proportion of sugar to menstruum insures the stability of the syrup. Should the sugar be deficient in quantity, it could not efficiently protect the other organic principles contained in the syrup, and it would be liable to ferment. On the other hand, if too much sugar be employed, the excess would crystallize after cooling, and dispose an additional quantity to separate in a like manner, thus leaving the syrup weaker in sugar than it should be, and subject to similar alterations, as if an insufficient quantity of sugar had been used. The proper proportion of sugar is a little less than twice the weight of water, or 19 parts of water to 36 parts of sugar, as directed by the United States Pharmacopœia. For colder climates a little more water may be employed; the German Pharmacopœia directs 20 parts of water to 36 parts of sugar. If the liquid contains already much organic matter in solution, or if it is partially alcoholic, a correspondingly smaller amount of sugar will be required.

A process was recommended by Isaac Davis (1878) in which the principle adopted by Orynski is still further extended. Mr. Davis proposed to make the medicated syrups by percolating the powdered drugs with simple syrup prepared by the cold process.

Preservation.—After syrups have been prepared and allowed to cool, they should be introduced into dry bottles, so as to avoid diluting them with water. They may then generally be kept, even in partially filled bottles, at the ordinary temperatures; but it is best to keep them in a place where the temperature will not vary materially between about 15° and 20° C. (59° and 68° F.). The addition of small quantities of spirit of ether, Hoffmann's anodyne, chlorate of potassium, and more recently of salicylic acid, have been recommended for the purpose of preserving syrups; but all these additions are more or less objectionable, and generally unnecessary if, in the exhaustion of the drug, heat is avoided.

Restoration.—When fermentation sets in, the carbonic acid gas disengaged causes the syrups to assume a frothy appearance and to have a vinous odor. As soon as these signs make their appearance the syrup should be heated to boiling, strained, and afterwards properly preserved. The medicinally active principles will rarely have undergone any alteration, except in the case of syrups of acacia and of almond; but syrups which owe their virtues wholly or in part to volatile principles cannot be thus restored without being impaired in their properties. For syrups prone to fermentation the employment of glycerin in place of a corresponding quantity of liquid and sugar has been recommended.

Properties.—Syrups should be perfectly transparent, with the few exceptions noted below. When heated to boiling, they have the density indicated by 30° B. = 1.26 (*Codex*). At 15.5° C. (60° F.) the density of simple syrup is 1.317 (*U. S.*), 1.330 (*Br.*), and most of the medicated syrups have about the same specific gravity. If introduced into bottles while hot, the upper stratum, from the evaporation and condensation of water, will be less dense and more prone to fermentation, unless well agitated after the contents have become cold. The employment of carbonate of magnesium in the preparation of syrups renders them unfit for being dispensed with salts of morphia, strychnia, or other poisonous alkaloids (see Aquæ medicatæ, p. 202).

SYRUPUS, *U. S.*, *Br.*—SYRUP.

Syrupus simplex, P. G.; *Syrupus sacchari s. albus.*—*Simple syrup*, E.; *Sirop de sucre*, *Sirop simple*, Fr.; *Weisser Syrup*, G.

Preparation.—Take of Sugar in coarse powder thirty-six troyounces; Distilled Water a sufficient quantity. Dissolve the sugar, with the aid of heat, in twenty fluidounces of distilled water, raise the temperature to the boiling point, and strain the solution while hot. Then incorporate with the solution a sufficient quantity of distilled water, added through the strainer, to make the syrup measure two pints and twelve fluidounces, or weigh fifty-five troyounces. Syrup thus prepared has the specific gravity 1.317. *U. S.*

Take of Refined Sugar five pounds; Distilled Water two pints. Dissolve the sugar in the water with the aid of heat, and add, after cooling, as much distilled water as may be necessary to make the weight of the product seven pounds and a half. The specific gravity should be 1.330. *Br.*

Pharmaceutical Uses.—Simple syrup is used in the preparation of some confections, mixtures, and syrups, and as an excipient in several pill masses.

SYRUPUS ACACIÆ, *U. S.*—SYRUP OF GUM ARABIC.

Syrupus gummosus, P. G.—*Sirop de gomme*, Fr.; *Gummisyrup*, G.

Preparation.—Take of Gum Arabic in pieces two troyounces; Sugar in coarse powder fourteen troyounces; Water eight fluidounces. Dissolve the gum Arabic in the water, without heat; then, having added the sugar, dissolve it with a gentle heat and strain. *U. S.*

The German Pharmacopœia directs the syrup to be made by mixing one part of mucilage of gum with three parts of simple syrup. The formula of the French Codex is similar, but the syrup is to be previously evaporated until, while boiling, it has the density 1.30 = 33° B.

Medical Uses.—Syrup of gum Arabic is chiefly used to aid in suspending more active substances in mixtures, and impart an agreeable flavor to them, as a demulcent in catarrhal affections of the throat and larynx, and as a palatable addition to drinking water.

SYRUPUS ACIDI CITRICI, *U. S.*—SYRUP OF CITRIC ACID.

Sirop d'acide citrique, Fr.; *Citronsäuresyrup*, G.

Preparation.—Take of Citric Acid in fine powder one hundred and twenty grains; Oil of Lemon four minims; Syrup two pints. Rub the citric acid and oil of lemon with a fluidounce of the syrup; then add the mixture to the remainder of the syrup, and dissolve with a gentle heat. *U. S.*

This syrup is similar to lemon syrup. Its flavor would be considerably improved if tincture of fresh lemon peel was used in place of oil of lemon.

Medical Uses.—This syrup is used as a flavoring ingredient chiefly. It is intended as a substitute for lemon syrup made from the recent fruit, for which, however, it is by no means an equivalent.

SYRUPUS ALLII, *U. S.*—SYRUP OF GARLIC.

Syrop d'ail, Fr.; *Knoblauchsyrup*, G.

Preparation.—Take of Garlic sliced and bruised six troyounces; Sugar in coarse powder twenty-four troyounces; Diluted Acetic Acid a pint. Macerate the garlic with ten fluidounces of the diluted acetic acid, in a glass vessel, for four days, and express the liquid. Then mix the residue with the remainder of the acid, and again express until sufficient additional liquid has been obtained to make the whole, when filtered, measure a pint. Lastly, introduce the sugar into a two-pint bottle, pour upon it the filtered liquid, and agitate until it is dissolved. *U. S.*

Thus prepared, syrup of garlic is somewhat opalescent and has the odor of the drug in a marked degree.

Medical Uses.—This is the form in which garlic is generally employed internally. It is very commonly used in subacute and chronic *catarrhs* of the respiratory passages in children and infants, and particularly in the decline of *whooping-cough.* The *dose* is about a teaspoonful.

SYRUPUS AMYGDALÆ, *U. S.*—SYRUP OF ALMOND.

Syrupus emulsivus.—*Sirop d'orgeat* (*d'amandes, emulsif*), Fr.; *Mandelsyrup*, G.

Preparation.—Take of Sweet Almond twelve troyounces; Bitter Almond four troyounces; Sugar in coarse powder seventy-two troyounces; Water three pints. Having blanched the almonds, rub them in a mortar to a very fine paste, adding, during the trituration, three fluidounces of the water and twelve troyounces of the sugar. Mix the paste thoroughly with the remainder of the water, strain with strong expression, add to the strained liquid the remainder of the sugar, and dissolve it with the aid of a gentle heat. Lastly, strain the solution through muslin, and, having allowed it to cool, keep it in well-stopped bottles in a cool place. *U. S.*

In order to obtain a white syrup, the complete removal of the integuments of the seeds is required, for which purpose the almonds are for a few minutes steeped in warm water, when the so-called skins are easily separated. In France and Germany, one-twelfth of the water is replaced by orange-flower water.

Medical Uses.—Almond or orgeat syrup is an agreeable addition to expectorant and diuretic mixtures, and is possibly a feeble sedative of mild forms of febrile and nervous disorder, through the minute proportion of hydrocyanic acid it contains. It is much used, mixed with water, in irritations of the *urinary passages.*

SYRUPUS AURANTII CORTICIS, *U. S.*—SYRUP OF ORANGE PEEL.

Syrupus aurantii, Br.—*Sirop d'écorces d'oranges*, Fr.; *Orangenschalensyrup*, G.

Preparation.—Take of Sweet Orange Peel recently dried and in moderately fine powder two troyounces; Carbonate of Magnesium half a troyounce; Sugar in coarse powder twenty-eight troyounces; Alcohol, Water, each a sufficient quantity. Moisten the orange peel with half a fluidounce of alcohol, introduce it into a conical percolator, and pour alcohol upon it until six fluidounces of tincture have passed. Evaporate this portion at a temperature not above 120° F., to two fluidounces, add the carbonate of magnesium and a troyounce of the sugar, and rub them together, gradually adding half a pint of water during the trituration. Then filter the liquid, and, having added sufficient water to make it measure a pint, dissolve in it the remainder of the sugar with the aid of a gentle heat, and strain. *U. S.*

Take of Tincture of Orange Peel one fluidounce; Syrup seven fluidounces. Mix. *Br.*

The syrup prepared by the first formula is an agreeable preparation of pleasant flavor, but the employment of carbonate of magnesium is objectionable for reasons stated above (page 1354). The corresponding syrups of the French and German Pharmacopœias are made with bitter orange peel, which according to the former authority is exhausted with alcohol of 6 per cent., and according to the latter with white wine; in the tinctures thus obtained the sugar is dissolved.

Off. Prep.—Confectio sulphuris, *Br.*; Trochisci ipecacuanhæ.

Medical Uses.—This syrup is merely an agreeable flavoring ingredient of medicinal mixtures. Its more decided taste, as compared with that of lemon and other simple officinal syrups, constitutes its special advantage.

SYRUPUS AURANTII FLORUM, *U. S.*—SYRUP OF ORANGE FLOWERS.

Syrupus aurantii floris, Br.—*Sirop de fleurs d'oranger*, Fr.; *Pomeranzenblüthensyrup*, G.

Preparation.—Take of Orange Flower Water twenty fluidounces; Sugar in coarse powder thirty-six troyounces. Dissolve the sugar in the orange flower water, with the aid of a gentle heat. *U. S.*

Take of Orange Flower Water eight fluidounces; Refined Sugar three pounds; Distilled Water sixteen fluidounces, or a sufficiency. Dissolve the sugar in the distilled water by means of heat; strain, and when nearly cold add the orange flower water, with a sufficient quantity of distilled water, if necessary, to make the product four pounds and a half. The specific gravity should be 1.330. *Br.*

Medical Uses.—Syrup of orange flowers is a pleasant flavoring agent, with a possibility of exercising a slight sedative influence upon morbidly sensitive persons, since one-half of it consists of orange flower water.

SYRUPUS CHLORAL, *Br. Add.*—SYRUP OF CHLORAL.

Sirop de chloral, Fr.; *Chloral syrup*, G.

Preparation.—Take of Hydrate of Chloral eighty grains; Distilled Water four fluidrachms; Simple Syrup a sufficiency. Dissolve the hydrate of chloral in the water, and add the syrup until the mixed product measures a fluidounce. *Br.*

Medical Uses.—This preparation is a convenient vehicle for the administration of chloral in definite doses. Each fluidrachm of it contains ten grains of hydrate of chloral. The ordinary *dose* is from half a fluidrachm to one fluidrachm.

SYRUPUS FERRI IODIDI, *U. S.*, *Br.*—SYRUP OF IODIDE OF IRON.

Syrupus ferri iodati, P. G.—*Sirop d'iodure de fer*, Fr.; *Eisenjodürsyrup*, G.

Preparation.—Take of Iodine two troyounces; Iron in the form of wire and cut in pieces three hundred grains; Distilled Water three fluidounces; Syrup a sufficient quantity. Mix the iodine, iron, and distilled water in a flask of thin glass, shake the mixture occasionally until the reaction ceases, and the solution has acquired a green color and lost the smell of iodine. Then, having introduced a pint of syrup into a graduated bottle, heat it by means of a water-bath to 212° F., and, through a small funnel inserted in the mouth of the bottle, filter into it the solution already prepared. When this has passed, close the bottle, shake it thoroughly, and, when the liquid has cooled, add sufficient syrup to make the whole measure twenty fluidounces. Lastly, again shake the bottle, and transfer its contents to two-ounce vials, which must be well stopped. *U. S.*

Take of Fine Iron Wire one ounce; Iodine two ounces; Refined Sugar twenty-eight ounces; Distilled Water thirteen fluidounces. Prepare a syrup by dissolving the sugar in ten ounces of the water with the aid of heat. Digest the iodine and the iron wire in a flask, at a gentle heat, with the remaining three ounces of the water, till the froth becomes white; then filter the liquid while still hot into the syrup, and mix. The product should weigh two pounds eleven ounces, and should have the specific gravity 1.385. *Br.*

On bringing iodine together with an excess of iron in the presence of water, as directed in the above formulas, ferrous iodide is formed and dissolves with a pale green color. This compound has the formula FeI_2 and the molecular weight 310, and contains very nearly 82 per cent. of iodine. The aqueous solution is prone to change; but when protected by sugar, as proposed by Frederking (1839), and preserved with some precautions, it keeps unaltered. The details of the process as given by the above two formulas are nearly alike, except that the syrup of the British Pharmacopœia is denser. The iron solution should not be filtered until it has a pale green color entirely free from any brown tint. The filtrate, being denser than the warm syrup, will sink in the latter, and thus be protected from atmospheric influences; subsequent agitation will insure a mixture of uniform strength.

Syrup of iodide of iron is of a pale green color, which, on exposure to the air, slowly changes to yellow and afterwards to brown; the change of color proceeding from the exposed surface downwards. Diffused daylight seems to somewhat accelerate the decomposition; but exposure to the direct sunlight entirely prevents the change, or, if it has taken place, restores the original color, and finally renders the syrup colorless. The effects of oxidation become manifest first by the production of ferric compound, and soon afterwards by the liberation of iodine recognized by the blue color produced with starch paste; subsequently hydrate of iron containing variable quantities of iodine is precipitated, and, after a short time, this precipitate is not wholly redissolved again under the influence of sunlight, though the solution becomes colorless, perhaps from the formation of hydriodic acid. The application of heat has a similar effect. Syrups of the density of the above officinal syrups are not easily affected by exposure to the air, and we have known them to be kept in half-filled vials for months without apparent change. But if, from want of attention to the details of the process, the syrup should become colored from iodine, we prefer to restore it by exposure to sunlight, in preference to using a hyposulphite or other deoxidizing agent.

Should the iron used in preparing the solution of ferrous iodide be contaminated with other metals, these are likely to be dissolved. We have occasionally observed the syrup to contain a minute quantity of copper. On evaporating the syrup with due care to dryness, a yellowish-white powder is obtained, which is again soluble in water, yielding a slightly turbid solution.

The strength of this syrup varies in the different Pharmacopœias: 1 part of iodine (= 1.2 part of ferrous iodide) being represented by about 12.5 (*U. S.*), 21.5 (*Br.*), 25 (*P. G.*), and 235 (*F. P.*) parts of the syrup. Old syrup of iodide of iron contains grape sugar in larger proportion than is found in simple syrup or in most other syrups of the same age.

Medical Uses.—For the treatment of *scrofula*, especially of the glandular form, in those numerous cases in which *anæmia* is owing to scrofula, tuberculosis, or syphilis; and in chronic affections of the *skin*, chronic *rheumatism*, *amenorrhœa* from exhaustion, *leucorrhœa*, &c., this compound was at one time greatly in vogue. It is now, however, very probable that its virtues in the greater number of those diseases depend more upon the iron than upon the iodine in its composition. This syrup may be given in *doses* of from ten to forty drops after meals. It should be largely diluted with water, and taken through a tube to prevent its injuring the teeth. As an additional precaution the mouth should be rinsed with water after each dose.

SYRUPUS FERRI PHOSPHATIS, *Br.*—SYRUP OF PHOSPHATE OF IRON.

Sirop de phosphate de fer, Fr.; *Eisenphosphatsyrup*, G.

Preparation.—Take of Granulated Sulphate of Iron two hundred and twenty-four grains; Phosphate of Soda two hundred grains; Acetate of Soda seventy-four grains; Diluted Phosphoric Acid five and a half fluidounces; Refined Sugar eight ounces; Distilled Water eight fluidounces. Dissolve the sulphate of iron in four ounces of the water, and the phosphate and acetate of soda in the remainder; mix the two solutions, and, after careful stirring, transfer the precipitate to a calico filter, and wash it with distilled water till the filtrate ceases to be affected by chloride of barium. Then press the precipitate strongly between folds of bibulous paper, and add to it the diluted phosphoric acid. As soon as the precipitate is dissolved, filter the solution, add the sugar, and dissolve without heat. The product should measure exactly twelve fluidounces. *Br.*

Sulphate of iron and phosphate of sodium react on each other, forming ferrous phosphate and sulphate of sodium. The resulting free sulphuric acid, which would keep a portion of the ferrous sulphate in solution, acts upon the sodium acetate, resulting in the production of sodium sulphate and free acetic acid, in which the ferrous phosphate is insoluble. (See Ferris Phosphas, p. 628.) After washing and expressing, the ferrous phosphate is dissolved in phosphoric acid, and this solution is converted into syrup, which is therefore presumed to contain acid ferrous phosphate. But during the washing the originally white precipitate has turned blue from the formation of ferroso-ferric phosphate; and this oxidation continues in the syrup notwithstanding the protective influence of the sugar. The change produced in the color of the syrup on exposure is thus accounted for.

The French Codex recognizes a *syrup of pyrophosphate of iron*, and directs it to be made by dissolving 10 parts of the officinal pyrophosphate of iron in 20 parts of water, and adding 970 parts of simple syrup. This syrup contains 1 per cent. of the salt, and has a green color.

Numerous other formulas for syrups containing phosphate of iron in solution, have been proposed, in some of which the free phosphoric acid has been wholly or partly replaced by hydrochloric acid, resulting in the formation of ferric chloride. H. W. Jones (1874) showed that a more satisfactory syrup is obtained by preparing the ferrous phosphate from iron and phosphoric acid; and E. B. Shuttleworth (1876) proposed the following formula: 38 grains of clean iron filings or fine iron wire are dissolved in a mixture of 6 fluidrachms each of water and phosphoric acid spec. grav. 1.5; the solution is filtered as soon as the iron is dissolved and mixed with 8½ fluidounces of simple syrup. Thus prepared, it is free from ferric salt, but otherwise represents the officinal syrup, and contains one grain of phosphate in the fluidrachm. Mr. Howie (1877) suggested dispensing with the acetate of sodium of the officinal formula, mixing the solutions of the other two salts while boiling hot, letting the mixture cool to about 50° C. (122° F.) and adding 45 grains of bicarbonate of sodium; the precipitate is washed with boiling water by decantation, and subsequently treated as directed in the officinal formula.

Among the compound syrups of phosphate of iron, the most commonly employed is that proposed by Edward Parrish (1857), and known as *Syrupus phosphatium compositus* or *Chemical food.* His formula is as follows: 600 grains of ferrous sulphate and 720 grains of sodium phosphate are separately dissolved in boiling water, the solutions mixed, and the precipitate thoroughly washed; 720 grains of calcium phosphate are dissolved in four ounces of hot water with the aid of hydrochloric acid, the solution is precipitated by ammonia, and the precipitate well washed. The recently obtained phosphates are dissolved in 1200 grains of glacial phosphoric acid previously dissolved in water; 40 grains of carbonate of sodium and 60 grains of carbonate of potassium are added to the solution, and if a precipitate should form, it is redissolved by sufficient hydrochloric, or, preferably, by phosphoric acid. The solution is now diluted with water to 20 fluidounces, 120 grains of powdered cochineal and 36 troyounces of sugar are added, and when the latter is dissolved, the syrup is strained and flavored with 10 minims of oil of orange. Each teaspoonful is stated to contain about 1 grain of phosphate of iron, 2½ grains of phosphate of calcium, and smaller proportions of the phosphates of sodium and potassium. E. C. Saunders (1876), however, showed that a syrup thus prepared cannot contain the amounts of phosphates stated, and proposed to dissolve 240 grains of fine iron wire in 3 ounces (avoirdupois) of tribasic phosphoric acid spec. grav. 1.75, and 4 ounces of water; 923 grains of recently slaked lime in 9½ ounces of phosphoric acid, and 14 ounces of water; and 54 grains of crystallized sodium carbonate and 72 grains of potassium carbonate in half an ounce of the phosphoric acid and 1 ounce of water. The three solutions are mixed and diluted with water to the measure of 28 fluidounces; the mixture, with 52 ounces of sugar and 85 grains of powdered cochineal, is made into a syrup, and this is flavored with two fluidounces of orange-flower water, and diluted with water to 64 fluidounces.

Another compound syrup frequently employed is *Eaton's syrup*, prescribed as *Syrupus ferri quiniæ et strychniæ phosphatis*, which is prepared as follows: 300 grains of ferrous sulphate and 480 grains of sodium phosphate are dissolved separately each in 4 fluidounces of hot water, the solutions are mixed, the precipitate washed with warm water, and then carefully pressed between bibulous paper as long as water is absorbed. 192 grains of sulphate of quinia are dissolved in 4 fluidounces of water with the aid of dilute sulphuric acid, the solution is precipitated by weak ammonia water until in slight excess, and the precipitate treated like the iron phosphate. The quinia thus obtained, with 6 grains of strychnia, is dissolved in 8 fluidounces of dilute phosphoric acid, and the iron phosphate in 6 fluidounces of the same acid, the solutions are mixed, and 14 troyounces of sugar are dissolved in the liquid. Thus prepared, it will after some time deposit ferric phosphate, which is avoided by the addition of ½ ounce of syrupy phosphoric acid. The above is Aitken's formula, somewhat modified by Charles Bullock (1867). The syrup contains in each fluidrachm about ¾ grain of ferrous phosphate, 1 grain of quinia phosphate, and $\frac{1}{32}$ grain of strychnia. E. C. Saunders (1876) proposed to prepare the ferrous phosphate for this syrup by dissolving the requisite quantity of fine iron wire in phosphoric acid.

Medical Uses.—This is a convenient and mild preparation of iron, which is assumed to have a special influence upon the nervous system. The *dose* is one fluidrachm. Other non-officinal syrups have been devised, such as those above described, in which, besides phosphorus and iron, are contained lime, soda, and potassa, or else quinia and strychnia. The latter are the most efficient. They have the disadvantage, in many cases, however, of confining the bowels.

SYRUPUS FUSCUS, *U. S.*—MOLASSES.

Theriaca, Br.; *Sacchari fæx, Syrupus communis s. hollandicus.—Treacle*, E.; *Mélasse, Pyromel*, Fr.; *Melasse, Brauner Syrup*, G.

The impure dark-colored syrup obtained in making sugar from Saccharum officinarum. *U. S.*

The uncrystallized residue of the refining of sugar. *Br.*

Origin and Properties.—The manner in which molasses is obtained is described on page 1208. That variety procured in the preparation of raw sugar is in the United States usually designated as *West India molasses*, while that drained from refined sugar is known as *sugar-house molasses*. Both kinds closely resemble each other, except that the former is of a lighter color, and has a different, somewhat empyreumatic flavor. Molasses is a brown, thick, fermentable, uncrystallizable syrup of a very sweet taste, and having a specific gravity of about 1.40. It contains about 75 per cent. of solid matter, of which from 5 to 7 per cent. are salts. The molasses of beet-root sugar, according to Landolt (1868), contains 56 to 64 per cent. of sugar and about 20 per cent. of oxalate, tartrate, and malate of potassium.

Pharmaceutical Uses.—Molasses is employed as an excipient in the preparation of some pill masses.

Medical Uses.—Molasses, or treacle, as it is called in England, is rather a food than a medicine. Apart from its pharmaceutical uses, it is seldom employed medicinally except as an ingredient of the common domestic enema, which consists usually of a pint of warm water to which a wineglassful or more of molasses and a heaped tablespoonful of salt have been added. It is a popular remedy for superficial *burns*, which it protects as well as oil.

SYRUPUS HEMIDESMI, *Br.*—SYRUP OF HEMIDESMUS.

Sirop de hemidesmus, Fr.; *Hemidesmussyrup*, G.

Preparation.—Take of Hemidesmus root bruised four ounces; Refined Sugar twenty-eight ounces; Boiling Distilled Water one pint. Infuse the hemidesmus in the water, in a covered vessel, for four hours, and strain. Set it by till the sediment subsides; then decant the clear liquor, add the sugar, and dissolve by means of a gentle heat. The product should weigh two pounds ten ounces, and should have the specific gravity 1.335. *Br.*

Medical Uses.—The syrup of Indian sarsaparilla probably possesses no definite or peculiar medicinal virtues; it is used chiefly as a flavoring agent.

SYRUPUS IPECACUANHÆ, *U. S.*—SYRUP OF IPECACUANHA.

Sirop d'ipécacuanha, Fr.; *Ipecacuanhasyrup*, G.

Preparation.—Take of Fluid Extract of Ipecacuanha two fluidounces; Syrup thirty fluidounces. Mix them. *U. S.*

A clear syrup cannot be obtained by this formula, if the fluid extract has been prepared as directed by the Pharmacopœia (see page 596). Better results are obtained if the fluid extract is diluted with twelve fluidounces of water, the turbid mixture rendered clear by filtration, and the filtrate converted into syrup by dissolving in it twenty-six troyounces of sugar. The syrup should measure thirty-two fluidounces.

The syrup of the German Pharmacopœia represents one per cent. of its weight of ipecacuanha root, and that of the French Codex $\frac{1}{10}$ per cent. of extract of ipecacuanha.

Medical Uses.—This syrup is used chiefly as an emetic for infants, and as an expectorant in cases of acute *laryngitis* and *bronchitis*. For the former purpose the dose is from a half to one fluidrachm, repeated every ten minutes until it operates; and for the latter it may be given to infants and children in doses of from five to twenty drops, and to adults in double that quantity. It forms a very useful ingredient of expectorant mixtures.

SYRUPUS KRAMERIÆ, *U. S.*—SYRUP OF RHATANY.

Syrupus ratanhæ.—*Sirop de ratanhia*, Fr.; *Ratanhasyrup*, G.

Preparation.—Take of Rhatany in moderately fine powder twelve troyounces; Sugar in coarse powder thirty troyounces; Water a sufficient quantity. Mix the rhatany with half a pint of water, and, having allowed the mixture to stand for two hours, introduce it into a glass percolator, and gradually pour water upon it until four pints of liquid are obtained. Evaporate this portion, by means of a water-bath, to seventeen fluidounces, and, having added the sugar, dissolve it with the aid of a gentle heat, and strain the solution while hot.

This syrup may also be prepared in the following manner: Take of Fluid Extract of Rhatany twelve fluidounces; Syrup twenty-four fluidounces. Mix them. *U. S.*

The syrup prepared by either formula is of precisely the same strength, if the fluid extract used in the second formula has been made strictly in accordance with the officinal formula. The syrup of the French Codex is made with the aqueous extract of rhatany, of which it contains 2.5 per cent. of its weight.

Medical Uses.—Syrup of rhatany is chiefly used as a medicine for infants and children affected with *bowel complaints*, independent of organic or inflammatory disease, and is usually associated in mixtures with chalk and other antacids and astringents. The *dose* for a child a year or two old is from one-half to one fluidrachm.

SYRUPUS LACTUCARII, *U. S.*—SYRUP OF LACTUCARIUM.

Sirop de lactucarium, Fr.; *Lactucariumsyrup*, G.

Preparation.—Take of Lactucarium a troyounce; Syrup fourteen fluidounces; Diluted Alcohol a sufficient quantity. Rub the lactucarium with enough diluted alcohol, gradually added, to bring it to a syrupy consistence. Then introduce it into a conical percolator, and, having carefully covered the surface with a piece of muslin, gradually pour diluted alcohol upon it until half a pint of tincture has passed. Evaporate this portion, by means of a water-bath, at a temperature not exceeding 160° F., to two fluidounces; mix it with the syrup, previously heated, and strain while hot. *U. S.*

Thus obtained, syrup of lactucarium is of a turbid and unsightly appearance. Since alkalies destroy the bitter taste of lactucarium (see page 797), neither potassa, soda, nor magnesia should be used in making the syrup. The turbidity is probably due to lactucerin, and may be removed, according to Kenworthy (1868), without impairing the virtues of the syrup, by triturating the concentrated tincture with powdered pumice stone, or, according to Lemberger (1878), by previously exhausting lactucarium with petroleum benzin. Paper pulp or other insoluble material may be used with the same effect; the mixture should be washed upon a filter with water until seven fluidounces are obtained, in which thirteen troyounces of sugar are dissolved. The finished syrup measures sixteen fluidounces.

The French Codex recognizes a *sirop de lactucarium opiacé*, containing in each tablespoonful 0.005 gram ($\frac{1}{14}$ grain) of extract of opium and 0.01 gram ($\frac{1}{7}$ grain) of alcoholic extract of lactucarium.

Medical Uses.—It is very doubtful whether this preparation possesses any hypnotic powers at all. It may be used as a *placebo* for mothers, in certain cases of infantile disorder, in the *dose* of one or more fluidrachms.

SYRUPUS LIMONIS, *U. S.*, *Br.*—SYRUP OF LEMON.

Syrupus succi citri, P. G.—*Sirop de limons* (*de citrons*), Fr.; *Citronensaftsyrup*, G.

Preparation.—Take of Lemon Juice recently expressed and strained a pint; Sugar in coarse powder forty-eight troyounces; Water a pint. Mix the lemon juice and water, and, having added the sugar to the mixture, dissolve it with the aid of a gentle heat, and strain the solution while hot. *U. S.*

Take of Fresh Lemon Peel two ounces; Lemon Juice one pint; Refined Sugar two and a quarter pounds. Heat the lemon juice to the boiling point, and, having put it into a covered vessel with the lemon peel, let them stand until they are cold, then filter and dissolve the sugar in the filtered liquid with a gentle heat. The product should weigh three pounds and a half, and should have the specific gravity 1.34. *Br.*

The second formula yields a more aromatic syrup than the first.

Medical Uses.—This syrup is scarcely medicinal. It is used habitually, with water, as a beverage, and thus forms a pleasant and suitable drink in febrile affections generally, especially when mixed with carbonic-acid water.

SYRUPUS MORI, *Br.*—SYRUP OF MULBERRIES.

Syrupus mororum.—*Sirop de mûres*, Fr.; *Maulbeersaftsyrup*, G.

Preparation.—Take of Mulberry Juice one pint; Refined Sugar two pounds; Rectified Spirit two and a half fluidounces. Heat the mulberry juice to the boiling point, and when it has cooled filter it. Dissolve the sugar in the filtered liquid with a gentle heat, and add the spirit. The product should weigh three pounds six ounces, and should have the specific gravity 1.33. *Br.*

This and all other syrups of acid fruit juices should be prepared only in porcelain or well-enamelled iron vessels. The heating of the juice to the boiling point has for its object the removal of the albumen.

The fruit syrups of the French Codex are prepared in a similar manner; but those of the German Pharmacopœia, with the exception of lemon syrup, are made by bruising the fruits to a pulpy mass, and keeping this loosely covered for about three days, during which time fermentation commences; the juice is then expressed and set aside until it has become clear by fermentation, when nine parts of sugar are dissolved in five parts of the clarified juice. Fermentation of the fruit juices removes not only the albumen, but likewise the fermentable sugars and mucilaginous compounds, and the syrups prepared in this manner are of a fine flavor and not prone to fermentation. *Syrupus cerasi*, Cherry syrup; *Syr. rhamni catharticæ*, Buckthorn syrup, and *Syr. rubi idæi*, Raspberry syrup, are prepared in this manner.

Medical Uses.—In this country syrups made from currants, raspberries, and strawberries are as commonly used as mulberry syrup and mulberry wine are in England. This syrup has no therapeutic virtues which are not possessed by the other syrups mentioned.

SYRUPUS PAPAVERIS, *Br.*—SYRUP OF POPPIES.

Syrupus capitum papaveris, Syrupus diacodii.—*Sirop de pavot blanc*, Fr.; *Beruhigungssaft*, G.

Preparation.—Take of Poppy Capsules, dried, freed from the seeds, and coarsely powdered, thirty-six ounces; Rectified Spirit sixteen fluidounces; Refined Sugar four pounds; Boiling Distilled Water a sufficiency. Mix the poppy capsules with four pints of the water, and infuse for twenty-four hours, stirring them frequently; then pack them in a percolator, and adding more of the water allow the liquor slowly to pass until about two gallons have been collected or the poppies are exhausted. Evaporate the liquor by a water-bath until it is reduced to three pints. When quite cold, add the spirit, let the mixture stand for twelve hours, and filter. Distil off the spirit, evaporate the remaining liquor to two pints, and then add the sugar. The product should weigh six pounds and a half, and should have the specific gravity 1.32. *Br.*

The concentrated infusion of poppy contains much mucilage, which is precipitated by the alcohol. This syrup is less liable to ferment than if prepared from an infusion not subjected to the treatment with alcohol. The syrup of the German Pharmacopœia bearing the same name is prepared from the hot infusion of three parts each of poppy capsules and St. John's bread (the fruit of Ceratonia siliqua, *Lin.*, also called *Siliqua dulcis*), and 2 parts of liquorice root, evaporated to 15 parts, and in these 25 parts of sugar are dissolved. On account of the variable composition of poppy capsules, the French Codex has very properly replaced this syrup by a *sirop d'opium*, which is made by dissolving 2 parts of extract of opium in 8 parts of water, and mixing the solution with 990 parts of simple syrup.

Medical Uses.—The variable proportion of opium in poppy capsules renders this preparation uncertain in its effects, and, therefore, capable of doing serious injury to young children, the class of persons it is intended for especially. It is far better to add a definite proportion of a liquid preparation of opium or of morphia to syrup of acacia or of wild-cherry, if a weak anodyne or narcotic action is required. The *dose* of this syrup is stated to be half a fluidrachm for young children.

SYRUPUS PRUNI VIRGINIANÆ, *U.S.*—SYRUP OF WILD-CHERRY.

Sirop d'écorce de cérisier, Fr.; *Wildkirschenrindensyrup*, G.

Preparation.—Take of Wild-Cherry in coarse powder five troyounces; Sugar in coarse powder twenty-eight troyounces; Water a sufficient quantity.

Moisten the wild-cherry thoroughly with water, and allow it to stand for twenty four hours in a close vessel; then pack it firmly in a glass percolator, and gradually pour water upon it until a pint of filtered liquid is obtained. To this, transferred to a bottle, add the sugar, and agitate occasionally until it is dissolved. *U. S.*

The treatment of wild-cherry bark with cold water results in the production of hydrocyanic acid and oil of bitter almonds (see page 1147), which, together with the bitter and astringent principles, are contained in the syrup.

Medical Uses.—Syrup of wild-cherry has no peculiar medicinal virtues, but is a most agreeable flavoring addition to mixtures. It is often added to such under the impression that it may aid in appeasing cough. The *dose* is a fluidrachm or more.

SYRUPUS RHAMNI, *Br.*—SYRUP OF BUCKTHORN.

Syrupus rhamni cathartici, s. Syr. spinæ cervinæ, s. Syr. domesticus, P. G. —*Sirop de nerprun,* Fr.; *Kreuzdornbeerensyrup, G.*

Preparation.—Take of Buckthorn Juice four pints; Ginger sliced, Pimento bruised, each three-quarters of an ounce; Refined Sugar five pounds, or a sufficiency; Rectified Spirit six fluidounces. Evaporate the juice to two pints and a half, add the ginger and pimento, digest at a gentle heat for four hours, and strain. When cold add the spirit, let the mixture stand for two days, then decant off the clear liquor, and in this dissolve the sugar with a gentle heat, so as to make the specific gravity 1.32. *Br.*

The syrups of the French and German Pharmacopœias are made with the juice not concentrated by evaporation, and do not contain any aromatics.

Medical Uses.—In Europe syrup of buckthorn is generally used as a purgative for children, in the *dose* of a teaspoonful.

SYRUPUS RHEI, *U. S.*, *Br.*—SYRUP OF RHUBARB.

Sirop de rhubarbe, Fr.; *Rhabarbersaft,* G.

Preparation.—Take of Fluid Extract of Rhubarb three fluidounces; Syrup twenty-nine fluidounces. Mix them thoroughly. *U. S.*

Take of Rhubarb Root in coarse powder, Coriander Fruit in coarse powder, each two ounces; Refined Sugar twenty-four ounces; Rectified Spirit eight fluidounces; Distilled Water twenty-four fluidounces. Mix the rhubarb and coriander; pack them in a percolator; pass the spirit and water, previously mixed, slowly through them; evaporate the liquid that has thus passed until it is reduced to thirteen fluidounces, and in this, after it has been filtered, dissolve the sugar with a gentle heat. *Br.*

The German Pharmacopœia orders this syrup to be prepared by macerating for twelve hours 12 parts of sliced rhubarb, 3 parts of bruised cinnamon, and 1 part of carbonate of potassium in 100 parts of water, straining, filtering, and dissolving in 80 parts of the filtrate 144 parts of sugar. Thus prepared it is of a rich brownish-red color, while by the first two formulas it is obtained of a deep brown, and is somewhat opaque.

Medical Uses.—The simple syrup of rhubarb is seldom used; but it may be given as a purgative to infants in the *dose* of a fluidrachm.

SYRUPUS RHEI AROMATICUS, *U. S.*—AROMATIC SYRUP OF RHUBARB.

Spiced syrup of rhubarb, E.; *Sirop de rhubarbe aromatique*, Fr.; *Gewürzter Rhabarbersaft*, G.

Preparation.—Take of Rhubarb in moderately fine powder two troyounces and a half; Cloves in moderately fine powder, Cinnamon in fine powder, each half a troyounce; Nutmeg in moderately fine powder one hundred and twenty grains; Syrup six pints; Diluted Alcohol a sufficient quantity. Mix the powders, and, having moistened the mixture with two fluidounces of diluted alcohol, introduce it into a conical percolator, and pour diluted alcohol upon it until a pint of tincture has passed. Add this to the syrup, previously heated, and mix them thoroughly. *U. S.*

The mixed powders should be slowly percolated to insure their complete exhaustion. The finished syrup has an agreeable odor, a spicy and bitterish but pleasant taste, and is somewhat opaque in appearance.

Medical Uses.—This preparation is in universal use as a purgative for children in *diarrhœa* attended with flatulence and colic. The *dose* is one fluidrachm.

SYRUPUS RHŒADOS, *Br.*—SYRUP OF RED POPPY.

Sirop de coquelicot (*de pavot rouge*), Fr.; *Klatschrosensaft*, G.

Preparation.—Take of Fresh Red Poppy Petals thirteen ounces; Refined Sugar two and a quarter pounds; Distilled Water one pint or a sufficiency; Rectified Spirit two and a half fluidounces. Add the petals gradually to the water heated in a water-bath, frequently stirring, and afterwards, the vessel being removed, infuse for twelve hours. Then press out the liquor, strain, add the sugar, and dissolve by means of heat. When nearly cold, add the spirit, and as much distilled water as may be necessary to make up for loss in the process, so that the product shall weigh three pounds ten ounces. It should have the specific gravity 1.33. *Br.*

The addition of alcohol to the finished syrup is designed to counteract its tendency to fermentation. The syrup is of a deep red color.

Medical Uses.—The syrup of red poppy is an opiate preparation of uncertain strength, and, being only used for coloring mixtures, it appears to be superfluous. The *dose* is a fluidrachm.

SYRUPUS ROSÆ GALLICÆ, *U. S.*, *Br.*—SYRUP OF RED ROSE.

Syrupus rosarum rubrarum.—*Sirop de roses rouges*, Fr.; *Rosensyrup*, G.

Preparation.—Take of Red Rose in moderately fine powder two troyounces; Sugar in coarse powder eighteen troyounces; Diluted Alcohol, Water, each a sufficient quantity. Moisten the rose with diluted alcohol, pack it firmly in a conical glass percolator, and gradually pour diluted alcohol upon it until a fluidounce of tincture has passed. Set this aside, and continue the percolation until five fluidounces more of tincture are obtained. Evaporate this portion with a gentle heat to a fluidounce and a half, and mix it with seven fluidounces of water. Then, having added the sugar, dissolve it with the aid of a gentle heat, and strain the solution while hot. Lastly, add the reserved tincture to the solution when it is cold, and mix them thoroughly. *U. S.*

Take of Dried Red Rose Petals two ounces; Refined Sugar thirty ounces; Boiling Distilled Water one pint. Infuse the petals in the water for two hours, squeeze through calico, heat the liquor to the boiling point, and filter. Dissolve the sugar in the liquor by means of heat. The product should weigh two pounds fourteen ounces, and should have the specific gravity 1.335. *Br.*

The syrup is of a fine red color, and has an agreeable, somewhat astringent taste.

Medical Uses.—It is used almost exclusively for giving an agreeable color and flavor to other syrups and to mixtures. *Dose*, a fluidrachm.

SYRUPUS RUBI, *U. S.*—SYRUP OF BLACKBERRY.

Sirop d'écorce de ronce noire, Fr.; *Brombeerrindensyrup*, G.

Preparation.—Take of Fluid Extract of Blackberry half a pint; Syrup a pint and a half. Mix them. *U. S.*

This syrup has a deep reddish-brown color and a strongly astringent taste.

Medical Uses.—As a remedy for slight *diarrhœa*, independent of irritants in the intestine and of inflammatory conditions of that organ, syrup of blackberry root is a convenient astringent. But the syrup is generally less appropriate than the decoction. Its *dose* is one or two fluidrachms.

SYRUPUS SARSAPARILLÆ COMPOSITUS, *U. S.*—COMPOUND SYRUP OF SARSAPARILLA.

Sirop de salsepareille composé, Sirop sudorifique, Fr.; *Zusammengesetzter Sarsaparillsyrup*, G.

Preparation.—Take of Sarsaparilla in moderately fine powder twenty-four troyounces; Guaiacum Wood in moderately fine powder three troyounces; Pale Rose in moderately fine powder, Senna in moderately fine powder, Liquorice Root in moderately fine powder, each two troyounces; Oil of Sassafras, Oil of Anise, each five minims; Oil of Gaultheria three minims; Sugar in coarse powder ninety-six troyounces; Water a pint; Diluted Alcohol a sufficient quantity. Mix the solid ingredients, except the sugar, with three pints of Diluted Alcohol, and allow the mixture to stand for four days; then transfer it to a cylindrical percolator, and gradually pour diluted alcohol upon it until six pints of tincture have passed. Evaporate this portion, by means of a water-bath, to three pints; add the water, filter, and, having added the sugar, dissolve it with the aid of heat, and strain the solution while hot. Lastly, rub the oils with a small portion of the solution, and mix them thoroughly with the remainder. *U. S.*

By careful percolation with diluted alcohol, the medicinal principles of the drugs ordered in the above formula are thoroughly extracted, perhaps, with the exception of the resin contained in guaiacum wood, and are not injured if the alcohol of the tincture is evaporated at a heat not exceeding the temperature attainable by a water-bath. In the watery liquid now remaining, the resinous matters which were dissolved by the alcohol are insoluble, and are removed by filtration; the filtrate, therefore, contains only the extractive matters of guaiacum wood, but none, or only little, of its resin. The syrup is of a dark-brown color, has an agreeable flavor, and leaves an acrid impression in the throat.

The syrup of the French Codex is made by hot infusion of sarsaparilla, borage flowers, pale rose, senna, and anise; it is known as *sirop de Cuisinier*.

The syrup of the German Pharmacopœia is likewise prepared by hot infusion, but contains sarsaparilla, guaiacum wood, sassafras root, China root, pale cinchona, and anise.

Medical Uses.—Compound syrup of sarsaparilla has been extensively used in the treatment of constitutional *syphilis;* but there is no evidence whatever to prove its efficiency, when given alone. For this reason, probably, it is omitted in the British Pharmacopœia. It is a convenient vehicle for the administration of iodide of potassium. Corrosive sublimate, which is sometimes added to it, is converted by it into calomel. The *dose* is half a fluidounce, diluted, several times a day.

SYRUPUS SCILLÆ, *U. S.*, *Br.*—SYRUP OF SQUILL.

Sirop de scille, Fr.; *Meerzwiebelsyrup*, G.

Preparation.—Take of Vinegar of Squill a pint; Sugar in coarse powder twenty-four troyounces. Dissolve the sugar in the vinegar of squill, with the aid of a gentle heat, and strain the solution while hot. *U. S.*

Take of Vinegar of Squill one pint (imperial); Refined Sugar two and a half pounds (avoirdupois). Dissolve with the aid of heat. *Br.*

Vinegar of squill contains albumen in solution, which is coagulated on dissolving the sugar with the aid of heat, and renders the syrup turbid. It is best removed from the vinegar by heating it to boiling and filtering, when, on dissolving the sugar, the syrup will be clear.

Medical Uses.—This syrup is an adequate representative of squill—at least in its action upon the bronchial mucous membrane. It is much used in the treatment of laryngeal and bronchial *catarrhs*, both for promoting the resolution of such affections, and, in children, when used in appropriate doses, for producing emesis, and thereby expelling accumulated secretions from the air-passages. It is habitually associated with syrup of ipecacuanha, or syrup of senega, according to the nature of the case. The *dose*, as an expectorant, is from half a fluidrachm to a drachm, and in the latter quantity it is an emetic when repeated at short intervals.

SYRUPUS SCILLÆ COMPOSITUS, *U. S.*—COMPOUND SYRUP OF SQUILL.

Sirop de scille composé, Fr.; *Zusammengesetzter Meerzwiebelsyrup*, G.

Preparation.—Take of Squill in moderately fine powder, Seneka in moderately fine powder, each four troyounces; Tartrate of Antimony and Potassium forty-eight grains; Sugar in coarse powder forty-two troyounces; Diluted Alcohol, Water, each a sufficient quantity. Mix the squill and seneka, and, having moistened the mixture with half a pint of diluted alcohol, allow it to stand for four days. Then transfer it to a conical percolator, and pour diluted alcohol upon it until a pint of the tincture has passed. Boil this for a few minutes, evaporate it by means of a water-bath to half a pint, add fourteen fluidounces of boiling water, and filter. Dissolve the sugar in the filtered liquid, and, having heated the solution to the boiling point, strain it while hot. Then dissolve the tartrate of antimony and potassium in the solution while still hot, and add sufficient boiling water, through the strainer, to make it measure three pints. Lastly, mix the whole thoroughly together. *U. S.*

Percolation with diluted alcohol exhausts squill and seneka thoroughly. The boiling of the tincture is probably intended to remove any albumen which may have been taken up. After the evaporation of the alcohol, the pectin compounds of the senega are sometimes separated in considerable quantity, so as to impede filtration. On the addition of a little alkali, or after trituration with magnesia, filtration proceeds more rapidly; but the alkali, if dissolved in sufficient quantity, will then cause a decomposition of the tartar emetic. Trituration with some inert and insoluble substance before filtration is, therefore, preferable. The tartar emetic is best dissolved in a small quantity of boiling water before it is mixed with the syrup. When carefully prepared, the syrup will keep well. It has been stated that by dissolving the sugar in the cold filtrate fermentation is entirely prevented.

This syrup is known as *hive syrup* and *croup syrup*, and is an officinal substitute for *Coxe's hive syrup*, which was made by boiling the drugs in water, and preserving the liquid by honey.

Medical Uses.—The union of squill, seneka, and tartar emetic in this preparation renders it expectorant, diaphoretic, emetic, and, in full doses, purgative also. It was originally devised for the treatment of "croup," or "hives," whence its popular name, "hive syrup." It is not appropriate, however, for membranous croup, but only for the affection which is properly called *spasmodic laryngitis*, and which it relieves mainly by its nauseant, and therefore antispasmodic action. Care must be taken in employing it not to allow its sedative operation to proceed too far. It may be prescribed in this affection in *doses* of from ten to thirty drops, repeated at intervals of ten minutes, or until its nauseant or emetic operation is developed. In acute *bronchitis* with inadequate secretion it should be administered in similar doses, but at longer intervals, so as to keep within the limits of both nausea and vomiting.

SYRUPUS SENEGÆ, *U. S.*—Syrup of Seneka.

Sirop de polygala, Fr.; *Senegasyrup*, G.

Preparation.—Take of Seneka in moderately fine powder four troyounces; Sugar in coarse powder fifteen troyounces; Diluted Alcohol two pints. Moisten the seneka with two fluidounces of the diluted alcohol; then transfer it to a conical percolator, and gradually pour on it the remainder of the diluted alcohol. When the tincture has ceased to pass, evaporate it, by means of a water-bath, at a temperature not exceeding 160° F., to half a pint; then filter, and, having added the sugar, dissolve it with the aid of a gentle heat, and strain the solution while hot. *U. S.*

As is the case with the preceding syrup, the separation of the pectin compounds sometimes occasions difficulty in filtration, which may be overcome in the same manner as there stated.

Medical Uses.—The syrup of seneka is a very useful medicine in subacute and chronic bronchitis and laryngitis, in the *dose* of one or two fluidrachms.

SYRUPUS SENNÆ, *Br.*—Syrup of Senna.

Sirop de séné, Fr.; *Sennasyrup*, G.

Preparation.—Take of Senna broken small sixteen ounces; Oil of Coriander three minims; Refined Sugar twenty-four ounces; Distilled Water five pints, or a sufficiency; Rectified Spirit two fluidounces. Digest the senna in seventy ounces of the water for twenty-four hours at a temperature of 120° F.; press out the liquor and strain it. Digest the marc in thirty ounces of the water for six hours at the same temperature; again press out the liquor and strain it. Evaporate the mixed liquors in a water-bath to ten fluidounces, and, when cold, add the rectified spirit, previously mixed with the oil of coriander. Clarify by filtration, and wash what remains on the filter with distilled water, until the washings make up the filtrate to sixteen fluidounces. Then add the sugar, and dissolve by means of a gentle heat. The product should weigh two pounds ten ounces, and should have the specific gravity 1.31. *Br.*

The weights and measures in the above formula are those of the British Pharmacopœia, and each fluidounce of the syrup represents the virtues of nearly half an ounce (219 grains) of senna.

Syrupus sennæ cum mannæ, P. G., which is frequently prescribed by German practitioners, is made by infusing for several hours 10 parts of senna and 1 part of fennel in 50 parts of hot water, expressing the liquid, and dissolving in it 15 parts of manna. The solution is allowed to settle, decanted, and in 55 parts of it 50 parts of sugar are dissolved.

Medical Uses.—This is a mild and efficient cathartic for children in the *dose* of from one to four fluidrachms.

SYRUPUS TOLUTANUS, *U. S.*, *Br.*—SYRUP OF TOLU.

Sirop de baume de tolu, Sirop balsamique, Fr.; *Tolubalsamsyrup*, G.

Preparation.—Take of Tincture of Tolu two fluidounces; Carbonate of Magnesium one hundred and twenty grains; Sugar in coarse powder twenty-six troyounces; Water a pint. Rub the tincture of tolu first with the carbonate of magnesium and two troyounces of the sugar, then with the water, gradually added, and filter. To the filtered liquid add the remainder of the sugar, and, having dissolved it with the aid of a gentle heat, strain the solution while hot. *U. S.*

Take of Balsam of Tolu one and a quarter ounce; Refined Sugar two pounds; Distilled Water one pint, or a sufficiency. Boil the balsam in the water for half an hour in a lightly covered vessel, stirring occasionally. Then remove from the fire, and add distilled water, if necessary, so that the liquid shall measure sixteen ounces. Filter the solution when cold, add the sugar, and dissolve with the aid of a steam or water-bath. The product should weigh three pounds, and should have the specific gravity 1.33. *Br.*

The first formula is objectionable on account of the use of magnesium carbonate. The objection to the second formula is in the boiling, by which the tolene is volatilized. Digesting the tolu balsam with water, as directed by the French Codex, appears to be preferable. The syrup is used in preparing Trochisci cubebæ, *U. S.*

Instead of syrup of tolu, the German Pharmacopœia recognizes *syrupus balsami peruviani, s. syrupus balsamicus*, which is prepared by digesting 1 part of balsam of Peru in 11 parts of water, decanting and filtering when cold, and dissolving 18 parts of sugar in 10 parts of the filtrate.

Medical Uses.—The medicinal virtues of this preparation are exceedingly feeble, if, indeed, it possess any. But its agreeable flavor renders it an eligible associate of other and less palatable syrups, especially such as are used in bronchial catarrhs. *Dose*, a fluidrachm.

SYRUPUS ZINGIBERIS, *U. S.*, *Br.*—SYRUP OF GINGER.

Sirop de gingembre, Fr.; *Ingwersyrup*, G.

Preparation.—Take of Fluid Extract of Ginger a fluidounce; Carbonate of Magnesium one hundred and sixty grains; Sugar in coarse powder seventy-two troyounces; Water forty-two fluidounces. Rub the fluid extract of ginger first with the carbonate of magnesium and two troyounces of the sugar, and then with the water, gradually added, and filter. To the filtered liquid add the remainder of the sugar, and, having dissolved it with the aid of a gentle heat, strain the solution while hot. *U. S.*

Take of Strong Tincture of Ginger six fluidrachms; Syrup nineteen fluidounces. Mix with agitation. *Br.*

Made by the first formula the syrup is nearly clear, but contains magnesia in solution and only a small quantity of the resin, to which the burning taste of ginger is due. The second formula obviates both objections. A syrup intended to represent the full virtues of ginger will be turbid, but the resin can be better diffused in the syrup by incorporating the tincture or fluid extract with the sugar, exposing the mixture in a warm atmosphere until most of the alcohol has evaporated, and then dissolving it in the water in the usual manner. The syrup is used in preparing Trochisci zingiberis, *U. S.*

Medical Uses.—It is chiefly employed as a flavoring ingredient of mixtures, but is most suitable as an addition to those which are intended to relieve colic by causing an expulsion of flatus. *Dose*, a fluidrachm or more.

TABACUM, *U. S.*—TOBACCO.

Tabaci folia, Br.; *Folia nicotianæ*, P. G.—*Leaf tobacco*, E.; *Nicotiane*, *Tabac*, Fr.; *Tabaksblätter*, G.

The commercial dried leaves of Nicotiana tabacum, *Lin.* Steph. and Church, Med. Bot., plate 37; Bentley and Trimen, Med. Plants, 191.

Nat. Ord.—Solanaceæ.

Origin.—The tobacco plant is indigenous to tropical America; but the country which originally produced it cannot now be ascertained, since tobacco is now unknown in the wild state. The seeds were sent to Spain in 1518 by Fra Romano Pane, and reached France in 1560 from Lisbon through the French ambassador, Jean Nicot. The cultivation of tobacco was commenced in Holland in 1615, soon afterwards in England, and about fifty years later in the Palatinate. About the same period, or a little earlier, it appears to have been introduced into China. At present tobacco is very extensively cultivated in most temperate and subtropical countries. During 1875 there were over 559,000 acres of land planted in the United States, yielding 367,000,000 pounds of tobacco. The annual production of tobacco in all countries has been estimated at about 3,000,000 tons.

N. tabacum attains a height of four or six feet, has a stout, viscidly hairy stem, shortly stalked or sessile amplexicaul and alternate leaves, and terminal panicles of dull pink or reddish flowers, consisting of a tubular, bell-shaped, five-toothed calyx, a funnel-shaped corolla, about two inches long, with a spreading five-lobed border, and five stamens and a conical ovary. The capsule is about an inch long, opens by two valves, is two-celled, and contains a large number of minute, somewhat reniform, pale-brown seeds. Nicotiana macrophylla *Sprengel*, Nic. fruticosa *Lin.*, Nic. petiolata *Ag.* and others are now regarded as varieties of the above species.

Nic. repanda *Willd.* is cultivated in Cuba; Nic. persica *Lindl.* yields the Shiraz or Persian tobacco; and Nic. rustica *Lin.* is the species which is chiefly cultivated in Turkey and India. The last named species is three or four feet high, has oval or ovate entire leaves on petioles about an inch and a half long, and produces greenish-yellow flowers nearly an inch long.

Cultivation.—The plant requires a deep, rich soil, which must be annually well manured; the seeds are sown in beds; and when the young plants are six or eight inches high, they are transplanted to the tobacco fields, and during their growth carefully freed from the larvæ of insects. The flowering tops and branches are broken off before the flowers expand, and when the leaves are fully matured, which takes place about the month of September, the plants are cut, allowed to wilt in the sun, and afterwards cured by being hung up in a drying house and exposed to the heat of a fire. The leaves at first become wet or "sweat," and in the course of several weeks are dried, after which they are stripped from the stems, assorted, gathered up into small parcels, and then are packed into large boxes or hogsheads.

Description.—Tobacco leaves are from six to twenty inches long, and from two to six inches wide, oval or ovate-lanceolate, sometimes rather obovate in form, pointed and acute at the apex, and with an entire margin. In the fresh state they are rather thick, green, and covered with viscid hairs and with small sessile glands; after drying, they are thinner, lighter or darker brown, or mottled with different shades of brown, and friable. The leaves have a thick, prominent midrib, branching under acute angles into lateral veins, which are curved near the margin. The odor of tobacco is peculiar and heavy, and its taste disagreeable, bitter, and acrid.

Constituents.—Tobacco contains a large amount of salts, consisting of sulphates, nitrates, chlorides, phosphates and malates of potassium, calcium, ammonium, and nicotia, and yields from 14 to 18.5 per cent. of ash. Larger amounts have been obtained, sometimes as much as 25 to 27 per cent., a result which is probably due in some cases to dust adhering to the glands, as was suggested by B. F. Creighton (1876). The other constituents of tobacco are albumen, resin, extractive, gum, citric acid (*Goupil*), nicotianin, and nicotina. *Nicotianin* was discovered by Hermbstädt on distilling tobacco with water; it separates from the distillate in the form of white foliaceous crystals, which have an odor resembling that of tobacco smoke, and a warm and bitterish aromatic taste (Posselt and Reimann, 1828). Landerer (1835) obtained nicotianin from the dried but not from the fresh leaves. Barral (1845) stated that it contains 7.12 per cent. of nitrogen.

Nicotina or *nicotia* is the poisonous principle of tobacco, and was discovered by Posselt and Reimann. It may be prepared by exhausting bruised tobacco with acidulated water, concentrating the infusion, adding an excess of potassa, and distilling. According to Ortigosa (1842), the distillate is neutralized with oxalic acid, evaporated to dryness, and the residue exhausted with boiling alcohol, which dissolves oxalate of nicotia. On evaporating the solution to a syrupy consistence and agitating it with potassa and ether, an ethereal liquid is obtained, which, on fractional distillation, yields the alkaloid. This is a colorless oily liquid, having at 15° C. (59° F.) the spec. grav. 1.027, and remaining liquid at —10° C. (14° F.). It has an unpleasant, and when heated a pungent acrid odor, a burning taste, and a strongly alkaline reaction. Exposed to air and light, it rapidly acquires a brown color, and is partly converted into a resinous compound. It boils near 250° C. (482° F.), but distils at a lower temperature, always leaving a residue. Its composition is $C_{10}H_{14}N_2$ (mol. weight 162). It dissolves readily in water, and is separated from this solution by caustic potassa. Alcohol and ether dissolve it in all proportions, and it yields with acids neutral and acid salts, of which the former crystallize with difficulty, and are mostly soluble in weak alcohol, but insoluble in ether. Dried tobacco leaves contain from 2 to 8, and occasionally as high as 11, per cent. of nicotia. The alkaloid is present in all parts of the green plant, as well as in the dried leaves, but according to H. Vohl and H. Eulenberg (1871) not in tobacco smoke. Instead of nicotina, they found chiefly *collodina*, with *pyridin*, *picolin*, and other bases of the same series (see page 961), besides ammonia and traces of ethylamina; and in passing the vapors through potassa solution, hydrocyanic, hydrosulphuric, acetic, formic, butyric, valerianic, carbolic, and probably other acids were retained.

Off. Prep.—Enema tabaci, *Br.;* Infusum tabaci, Oleum tabaci, Ung. tabaci, Vinum tabaci, *U. S.*

History.—The use of tobacco by smoking cigars was practised by the natives of Cuba when that island was discovered in 1492, and pipe smoking was then probably common among the aborigines of this continent, since it was observed in Canada in 1585, and in Florida in the seventeenth century. It was introduced into England in 1586. From these beginnings the use of tobacco spread over the whole world, and in several countries of Europe the imposts upon it furnish the largest item of the national revenue, and it is there, as in this country, one of the most important articles of commerce.

Physiological Action. *On Plants and Animals.*—Tobacco is hostile to all forms of life. Plants confined in rooms where the fermentation of tobacco is conducted, during the manufacture of snuff, soon lose their foliage; and nearly all insects shun tobacco, whence its use to protect woollen fabrics from moths, etc. Herbivorous animals are not readily affected by it, but large doses even by the stomach are fatal to them. When its fumes are thrown into the lungs of animals, or when its decoction is applied to their skin, its poisonous operation is speedily developed. In horses its most striking influence is upon the pulse, which becomes less frequent, and continues to be so for many hours. In dogs it is fatal by arresting, after reducing the action of the heart, and occasioning faintness, trembling, and vomiting.

Nicotia acts poisonously upon all animals. It neither irritates nor cauterizes the skin or the mucous membrane. In small doses it quickens, in large doses checks, respiration, which is also accompanied by a hissing sound attributed to a spasm of the laryngeal and bronchial muscles. It also retards and depresses the pulse when given in full doses. In frogs and snakes, among its poisonous effects tetanic spasm is conspicuous; and in warm-blooded animals, generally, it excites alternate tonic and clonic spasms, followed by general relaxation and trembling. The motor paralysis appears to affect the hinder legs chiefly. When the dose is very large its direct and immediate effects are extreme prostration and death. In some cases it appears to act as an anæsthetic, and in some to occasion pain. Primarily it dilates the pupil, but secondarily may contract it. Sometimes salivation and diuresis are abundant; and in non-lethal doses it is apt to cause vomiting and purging. From these statements it may be inferred that nicotia depresses the heart, quickens the respiration, and excites the muscular system, but its ultimate effect is general exhaustion.

In the death of animals by nicotia "the brain is empty of blood; the stomach is reddened in round spots, so raised and pile-like that they resemble patches of dark Utrecht velvet; the blood is preternaturally fluid; the lungs are pale as the lungs of a calf as we see them suspended in the shambles; while the heart is overburdened with blood, and having little power left for its forcing action, is scarcely contracting, but is feebly trembling, as if, like a conscious thing, it knew equally its own responsibility and its own weakness." (Richardson.)

On Man.—The essential effects of tobacco are best illustrated by the action of nicotia employed experimentally. The following summary represents the effects of doses of nicotia varying from $\frac{1}{32}$ to $\frac{1}{16}$ gr., taken in water. The minutest doses occasion a burning sensation in the tongue, a hot, acrid feeling in the fauces, and a sense of rawness throughout the œsophagus. Salivation is abundant. Small doses produce a sense of heat in the stomach, chest, and head, and even in the fingers, with some excitement of the nervous system; larger ones cause heaviness, giddiness, torpor, sleepiness, indistinct vision, with sensitiveness of the eye to light, imperfect hearing, laborious and oppressed breathing, and dryness of the throat. In forty minutes after the larger doses, a sense of great debility is perceived, the head droops, the pulse rate falls, the face grows pale, the features are relaxed, the limbs seem paralyzed, the hands and feet are cold, the coldness advances gradually toward the trunk, and faintness ends in loss of consciousness. The disorder of the digestive organs manifests itself by eructations, nausea, and even vomiting, the abdomen becomes distended, and an urgent desire is felt to go to stool; wind is discharged and urine voided copiously. The nervous system, after the debilitating influence of the poison has developed itself, shows its condition by muscular spasm, which begins with tremulousness of the extremities, and gradually involves the whole muscular system, including the respiratory muscles, so that the breathing is oppressed, gasping, and incomplete. This enumeration of effects is sufficient to prove that nicotia acts primarily upon the spinal and sympathetic nervous systems, and not upon the brain. It may cause death by direct paralysis of the heart, or more indirectly by paralysis of the respiratory muscles, producing asphyxia. The blood examined during life, of a person under the full influence of tobacco, presents a striking disaggregation of the red corpuscles, which are also less regularly circular than natural, and have jagged or crenated edges. As the poisonous operation passes off, however, the blood regains its normal characters. The action of tobacco itself is so nearly identical with that of nicotia as to render unnecessary a detailed account of it in this place. It, however, is mainly exhibited in muscular relaxation and collapse. In some cases "lethargy" and "insensibility" are mentioned, but the condition is not that of cerebral oppression so much as of cerebral exhaustion. Of other symptoms especially prominent in certain cases of tobacco poisoning, either caused by a single excessive dose or by inordinate indulgence in smoking tobacco, may be mentioned: a rapid followed by a very slow pulse, hiccup, and cold perspiration, profuse diuresis, convulsions without loss of consciousness, sometimes cataleptic and sometimes hysterical, and great numbness as well as impaired motor power of the limbs and of the tongue.

Many cases of fatal poisoning by tobacco are recorded; some of them being due to its being swallowed purposely or accidentally, some to its being used medicinally in an enema, and some to its application to eruptions on the skin. The fatal dose of tobacco, internally, and generally by enema, has varied from the maximum of an ounce or two to a minimum of fifteen grains. It was generally administered in decoction or infusion, as an enema. Nicotia stands next to prussic acid in the rapidity and energy of its poisonous action; but the minimum fatal dose of it is unknown.

A detailed account of the evil effects of the habitually excessive use of tobacco by smoking, snuffing, or chewing, would occupy more space than can be spared for the purpose in this work; but a condensed statement of the principal ones may not be omitted. It lessens the natural appetite, more or less impairs digestion, and induces constipation; while it irritates the mouth and throat, rendering it habitually congested and destroying the purity of the voice. It induces an habitual sense of uneasiness and nervousness, with epigastric sinking or tension, palpitation, hypochondriasis, neuralgia, and frequent urination. Chewing and snuffing tend to cause gastralgia, but smoking neuralgia of the fifth pair. It renders the vision weak and uncertain, causing objects to appear nebulous, or creates muscæ volitantes and similar subjective perceptions. In numerous instances it has produced amaurosis. Similar derangements of hearing occur, with buzzing, ringing, etc., in the ears, and even hallucinations of this sense. Often there is a feeling of a rush of blood to the head, with vertigo, and impairment of attention so as to prevent continuous mental effort; the mind is also apt to be filled with crude and groundless fancies, leading to self-distrust and melancholy. The sleep is frequently restless and disturbed by distressing dreams. It impairs muscular power and co-ordination, probably both by interfering with nutrition, and by exhausting nervous force, and usually keeps down the growth of muscle and the deposit of fat. Doubtless there are many persons who use tobacco in one or more forms who experience few or none of these evils, and whose constitutions seem proof against its mischievous effects; but to the greater number the habitual use of it is more injurious than useful, and it acts upon a certain number, in almost all doses, as a poison.

Medical Uses.—Although the use of tobacco as an external remedy is no longer common, its efficacy is sufficiently well established in several diseases. It has been applied in the treatment of *scabies* in man, and long was used, and perhaps still is, for the same disease in domestic animals; but the risk of producing toxical symptoms when the skin is broken has probably led to its disuse. The same remark applies to other cutaneous eruptions. The bruised fresh leaves of the tobacco plant have been found a local palliative in *urticaria*, *gout*, and *rheumatism*, and the fumes of tobacco have been applied with advantage in the last two disorders. Snuffing has been employed with success in the cure of *nasal polypus*, for the relief of chronic *ophthalmia*, and catarrh of the *frontal sinuses*, and in tropical countries for destroying the *worms* which sometimes breed in the antrum highmorianum and the adjacent parts.

Internally, the smoke of tobacco inhaled is a palliative of nervous *cough* produced by tickling in the larynx or trachea, and has put an end to an attack of *spasmodic laryngitis* in the same manner as other nauseants and cardiac sedatives. A plaster made with strong snuff and tallow is a popular remedy in the same disorder; and has been applied successfully in *laryngismus stridulus*. Obstinate *hiccup* has been arrested by swallowing tobacco smoke, and *dislocations* of the lower jaw and of various joints have been remedied while the patient was relaxed by tobacco fumes.

The relaxing, nauseating, and purgative operation of tobacco has been successfully employed to overcome *obstruction of the bowel* by fecal accumulations. When the usual purgative agents have failed, tobacco cataplasms or enemas may be cautiously employed. It is not certain that *internal herniæ* and *intussusception* have not been relieved by this treatment; but the accurate diagnosis of intestinal obstructions is very difficult, and care must be taken not to exhaust the patient by heroic measures while a reasonable hope remains that nature will suffice for the cure. It is quite erroneous to suppose that these intestinal obstructions are overcome by relaxing muscular spasm; the only rational explanation of the utility of tobacco, and of various other medicines of the same class, is that by lowering the heart's action they tend to diminish the vascular congestion of the strangulated organ. In *lead colic*, in which tonic spasm probably exists, tobacco may act as a true antispasmodic; but in this affection it is seldom used.

The powerful relaxing influence of tobacco led naturally to its use in the treatment of *tetanus*, and the list is long of the cases in which its infusion was given by enema. More recently nicotia was administered in this disease by the mouth or the rectum. It is, as might be expected, a surer remedy in the idiopathic than in the traumatic form of the disease. Tobacco has generally been prescribed in an infusion made with twenty grains of the drug to half a pint of water; and nicotia in the dose of a fraction of a drop increased until its specific effects are developed. The same means as in tetanus have been employed in several cases of *strychnia poisoning*. The power of tobacco smoke to arrest or palliate paroxysms of *asthma* is well established. There is reason to believe that it is quite as efficient as lobelia, with which it is almost identical in operation. *Ascarides* of the rectum and even *lumbricoid* worms have been expelled after the injection into the rectum of tobacco smoke or of tobacco infusion. This substance is alleged to be an antidote to poisoning by *mushrooms*, but upon insufficient grounds.

Administration.—Tobacco may be given as an emetic in the *dose* of five or six grains; but it is rarely prescribed in this form. The infusion, wine, and ointment are officinal. Fresh tobacco leaves, which are sometimes used as a topical application, are much feebler in their action than the cured leaves, and those especially which have undergone fermentation in their manufacture. The dose of nicotia may be stated as from one-sixth of a grain to one grain. But it should never be used internally if either of the other preparations of tobacco can be procured.

TAMARINDUS, *U. S.*, *Br.*—TAMARIND.

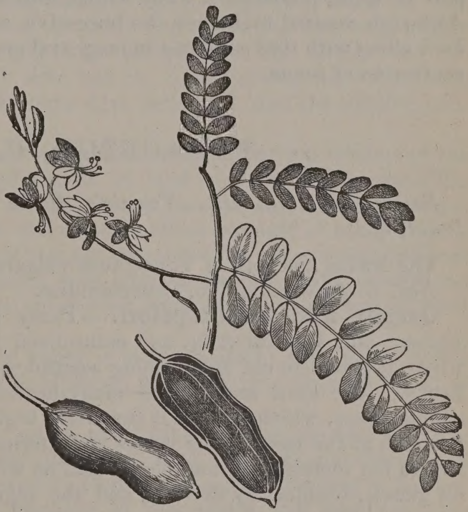
Pulpa tamarindorum cruda s. Fructus tamarindorum, P. G.—*Tamarin*, Fr., *Tamarindenmus*, G.

The preserved fruit of Tamarindus indica, *Lin.*, s. T. officinalis, *Hooker.* Woodville, Med. Bot. pl. 166; Bentley and Trimen, Med. Plants, 92.

Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—The tamarind tree attains a height of 60 to 80 feet, is indigenous to India and throughout tropical Africa, and has been introduced into all tropical countries. It has alternate abruptly pinnate leaves, with from 10 to 18 pairs of oval-oblong, at the base unequal, veined leaflets, and produces the white or yellowish, red-veined flowers in terminal and lateral racemes. The fruit is an indehiscent, usually curved legume, about six inches long, and nearly one inch broad. The West-Indian tree bears a fruit which is only about three times longer than broad, and was formerly regarded as a distinct species, T. occidentalis, *Gaertner.* The fruit has a thin, fragile, pale brownish shell (pericarp), and underneath this there are found on each side three tough fibrous somewhat branching veins running from the base to the apex. Next follows an acidulous pulp, and this adheres to a tough membrane, which incloses from three to ten cavities, each of which contains a single flat somewhat quadrangular and polished brown seed.

Fig. 191.



Tamarindus indica, *Lin.* Flowering branch, pod, and pod with shell removed.

Preparation.—Before tamarinds enter commerce the shell is removed, and the inner portion is in India pressed together into a mass to which sometimes sugar is added. In Upper Egypt it is formed into cakes, which are dried in the sun; and in the West Indies hot syrup is poured over the pulpy mass.

Description.—As seen in our commerce, tamarinds form a reddish-brown soft mass, in which the interior portion of the fruit is more or less broken. They have a fruit-like odor and an acidulous and sweet taste. *East Indian tamarinds* are tougher and darker in color, and have a less sweet taste. *Egyptian tamarinds* appear in hard, flattish, circular cakes, about six inches in diameter, of a brown-black color externally, and frequently mouldy. The last two varieties are rarely met with in American commerce. On leaving the clean blade of an iron spatula for some time in contact with tamarinds, it should not become covered with a coating of copper.

Constituents.—Vauquelin ascertained tamarinds to contain sugar, tartaric, citric, and a little malic acid, pectin, and mucilaginous matter. The acids are mostly present as potassium compounds. Acetic acid has likewise been found in tamarinds; it probably results from the fermentation of the sugar. Tannin is not present, except in the testa of the seeds.

Pharmaceutical Uses.—Tamarinds are employed in the preparation of Confectio sennæ, *U. S.*, *Br.*, being freed from vegetable tissues by means of water and straining.

PULPA TAMARINDA DEPURATA, P. G., is made by softening East Indian tamarinds with an equal weight of boiling water, straining the mass through a hair sieve, evaporating the strained portion to the consistence of an extract, and incorporating with six parts of it, one part of powdered sugar.

Medical Action and Uses.—Tamarinds are mentioned by the Arabian medical writers as antibilious, and useful in correcting nausea, quenching thirst, and allaying febrile excitement, and also as being efficient in healing aphthous sores. They are still used for similar purposes, and especially to prepare a cooling drink in *febrile diseases.* They should be mixed with hot water, and the strained liquid be allowed to cool. An ounce of tamarind pulp boiled with a pint of milk, produces a whey which also forms an agreeable drink in fevers. Although reputed to impair the purgative action of senna, they are habitually used along with that cathartic in magistral preparations, as well as in the officinal confection of senna.

TANACETUM, *U. S.*—TANSY.

Summitates tanaceti. — *Tanaisie, Herbe aux vers*, Fr.; *Rainfarn, Wurmkraut*, G.

The leaves and tops of Tanacetum vulgare, *Lin.*

Nat. Ord.—Compositæ, Senecionideæ.

Origin and Description.—Tansy is a perennial herb indigenous to Europe and Central Asia, and naturalized in many parts of North America, where it grows in old fields, along roadsides, and in the neighborhood of riverbanks. The stout and fibrous many-headed root sends up a cluster of nearly simple stems, which are about three feet high, roundish-angular, and frequently purplish at the base. The leaves are alternate, shortly petiolate or sessile, from five to ten inches long, and nearly half as wide, smooth, dark green, dotted with oil glands, bipinnately divided, and the segments rounded, incised, or coarsely serrate. The flowers are in a dense terminal corymb, have an imbricate involucre with numerous brown-margined scales, a convex naked receptacle, and numerous yellow florets, with the marginal ones pistillate, but not ligulate. The akenes are obovate, about five-ribbed, and terminate with a crown-like pappus. The plant commences to bloom in July, and should be collected while flowering. It has a strong, rather unpleasant odor, and an aromatic, pungent, and bitter taste. A variety, *Tan. crispum*, with twice pinnatifid and curled leaves, is frequently cultivated, and known as *double tansy.*

Constituents.—Among the ordinary constituents of tansy, Peschier and Frommherz found mucilage, sugar, albumen, fixed oil, resin, tannin, coloring matter, and malic acid, with which Peschier's *tanacetic acid* is probably identical. The bitter principle was isolated by Leroy (1845) by a process similar to that for digitalin. This *tanacetin* is described as being yellowish-white, granular, inodorous, fusible, soluble in ether, less freely soluble in alcohol, and sparingly soluble in water. The most important constituent of tansy is its volatile oil, of which the fresh flowering herb yields $\frac{1}{4}$ to $\frac{1}{3}$ per cent. of its weight. *Oil of tansy, oleum tanaceti*, is an oxygenated oil of neutral or slightly acid reaction, varies in density between 0.92 and 0.95, and has either a yellow or green color. According to Geoffroy, the herb grown in dry places yields a green-colored volatile oil, but if grown in moist localities the oil is yellow. Oil of tansy has a camphoraceous aromatic odor, and a bitterish pungent taste; deviates polarized light to the left, is readily soluble in alcohol, dissolves iodine without explosive action, and is readily oxidized on being heated with nitric acid.

Allied Plant.—TANACETUM BALSAMITA, *Lin.* (s. Pyrethrum tanacetum, *D. C.;* Balsamita suaveolens, *Pers.*); Costmary, *E.;* Balsamite, *Fr.;* Frauenminze, *G.*—This is a perennial herb of Southern Europe, with undivided serrate, oval-oblong, petiolate leaves, and discoid, yellow, hemispherical flower-heads in terminal corymbs. It has a strong aromatic odor and bitter taste, and is employed like tansy.

Physiological Action. *On Animals.*—In some experiments two fluidrachms of the oil of tansy given to a dog caused vomiting, salivation, dilated pupils, twitching of the muscles followed by clonic convulsions, and a cataleptic condition from which the animal recovered. Half a fluidounce produced the same symptoms, from which, however, recovery took place; and then, on the same dose being repeated, a prolonged and fatal convulsion occurred, death being apparently due to asphyxia from paralysis of the respiratory muscles. On examination after death the veins of the brain and spinal marrow were highly congested, and a serous effusion existed in the pia mater. The lungs were engorged, the heart empty on its left side, but its right cavities were distended with dark and liquid blood. The kidneys were congested, and the bladder contracted (Van De Warker).

On Man.—The author of the above experiments found that ten minims of the oil of tansy taken by himself caused a sense of heat in the stomach extending throughout the abdomen, flushing and fulness of the face and head, giddiness, and diuresis lasting for many hours, the urine smelling strongly of tansy. Subsequently, a dose of fifteen minims of the oil, repeated after three hours, induced similar effects, only the head symptoms were more marked and unpleasant, and the diuresis was very copious. The pulse grew more frequent and less full, and the temperature was slightly raised.

The fatal poisonous dose of oil of tansy is undetermined; very grave symptoms have been produced by half a fluidrachm, and even by a dose of fifteen or twenty drops.

In excessive and poisonous doses oil of tansy causes a sense of heat or burning in the œsophagus, stomach, and abdomen, with dizziness, numbness, and apparent paralysis, attended or followed by clonic convulsions, flushing or lividity of the face, dilated pupils, stertor, frothing at the mouth, and vomiting; the skin is usually moist and warm, the pulse somewhat increased in frequency; in fatal cases death is caused by coma and asphyxia. In a case of fatal poisoning by a decoction of the herb death took place by paralysis of the muscles of deglutition, respiration, and voluntary motion.

Medical Uses.—Tansy was used in the middle ages and subsequently as a remedy for *amenorrhœa*, *worms*, and *dropsy;* and although it is no longer regarded as of equal potency with other medicines, in these diseases, its efficacy cannot be reasonably questioned. Its tonic and stimulant virtues resemble those of absinth, but there can be little doubt that it causes a vascular congestion of the abdominal organs, increasing the secretion of urine and promoting the menstrual discharge. It is largely employed in domestic practice, especially in rural districts, to promote or restore *menstruation*, and sometimes with a criminal intention as an abortifacient, but, so far as appears, unsuccessfully. Its fruit is held by some to be as efficient as chenopodium in the destruction and expulsion of lumbricoid *worms;* and the bruised leaves have been applied to the abdomen for the same purpose. In this manner, and also in vinous and spirituous infusion, tansy has been in vogue as a topical application for *bruises*, *sprains*, *muscular rheumatism*, chronic *ulcers*, etc. Internally it affords relief in flatulent *colic*, and is not without efficacy in *hysterical* disorders.

The *dose* of the powder of the fruit of tansy is from ten to forty grains; and of the flowers from twenty grains to two drachms. An infusion may be prepared with from half an ounce to an ounce of the seeds, or with twice that quantity of the flowers, in a pint of boiling water, and prescribed in doses of one or two fluidounces. The oil may be given in doses of from one to four drops, or more.

TAPIOCA, *U. S.*—TAPIOCA.

Tapioca, Fr., G.

The fecula of the root of Janipha (Jatropha, *Lin.*) manihot, *Kunth*, s. Manihot utilissima, *Pohl.* Bentley and Trimen, Med. Plants, 235.

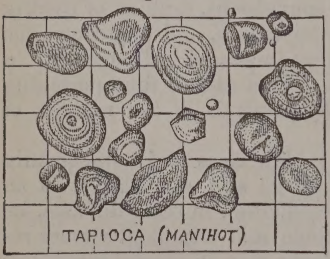
Nat. Ord.—Euphorbiaceæ.

Origin.—The tapioca plant, also known as *cassava*, *mandioc*, and *manioc*, is probably indigenous to Brazil, where it has been cultivated from a remote period. It has been introduced into other parts of tropical America, into Florida, Africa, and the East Indies. It has large cylindrical and fleshy tuberous rhizomes, which send up slender suffruticose or herbaceous stems with alternate petiolate leaves, which are palmately divided into five or seven acute narrow segments. The flowers appear in the forks of the branching stem, are monœcious, and form small racemes, in which the lower flowers are usually pistillate. The starch is obtained from the tubers, which contain a milk-juice that is poisonous from the presence of hydrocyanic acid.

A closely allied species Jatropha dulcis, *Gmelin* (Manihot aipi, *Pohl*), which is regarded by many botanists as a mere variety of the preceding, has non-poisonous tuberous rhizomes, is known as *sweet cassava*, and yields products identical with those of the poisonous plant.

Preparation.—On grating the tubers, expressing the poisonous juice, drying the residue and grinding it, *cassava meal* is obtained, which, when baked in thin cakes, furnishes *cassava bread.* From the expressed juice, and by washing the meal with water, on standing, *cassava starch* is deposited, known also as *Brazilian arrowroot* and *tapioca meal.* On drying this starch while still moist, on heated plates, *tapioca* is obtained.

Fig. 192.



Description.—Cassava starch forms a white powder, having all the properties of starch; but it is readily distinguished from other starches by means of the microscope, when it is seen to consist of muller-shaped granules, which, viewed from one end, have the appearance of spherical grains. The nucleus is small, circular, or often elongated, and the different layers are indistinctly marked. The grains were originally united in groups of two to four, but in the commercial article are mostly separate. Their size is usually less than half that of potato starch (see page 883). Tapioca is in irregular opaque or somewhat translucent pieces, which consist of the same starch granules, partly distended, ruptured, and agglutinated. It is inodorous, has an insipid taste, and agrees in chemical behavior and composition with other starches.

Medical Action and Uses.—The demulcent and nutritive properties of tapioca, as well as the poisonous properties of the juice of the recent plant, were known in the seventeenth century. The qualities of the juice are due to the prussic acid it contains. The symptoms it produces are identical with those of prussic acid, as spasmodic constriction of the throat, convulsions, coma, and death with dilated pupils.

Tapioca is chiefly used for making puddings, and as a simple mucilaginous food for the sick and for infants. A palatable form of it is prepared as follows: Take a tablespoonful of tapioca, macerate it in a pint of warm water for an hour, and then boil it for ten minutes, stirring all the time. Sugar, lemon-juice, or some fruit syrup, nutmeg, wine, etc., may be added for flavoring, and to neutralize its pasty and mawkish taste.

TARAXACUM, *U. S.*—DANDELION.

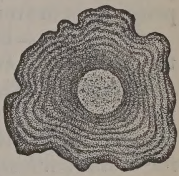
Taraxaci radix, Br.; *Dandelion root*, E.; *Pissenlit*, *Dent de lion*, Fr.; *Löwenzahn*, G.

The root, gathered in the autumn, of Taraxacum Dens-leonis, *Desf.* (s. T. officinale, *Wiggers;* T. vulgare, *Schrank;* Leontodon taraxacum, *Lin.*). Woodville, Med. Bot., plate 3; Bentley and Trimen, Med. Plants, 159.

Nat. Ord.—Compositæ, Cichoreæ.

Origin.—Dandelion is a perennial acaulescent herb, with a tuft of spreading short-stalked radical leaves, which are about 8 inches long, obovate-oblong, acute, and on the margin runcinately and coarsely serrate. The flower-heads are terminal upon the hollow scapes, about $1\frac{1}{2}$ inch in diameter, and have an erect imbricate involucre, and numerous ligulate, yellow, and five-toothed florets. The akene is compressed, obovate-oblong, and terminated by a silky-hairy, spreading pappus raised upon a long stalk. The plant grows in waste places, pastures, and on roadsides, and is met with in most countries of the Northern hemisphere.

Fig. 193.



Transverse section of Taraxacum Root.

Description.—The root is from 6 to 12 or 16 inches long, nearly cylindrical, $\frac{1}{2}$ to 1 inch thick, crowned with several short thickish heads above and furnished with few branches below. Fresh it is light yellowish-brown and fleshy; when dry, dark brown or blackish-brown, much wrinkled longitudinally; internally it is white, with a yellowish centre. It is inodorous, and has a bitter taste. It is hygroscopic, and in damp weather rather flexible, but when dry breaks with a short fracture, showing the pale yellow porous wood surrounded by a dark brown cambium line and a thick white bark, with concentric circles of milk vessels of a brownish color.

After frost and early in the spring the root is sweet; during the spring and summer the milk-juice becomes thicker and the bitter taste increases; the root is therefore directed to be collected late in the autumn. The spring root yields a bitterish-sweet extract. Bentley regards the root collected about July as being most efficient.

Constituents.—The bitter principle, *taraxacin*, was obtained by Polex (1839) in a crystalline state by treating the milk-juice with boiling water and evaporating. Kromayer (1864) found it necessary to leave the aqueous solution in contact with animal charcoal, from which afterwards alcohol dissolved the bitter principle, requiring treatment with lead acetate and sulphuretted hydrogen to free it from coloring matter and other principles. Kromayer obtained taraxacin as an amorphous bitter mass. The milk-juice contains also *resin* and *taraxacerin*, $C_8H_{16}O$, which is insoluble in water, crystallizes from hot alcohol, and when in alcoholic solution has an acrid taste.

Dandelion root collected in autumn is rich in inulin. Dragendorff (1870) obtained from the root collected in October 24 per cent. of inulin and a little sugar; but when collected in March, only 1.74 per cent. of inulin was found, and about 18 per cent. each of uncrystallizable sugar, and *levulin,* the latter being intermediate between inulin and sugar in having the composition of inulin, but being of a sweet taste, soluble in cold water, and without influence on polarized light. Frickhinger, Widemann, and others had obtained notable quantities of *mannite* from the concentrated juice of dandelion; but T. and H. Smith proved that this principle does not pre-exist, and that on the contrary it is a product resulting from fermentation.

The presence of fermentable sugar has been observed by most investigators, and Dragendorff's observations confirm the results previously obtained by Frickhinger, Widemann, and Overbrook, that the sugar predominates in the spring-root, and inulin in the root collected in autumn. It seems to follow therefrom that the extract and other preparations made from the expressed juice, or by treating the autumn-root with cold water, should be more efficacious and less loaded with inert matters (sugar, etc.) than those obtained from the spring-root.

According to Marmé (1864), the leaves and stalks of dandelion contain *inosite,* which sugar is not found in the root.

Substitutions.—Chicory root is not unfrequently substituted for dandelion root in the preparation of extract and fluid extract. While the roots of the two plants, notwithstanding their resemblance, may be distinguished from each other without difficulty, no reliable tests are known by which their pharmaceutical preparations may be distinguished. It is therefore best for pharmacists to prepare them from the properly selected drug.

Off. Prep.—Decoctum taraxaci, *Br.;* Extract. taraxaci, *U. S., Br.;* Extr. taraxaci fluid., Infus. taraxaci, *U. S.;* Succus taraxaci, *Br.*

Medical History.—The first distinct mention of dandelion is by Arabian medical writers, who state it to be a very efficacious deobstruent and purifier of the blood. At the close of the last century it was greatly in vogue as a remedy for chronic affections of the liver and bowels, for renal calculus, some cutaneous diseases, etc. Its diuretic qualities are recognized in its popular names, pisse-en-lit, lectiminga, etc.

Medical Action and Uses.—No experimental determination has been made of its physiological action, but it continues to be employed now, as formerly, in cases of *hepatic congestion* due to or associated with *atonic dyspepsia* and *constipation.* It has been regarded as useful in pulmonary *consumption,* possibly, if at all, by its action upon the stomach and bowels, and indirectly upon the liver.

Dandelion is frequently administered in decoction, of which the *dose* is from two to four fluidounces. It is apt to ferment. The extract is of little use. The fluid extract and the juice are probably its most active preparations.

TAXUS.—Yew.

If commun, Fr.; *Eibe,* G.

Taxus baccata, *Lin.* Bentley and Trimen, Med. Plants, 253.

Nat. Ord.—Coniferæ.

Origin and Description.—The yew is an evergreen shrub, or more frequently a tree of very slow growth, but attaining a height of 30 or 40 feet. It is indigenous to Asia from Siberia southward to the Himalaya mountains, and westward to Syria, Northern Africa, and the greater part of Europe. It has been introduced as an ornamental tree into North America, and is naturalized to some extent. The tree has a red-brown bark, numerous, and spreading, or in one variety fastigiate branches, and closely placed, nearly sessile and two-ranked or crowded leaves which are linear, entire, flat, somewhat curved, acute, glossy green above, pale green beneath, and about one inch long. The fruit or berry consists of a globular-ovate, acutish or blunt, black-brown seed, surrounded by a fleshy cup-shaped scarlet-red arillus, which is open at the top, and at the base furnished with two or three rows of small scales. The young branches with the leaves attached and the fruit have been employed medicinally. The former have an unpleasant terebinthaceous odor, and a disagreeable bitter and acrid taste. The taste of the fleshy part of the berry is sweetish and not unpleasant; but the seed is bitter.

Constituents.—The leaves were examined by Peretti (1828) and Righini (1837), who, besides the common principles, found in them, volatile oil, tannin, and an amorphous bitter principle. Lucas (1843) isolated the latter in the form of an amorphous bitter powder, which is sparingly soluble in water, but freely soluble in dilute acids, in alcohol, and ether. The salts of this *taxina* are uncrystallizable, and are precipitated by tannin and by alkalies. Taxina is colored yellowish-brown by nitric acid, and purplish-red by sulphuric acid. Marmé (1876) obtained the alkaloid in small proportion from the seeds, and found it to be crystalline, soluble also in chloroform, benzol, and carbon bisulphide, and precipitated by all group reagents of the alkaloids, except the chlorides of mercury, gold, and platinum, and the platino-cyanide of potassium. It is uncertain whether the alkaloid has poisonous properties. The red coloring matter of the arillus is soluble in alcohol and ether, but insoluble in water.

Allied Plants.—The American yew, Taxus canadensis, *Lin.*, is probably a low straggling variety of the above species; its leaves are mucronate, and have a revolute or subrevolute margin. The Irish yew, T. hibernica, *Mack*, has a yellow fruit. T. nucifera, *Kämpfer*, indigenous to Japan, has a green fruit, the fleshy portion of which is astringent and pungent, while the seed is sweet and oily.

Physiological Action.—In his account of yew, Pliny says, that the berries, especially of Spanish yew, contain a mortal poison, and that wine barrels made of its wood render their contents poisonous. He relates that in Arcadia the very shadow of the yew tree is fatal to those who sleep in it, and that arrows are rendered poisonous by its juice. Dioscorides states that the berries are poisonous to birds. The poisonous effects of the emanations of this tree have been mentioned by several later observers who have put them to the test; and it is recorded that a girl who slept all night under a yew tree suffered from a copious miliary eruption, and for days remained in a half delirious state. The poisonous portions of the plant are its foliage and the stony seed; the fleshy covering of the latter is innocuous.

On Animals.—Fifteen grains of the alcoholic extract of the leaves given to rabbits have occasioned hurried breathing, and palpitation of the heart, followed by recovery; and double the dose produced the same effects, ending in sudden death. In other cases convulsions have preceded the extinction of life; but it would appear that they are least apt to occur when the dose has been large. In several experiments with such doses the animal has died quietly by syncope. So, in certain cases horses poisoned by yew have died suddenly without any spasm or sign of pain. After death the evidences of gastro-intestinal inflammation have generally been slight, the heart is usually empty, the kidneys strongly congested, and the blood less coagulated than usual.

On Man.—The effects which are produced by yew on man vary materially in different cases; and, in general, the larger the dose of the poison the less definite and various are the symptoms. Where they are fully developed they comprise irritation of the stomach and bowels with vomiting and sometimes purging; difficult urination; pallor, giddiness, prostration, coldness, spasm, or partial paralysis: irregular and feeble action of the heart, and death by coma or by syncope. The latter mode of death occurs most frequently when the dose of the poison is very large, and then the phenomena of nervous irritation and exhaustion and the gastric disturbance may be very trifling, the patient dying by rapid asthenia or by absolute syncope. In the case of a young woman who took the leaves of yew as an abortive, death occurred without convulsion, and her countenance was as natural as in sleep. In another case eleven persons partook of a decoction of yew; some of them were seized with giddiness, confusion of sight, pain in the head, nausea and vomiting, and then fell asleep; but two of them died within an hour without pain or convulsion. The fatal dose varies greatly; a decoction of from two to five ounces has destroyed life. The lesions found after death in man produced by this poison are the same as those already mentioned as occurring in animals.

Medical Uses.—A jelly prepared from the berries has been employed in the treatment of chronic catarrh of the bronchia and the urinary passages, and the leaves have been recommended in scurvy, epilepsy, and other spasmodic affections, and been used by the vulgar as an emmenagogue, and especially as an abortive. Its efficiency in any of these conditions is far from proven, and among the numerous cases in which it has been employed to provoke abortion, several have resulted fatally to the mother, but in none was the fœtus expelled.

In poisoning by this substance the stomach should be speedily evacuated, after which milk may be given in small quantities to allay its irritation, with alcoholic liquids in stimulant doses.

TEPHROSIA.—GOAT'S RUE.

Turkey pea, Hoary pea, Devil's shoestring, E.; *Tephrosie*, Fr., G.

Tephrosia (Galega, *Lin.*) virginiana, *Pers.*

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin and Description.—This species is an herbaceous perennial, growing in sandy soil in Canada and the United States westward to the Mississippi. Its root is many-headed, and divided into several nearly horizontal branches, which are half an inch and less in diameter, one to two feet long, somewhat beset with fibres, rather tough and flexible, externally brown-gray, and internally whitish. The stems are about two feet high, nearly simple, more or less woolly, and have numerous alternate, oddly-pinnate leaves, with about ten pairs of oblong, mucronate, shortly-stalked, straight-veined, and silky-villous, pale-green leaflets. The flowers are in terminal and axillary racemes, white, rose-colored, and red, and produce a curved silky legume.

The root, and occasionally the herb, have been employed; the root is without odor, and has a bitterish and somewhat acrid taste.

Constituents.—The principles to which the properties of goat's rue may be due are unknown.

Allied Plants. TEPHROSIA APPOLINEA, *DeC.*—The leaflets have occasionally been used as a substitute for, or for the adulteration of, senna leaves (see p. 1255).

T. TOXICARIA, *Pers.*, is indigenous to Africa, and naturalized in tropical America. It has deep red flowers and a poisonous root.

T. PURPUREA, *Pers.*, and T. SPINOSA, *Pers.*, indigenous to India, have bitter roots, which are employed for their tonic properties.

T. LEPTOSTACHYA, *DeC.*, is a native of Senegambia. Its root and leaves are regarded as possessing purgative properties.

Medical Action and Uses.—The root, as well as the leaves of the native tephrosia, are said to be laxative, tonic, and vermifuge. For the last-named purpose a decoction of the root has been used. It may be prepared by boiling an ounce of the plant in a pint of water to the reduction of one half. Dose, one or two tablespoonfuls. It has also been reported to be useful in the treatment of typhoid fever, but as it was not given alone, its value in this disease cannot be estimated.

TEREBINTHINA, *U. S.*—TURPENTINE.

Terebinthina communis.—*Crude turpentine*, E.; *Térébenthine commune*, Fr.; *Gemeiner Terpentin*, G.

The concrete oleoresin obtained from Pinus palustris, and from other species of Pinus. Bentley and Trimen, Med. Plants, 259.

TEREBINTHINA CANADENSIS, *U. S.*, *Br.*—CANADA TURPENTINE.

Balsamum canadense.—*Canada balsam, Balsam of fir*, E.; *Térébinthine du Canada, Baume du Canada*, Fr.; *Canadischer Terpentin*, G.

The liquid oleoresin obtained from Abies (Pinus, *Lin.*, s. Picea, *Loud.*) balsamea, *Mill.* Michaux, N. Amer. Sylva, III., t. 150; Bentley and Trimen, Med. Plants, 263.

Nat. Ord.—Coniferæ.

Origin.—The different species of pine and fir form resin-ducts in the bark or wood in which liquid oleoresins secrete. In some species the oleoresin exudes to some extent spontaneously; but the various turpentines of commerce are obtained by wounding the trees. Many species secrete the oleoresin in such small quantities that it is not collected. The turpentines recognized in the U. S. and British Pharmacopœias are furnished by the following species:—

PINUS PALUSTRIS, *Lam.*, s. P. australis, *Mich.*—This is the *broom pine* or *swamp pine* of the United States, where it is very abundant from North Carolina to Florida. Its leaves are ten to fifteen inches long, crowded near the ends of the branches, and in tufts of threes surrounded by long, ragged sheaths. The cones are nearly cylindrical, about as long as the leaves, and have the scales furnished with a short spine.

PINUS TÆDA, *Lin.*, grows in barren, sandy soil, near the coast from Virginia to Florida, and is known as *loblolly* or *oldfield pine.* The leaves are eight or ten inches long, in fascicles of threes, and surrounded by elongated, subentire sheaths. The cones are ovate-oblong, about one-half the size of the leaves, and have the scales tipped with a stout inflexed spine.

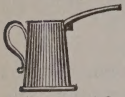
ABIES BALSAMEA, *Mill.*, is the *balsam fir*, or *balm-of-Gilead fir* of Canada and the Northern United States. It attains a height of thirty or forty feet, has numerous solitary leaves, which are about three-quarters of an inch long, linear, flat, obtuse, and glaucous-silvery leaves, and produces cylindrical bluish cones three or four inches long, and with scales tipped by a short spine.

ABIES FRASERI, *Pursh*, resembles the last species, but has the cones only about two inches in length, and the upper part of their sharp-pointed scales much projecting and recurved. It grows from New England to North Carolina, principally in the mountains, and may be used for collecting *balsam of fir.*

Collection. COMMON TURPENTINE.—In the United States turpentine is chiefly obtained in North Carolina, and more recently it has been procured from South Carolina and Georgia. During the autumn and winter the pine trees are *boxed*, one to four excavations being made, by means of an axe, through the bark into the sapwood, commencing about six or eight inches above the roots. The bottom of these *boxes* is about five inches below the lower, and eight or ten inches below the upper lip, and their capacity varies from four to eight pints. A few days after the boxes have been cut the bark is removed above the box to the height of about three feet, and some of the wood is scraped off or *hacked*, the hacks being made in the shape of the letter L. The oleoresin or *crude* begins to flow about the middle of March, runs best during July and August, and slackens again in September and October. The boxes are from time to time emptied by means of a peculiarly constructed spoon or ladle, called turpentine-dipper, and the turpentine is at once transferred into rudely constructed barrels, and usually used for distilling the oil. The trees are slightly scraped every eight or ten days, and the scraping or hacking is continued until finally ladders have to be employed. The flow of the first year is the best, and is called *virgin dip;* after four or five years the turpentine yields less oil, and the rosin obtained from it is considered inferior. (See I. Zacharias, *Amer. Jour. Phar.*, 1877, 543.)

Canada turpentine is largely collected in the province of Quebec, Canada, the balsam-gatherers, with their whole families, encamping in the woods for two months each year. The turpentine is secreted in vesicles formed in the bark, each of which requires to be pierced by the sharp-pointed iron tube attached to a can, when the balsam flows into the vessel. The average yield of each tree is about eight ounces, and a man, with the aid of two children, may gather about one gallon during the day. The trees require two or three years' rest before they are tapped again, and the yield is then always less than the first time. The largest crop ever gathered in the Laurentine Mountains of Quebec in one year was 5000 gallons (see Wm. Saunders, *Proceedings Amer. Phar. Assoc.*, 1877, p. 337).

Fig. 194.



Instrument for collecting balsam of fir.

Description.—Turpentine is a yellowish viscid, rather opaque liquid, which has an agreeable terebinthinate odor, and pungent, bitterish taste, and separates, on standing, a whitish granular deposit, the upper layer becoming almost transparent. But for pharmaceutical uses the oleoresin which has concreted on the trees is generally kept under the name of *white turpentine*, and is recognized in the British Pharmacopœia as *Thus americanum*, or *common frankincense.* It is identical with the granular sediment deposited from liquid turpentine, and is found in irregular yellowish-white, more or less tough masses, which contain fragments of bark and wood, are brittle in winter, breaking with a crummy fracture, and are more tenacious, or even semi-liquid in warm weather. It contains from 12 to 16 per cent. of volatile oil, on the loss of which by exposure it becomes firm and friable.

Canada turpentine is a yellowish or faintly greenish, perfectly transparent, and occasionally somewhat fluorescent, viscid liquid, having a more agreeable odor and taste than the preceding. On exposure it acquires a darker tint, and dries into a transparent, pale yellow mass. It is completely soluble in chloroform, benzol, ether, and warm amylic alcohol, but incompletely in bisulphide of carbon, glacial acetic acid, acetone, and absolute alcohol. (Pharmacographia.)

Substitutions.—Common turpentine is not liable to adulterations; but a fictitious Canada turpentine has occasionally been sold under the name of *Oregon balsam of fir*, which was made by dissolving rosin in oil of turpentine, and flavoring the solution by the addition of a little oil of wormwood. A liquid pale-yellow turpentine may be procured by puncturing the vesicles of the bark of Abies Menziesii, *Lindl.*, the *balsam pine* of the Pacific coast. The sample in our possession slowly deposits a small amount of white granular matter.

Other Turpentines.—European turpentine closely resembles American turpentine, and is obtained in Russia from Pinus sylvestris, *Lin.* (Bentley and Trimen, Med. Plants, 257); in Germany, from the same species, and from P. rotundata, *Lk.;* in Austria, from P. laricio, *Poir.;* and in Southwestern Europe from P. pinaster, *Ait.* (P. maritima, *DeC.*). The turpentine is secreted in the sapwood, and is obtained in a manner similar to that in which the American turpentine is procured. The concrete French or *Bordeaux turpentine* is known in European commerce as *gallipot*, and resembles white turpentine.

STRASSBURG TURPENTINE, *Terebinthina argentoratensis*, is procured, like Canada balsam, which it resembles, by puncturing the vesicles of the bark of Abies pectinata, *DeC.* (Pinus picea, *Lin.*). It is collected in the Vosges, and has an agreeable odor, somewhat resembling that of lemon.

VENICE TURPENTINE, *Terebinthina laricina, s. laricis, s. veneta*, P. G., is procured in Tirol and Switzerland from Larix europæa, *DeC.* (L. decidua, *Mill.;* Pinus larix, *Lin.*). The oleoresin is secreted in the heartwood, and is obtained by boring a hole into the trunk to the centre, and dipping the liquid out as it accumulates. It is a nearly transparent or slightly opaque and somewhat fluorescent thick liquid, of a terebinthinate odor, a bitter and aromatic taste, and a yellowish or greenish-yellow color. It does not become hard when mixed with magnesia. The article usually sold here under this name is an artificial product.

HUNGARIAN TURPENTINE, *Balsamum hungaricum*, exudes from Pinus pumilia, *Hænke*, after cutting off the tops of the branches in spring. It is thin, transparent, yellowish, and has an aromatic odor and warm taste.

Constituents.—All turpentines consist of volatile oil, having the composition $C_{10}H_{16}$ (see p. 998), and of resin, which is left behind on distilling the oil, and then constitutes rosin (see p. 1183). The transparent turpentines, according to Maly, are solutions of *abietinic anhydrid* in the volatile oil, and, on exposure to a moist atmosphere, gradually become turbid and opaque from the crystallization of *abietinic acid.* But the resin contained in those turpentines which do not become opaque on exposure must necessarily be different. Hot water, agitated with turpentine, acquires an acid reaction from the presence of formic, and probably also of succinic acid.

Other Products of Pines.—The leaves of the different species. when distilled with water, yield volatile oils, which differ from the volatile oils obtained from the resin of the same species. Such an oil is known, and to some extent employed in Germany, as *Fichtennadelöl* (*fir leaf oil*); and the leaves, by pounding, are converted into a fibrous substance known as *Fichtenwolle* (*fir wool*). The volatile oil distilled from the young shoots of *P. pumilio* is called *Krummholzöl*, or *Oleum templinum*, and, like the oil of fir leaves, is of a yellowish-green color, and of an agreeable, somewhat terebinthinate odor. The volatile oils of Pinus sabiniana, *Dougl.*, and of other species of pine indigenous to California, resemble these products.

Allied Oleoresins.—TEREBINTHINA CHIA, s. CYPRIA, *Chian turpentine*, is the turpentine of ancient authors. It is obtained from incisions made into the bark of Pistacia terebinthus, *Lin.* *Nat. Ord.*, Anacardiaceæ (Bentley and Trimen, Med. Plants, 69). This species is a small tree, found in the basin of the Mediterranean, and eastward in Asia. The oleoresin is greenish-yellow or brownish, transparent, has a terebinthinate and somewhat fennel-like odor, and a mild bitterish taste, and hardens to a transparent resin.

BALSAMUM GILEADENSE (see p. 932).

CARANNA is a soft oleoresin of a greenish-brown or brownish-green color, coming from Central and South America, and probably obtained from Icica caranna, *H. B. K.*, and other trees of the nat. ord. Burseraceæ. It has an agreeable balsamic odor and a bitterish taste.

TACAMAHACA is the product of Elaphrium tomentosum, *Jacq.*, and probably of several South American trees. *Nat. Ord.*, Burseraceæ. It is in brown or yellowish translucent pieces, of an aromatic odor, and breaking with a smooth and glossy fracture. The exudations of Calophyllum inophyllum, *Lin.*, and Cal. tacamahaca, *Willd.*, indigenous to India and the islands of the Indian Ocean, have been used under the same name. Their odor bears a resemblance to lavender and fenugreek.

Anime.—South American anime is probably derived from some species of the nat. ord. Burseraceæ, though it has been referred to Hymenæa courbaril, *Lin.* (*Nat. Ord.*, Leguminosæ). It is in yellowish-white or brownish, rather opaque pieces, which soften between the teeth, and have an odor resembling that of olibanum. East Indian anime is reddish and yellowish, friable, of a waxy lustre, and has a somewhat fennel-like odor.

Off. Prep.—Of Turpentine: Ceratum resinæ comp.; Empl. galbani comp., *U. S.;* Empl. picis, *Br.* Of Canada turpentine: Charta cantharidis (epispastica); Collodium flexile, *U. S.*, *Br.*

Medical Uses.—Turpentine is seldom or never used in medicine, as its virtues depend entirely upon its volatile oil (see Ol. Terebinthinæ), which is separately employed. In ancient times it was chiefly used as a stimulant in *amenorrhœa;* as a diuretic; as a remedy for catarrhal affections of the *urinogenital* organs, and of the *lungs;* and in *ulceration of the bowels, hemorrhoids,* and *rheumatism.* Externally it was applied in the treatment of *itch*, and of numerous chronic *diseases of the skin*, and its vapor, at a high temperature, as a bath in *chronic rheumatism.* The *dose* of turpentine may be stated at from twenty to sixty grains.

Under the name of Canada balsam, balsam of fir, and even under the deceptive title of balm of Gilead, Canada turpentine has been used especially in the treatment of chronic *bronchitis*, as well as for the purposes to which other turpentines are applied. It is destitute of the special qualities of the true balsams, since it does not contain benzoic acid.

The resin of Tacamahaca was formerly used in fumigations for rheumatism, and in plasters for that affection, sprains, and other local disorders requiring stimulation or mechanical support. It was given internally in a balsam associated with amber, cloves, nutmeg, etc.

TESTA, *U. S.*—Oyster-shell.

Conchæ.—Coquilles, Écailles d'huîtres, Fr.; *Austerschalen, G.*

The shell of Ostrea edulis, *Lin.*

Class Acephala (Conchifera), *Ord.* Lamellibranchia, *Fam.* Ostracea.

Origin.—The oyster inhabits the Atlantic and Indian Oceans, and adjacent seas in the neighborhood of the coasts, and is abundant in the bays and on the coast of North America. It consists of a soft, fleshy, suborbicular body, which is inclosed in a calcareous shell opening by two valves, the deeper one being adherent to the rock. Oysters are caught by dredging, and are often planted in creeks and rivers near the seashore. The flesh is a nutritious article of food; but the officinal parts of oysters are the shells.

Description.—Oyster shells are of an irregular shape, and vary between roundish, obovate, and oblong in outline. The lower valve is deeper than the upper one, which is nearly flat, the two being united by a toothless hinge. The shells are composed of imbricate foliaceous layers, are externally rough, uneven, and of a gray or brownish color, and have their internal surface smooth and white.

Constituents.—The principal constituent of oyster-shells is *carbonate of calcium*, which, according to Schlossberger, varies in the different layers between 88 and 98 per cent., the pearly inner layer containing the largest quantity. The analyses of Bucholz and Brandes, Phipson (1860), How (1866), and others indicate that the organic matter present in oyster-shells may vary between 0.5 and 4.5 per cent. The remaining inorganic constituents are phosphate and sulphate of calcium, magnesia, silica, oxide of iron, and alumina.

Pharmaceutical Uses.—Testa præparata, *U. S.;* Conchæ præparatæ, *P. G.;* Prepared oyster-shell, *E.* Take of oyster-shell a convenient quantity.

Free the oyster-shell from extraneous matter, wash it with boiling water, and having reduced it to a fine powder, treat this in the manner directed for Prepared Chalk (page 468). *U. S.*

The colored external layer of oyster-shell should be removed with a knife; the clean white inner layers are powdered in a mortar, then rubbed upon a slab by means of a muller, and the finest portion of the powder separated from the coarser particles by elutriation. After drying, prepared oyster-shell is an impalpable white powder, which is rather rough as compared with prepared chalk when taken between the teeth. It is completely soluble with brisk effervescence when treated with diluted hydrochloric acid.

Medical Action and Uses.—Richter, in noticing the general substitution of mineral for animal preparations of lime, expresses a doubt of its expediency. Prepared chalk, he remarks, is by no means a substitute for cretaceous preparations derived from the animal kingdom, which contain phosphate as well as carbonate of lime, are more acceptable to the stomach in moderate doses, constipate less, and are more readily absorbed into the system. This writer ascribes a diaphoretic virtue to crab's eyes; alleges that they may produce urticaria; and that they tend to excite hemorrhage. The latter qualities may perhaps be hypothetical; but the belief that the animal carbonates in general derange the stomach less than other cretaceous medicines, and are on that account preferable for infants and delicate persons generally, cannot, it is believed, be successfully controverted.

TEUCRIUM.—GERMANDER.

Germandrée, Fr.; *Gamander*, G.

Nat. Ord.—Labiatæ, Ajugoideæ.

Origin.—Of the numerous species of the genus Teucrium, which are occasionally employed in medicine, nearly all are indigenous to Europe, only one, *T. canadense*, being a native, and growing in most parts of North America. The genus is characterized by its flowers, which have the lower lip elongated, and the upper lip short and deeply divided, the four stamens projecting from the cleft. All are aromatic and more or less bitter.

Description.—The following are most frequently employed:—

TEUCRIUM CANADENSE, *Lin.* Woodsage, *E.*—It is downy or hairy, of a grayish-green color, and about two feet high. The leaves are two or three inches long, short-stalked, lance-ovate, rounded at the base, and serrate on the margin. The pale purple flowers are in whorls of about six and form a terminal spike.

T. CHAMÆDRYS, *Lin.*—It is low, suffruticose, and branching. The leaves are about an inch long, petiolate, hairy, ovate or obovate, obtuse, cuneate at base, and crenately serrate. The flowers are purplish-red.

T. MARUM, *Lin.* *Herba mari veri*, Herb mastich, Cat thyme, *E.; *Germandrée maritime, *Fr.;* Amberkraut, *G.*—It is shrubby, about ten inches high, and much branched. The leaves are about one-third of an inch long, petiolate, oval, with the margin entire and revolute, and whitish tomentose beneath. The rose-red flowers are single in the axils of the bracts, forming a one-sided spike-like raceme.

T. SCORDIUM, *Lin.* Water germander, *E.;* Germandrée aquatique, *Fr.;* Lachenknoblauch, *G.*—It is about twelve inches high, has sessile, lance-oblong, serrate and soft hairy leaves about an inch and a half long, and rose-colored flowers in whorls of two to four. In the fresh state it has an alliaceous odor.

T. POLIUM, *Lin.* Polymountain, *E.;* Polium, *Fr.;* Bergpoley, *G.*—The leaves are half an inch long, tomentose, sessile, lance-linear, obtuse, crenate, and strongly revolute on the margin. The flowers are white. The allied T. montanum, *Lin.*, has yellowish flowers.

Constituents.—These species owe their virtues probably to volatile oil, to a small quantity of bitter principle, and to tannin.

Medical Action and Uses.—The numerous species of teucrium appear to possess similar qualities in different degrees, and among them T. marum, or germander, has enjoyed the greatest reputation. It is described as tonic, stimulant, diaphoretic, diuretic, and emmenagogue, and has been used in scrofula, chlorosis, chronic *bronchitis*, *leucorrhœa*, *amenorrhœa*, *dropsy*, *chronic gout*, etc.; in a word, in various affections requiring a stimulant and tonic treatment. A snuff made from its powder has been employed to cure nasal polypi. Teucrium is administered in powder, in the dose of thirty or forty grains; or in an infusion made with from half an ounce to an ounce in a pint of water.

THAPSIA.—THAPSIA.

Thapsie, *Faux fenouil*, Fr.: *Thapsie*, G.

Thapsia garganica, *Lin.* *Nat. Ord.*—Umbelliferæ, Orthospermæ.

Origin and Description.—This plant is a perennial herb of Northern Africa and Southern Europe, and has a smooth, thick, and hollow stem; smooth, shining, twice or thrice pinnate leaves, with large sheaths and lance-linear, acute, often two- or three-lobed leaflets, and pale yellow flowers in large compound umbels. The root is usually employed. It is about two feet long, two to three inches thick, gradually tapering, somewhat branched, brownish-gray externally, and internally whitish. When fresh it contains a white acrid juice. It is nearly inodorous, and has a biting acrid taste.

The closely allied Th. sylphium, *Lin.*, of Northern Africa, has a similar root.

Constituents.—The acrid properties appear to be due to a resin.

Pharmaceutical Uses.—A *plaster of thapsia* is employed in France, which, according to Desnoix, is composed of 1500 parts of rosin, 1250 elemi, 1800 yellow wax, 500 turpentine, and 350 parts of thapsia resin.

Medical Action and Uses.—Galen, Dioscorides, and the Arabians agree in describing the action of the powdered root and juice of this plant as irritating to the skin, and, when taken internally, as emetic and purgative. The juice, and ointments and plasters prepared with it, were used as stimulants and counter-irritants, for the relief of rheumatic and other local pains, and to lessen dyspnœa. About 1868 some attempts were made to revive its use in the form of the resin extracted from its root. Applied in a plaster the skin became inflamed, with intolerable itching, and a copious vesicular eruption occurred. If the application was not prolonged this eruption speedily dried up; but in the contrary case the vesicles became confluent, broke, and exposed an ulcerated and suppurating surface, which on healing left scars resembling those of smallpox. On delicate skins its operation was extremely severe. It is stated that the men employed in preparing extract of thapsia on a large scale were affected with fever and swelling of the hands and face, and from time to time were obliged to suspend their work. A case is also related in which the application of a plaster of thapsia resin to the chest was followed in about twelve hours by severe strangury and violent itching about the genitals and anus. It does not appear that its therapeutic operation differs in any wise from that of other counter-irritants, such as croton oil, euphorbuim, mezereon, and tartar emetic. But it may be added to the number of such agents for occasional use. The resin may be mixed with diachylon in the form of a plaster; or ordinary adhesive plaster may be coated with an alcoholic solution of the resin and applied to the skin.

THEA.—TEA.

Thé, Fr.; *Thee*, G.

The leaves of Camellia thea, *Link*, s. C. theifera, *Griffith*. Bentley and Trimen, Med. Plants, 34.

Nat. Ord.—Ternstrœmiaceæ.

Origin.—Tea is obtained from a shrub, which is indigenous to Southern or Southeastern Asia, and has been cultivated in India, China, and Japan from a very early period. The varieties produced by long cultivation were formerly regarded as distinct species, and described as *Thea bohea*, *T. viridis*, *T. stricta*, *T. chinensis*, and *T. assamica*. The plant has been successfully introduced in several parts of the United States. It bears white axillary flowers and roundish-triangular, three-celled, and three-seeded capsules.

Preparation.—After the leaves have been gathered, they are either rapidly dried, when they change to a dull-green color (*green tea*), or they are allowed to wilt and are subsequently kept for some time in heaps, when they acquire a dark color (*black tea*). Both varieties are subjected to various manipulations, such as rolling upon a table, heating over a fire, etc., and are sometimes flavored by being left in contact with the flowers of the orange, fragrant olive, jessamin, and others. Hyson, Young Hyson, Gunpowder, and Imperial are some of the best known brands of green tea, and Souchong, Oolong, and Pekoe are black teas.

Description.—Tea is met with in commerce in the form of little cylinders or rolls, into which the leaves have been twisted during the manipulation of rolling, and in some varieties these leaves have again been formed into balls of different size. Tea leaves after having been softened in water and unfolded are found to be from one to two inches long; oval, obovate, or oblanceolate in shape; short stalked, pointed at both ends, or blunt, sometimes emarginate at the apex, and irregularly toothed at the margin. They have a prominent midrib, the lateral branches of which are curved upwards near the margin. Tea has an agreeable odor, which varies, however, in the different varieties; its taste is pleasantly astringent and bitterish. The green color is not unfrequently heightened or imparted to tea by a mixture of Prussian blue and gypsum.

Constituents.—Tea contains $1\frac{1}{2}$ to 4 per cent. of *theina*, which was discovered by Oudry (1827), and by Mulder and Jobst (1838) proved to be identical with caffeina (see page 308). It may be obtained by sublimation on carefully heating powdered tea leaves, or by precipitating the tincture with subacetate of lead, removing the excess of lead by sulphuretted hydrogen, and evaporating to crystallization. Mulder obtained from tea between 13 and 18 per cent. of tannin, which, according to Peligot, is peculiar, and, according to Stenhouse, differs from gallo-tannic acid, and is accompanied by a little gallic acid. Rochleder (1848), on the contrary, found a small quantity of tannin identical with that of nutgalls, and a smaller proportion of *boheic acid* $C_{14}H_{20}O_{12}$, which is freely soluble in water and alcohol, and is colored brown, but not precipitated by ferric chloride. Peligot found tea leaves to contain pectin. Mulder obtained about 3 per cent. of albumen, 2 to nearly 4 per cent. of wax and resin aside from the chlorophyll, and between 0.6 and 1 per cent. of volatile oil, which necessarily must vary with the variety of tea yielding it; it is of a lemon-yellow color, has a strong aromatic odor and taste, and congeals readily.

Physiological Action. *On Animals.*—Long ago Lettsom proved that the fragrant and volatile substance which may be distilled from an infusion of tea was capable of paralyzing the hinder limbs of a frog, and even of causing the death of the animal when introduced into a wound in its abdomen. In 1868 Leven experimented upon frogs with thein and caffein, and concluded that to these animals the former was the less powerful poison of the two, since twice as much of it as of caffein was required to produce the same effects. Yet it produced convulsive movements in the animals' limbs, which caffein did not. In other respects the physiological actions of the two alkaloids were identical. They both seemed to directly excite the heart and the respiratory movements, and to increase arterial tension. They both appeared to stimulate the brain and the spinal marrow, but not to arrest the functions of either. The tetanic convulsions were attributed by him to excitation of the spinal cord. They did appear to abolish muscular contractility, and the heart continued to beat after general death. The experiments of Dr. A. Burnett, on the other hand, which were made upon frogs, mice, rabbits, and cats, led him to conclude that thein and caffein are identical throughout the whole range of their action, and he especially makes no distinction between the convulsifying operations of the two alkaloids. According to this experimenter, then, thein in small doses produces cerebral excitement, not succeeded by coma, and partial loss of sensibility; and in large doses occasions cerebral excitement, paralysis of sensibility, tetanic spasm, convulsions, and death. Further, it does not cause muscular paralysis, but at first it produces contraction, and afterwards dilatation of the capillaries and small bloodvessels, with stasis of the blood in them.

On Man.—The most familiar effect of tea is its power of inducing a cheerfulness of disposition and a lively flow of ideas without that tendency to mental and physical torpor which follows the exhilaration caused by alcohol. The familiar line of Cowper, "The cups that cheer, but not inebriate," describes its usual mode of action. There can be no doubt that, like its congeners, tea diminishes the need of food even while it quickens the activity of the nervous system. In this way, probably, it has become the favorite drink of women, whose sedentary lives impede the activity of tissue waste, without lessening the craving peculiar to their sex for lively conversation. Tea imparts to them the mental activity which their ordinary occupations restrain. It also tends to banish the drowsiness which their monotonous labor induces. Many men have been great tea-drinkers; but they were chiefly of the class addicted to prolonged mental labor, particularly at night; and they found in it not only the power of resisting sleep, but often the inspiration of bright ideas. It is evident that these effects, which are notorious and familiar, must be attributed to the direct stimulation of the brain, and by no means to the restriction of tissue change, which is too often regarded as the prime and indeed the sole influence of tea. The latter is, undoubtedly, a real effect of tea-drinking, but it is not that for which tea is so universally employed.

In comparing the physiological effects of thein and caffein upon the excretions it has been found by some experimenters that the former does not affect the elimination of carbonic acid, while the latter diminishes it, as well as the discharge of urea, uric acid, and water, in a larger proportion than thein. Caffein, also, is said to increase the watery constituent of the urine while thein diminishes it. However this may be, it is a matter of familiar observation that the effects of tea and coffee upon the system are by no means identical; for while coffee causes wakefulness as well as tea, in the former case it is rather a pleasing insomnia, not unlike that of small doses of opium, tranquil for the most part, and filled with pleasing reveries; while tea, on the other hand, induces in one who endeavors in vain to sleep after its use, a state of tension of the nervous system which is in the highest degree distressing. Upon almost every one coffee acts as a stimulant, which is more or less cordial, flushing the face and rendering the pulse fuller; but such effects never follow the use of tea as direct consequences. It is seldom that a single indulgence in strong coffee induces that nervous agitation and tremulousness and impaired muscular power which are ordinary effects of strong tea; and, unless we are greatly mistaken, gastralgia and other neuralgic affections are much more frequent among tea-drinkers than coffee-drinkers.

It is very true that some of these apparent differences may be explained by the fact that tea is generally taken with only a small modicum of cream or milk, while coffee is as commonly used with a large proportion of one or both. Indeed, in France, where coffee is the universal breakfast drink, it is always mixed with a great excess of milk, and it is used pure only after dinner when the presence of food in the stomach retards its absorption and modifies its action.

It has been already objected that thein and caffein do not fully represent the sources from which they are respectively obtained. The identity of these alkaloids in their physiological action does not imply a similar identity in tea and coffee. As little should we be entitled to infer that all alcoholic drinks produce identical effects because they all contain alcohol as their chief constituent. It is just as certain that tea and coffee differ in their action upon the human system, as that Rhenish or Bordeaux wines act very differently from whiskey or brandy, although in all of these liquors the common cause of their effects is alcohol. Moreover, not only are thein and caffein physiologically identical, but so are guaranine, cocoaine, and theobromine, with them and with one another; and yet the operations of guarana, coca, and theobroma are different from one another, and from those of tea and coffee, in important particulars. It is, unquestionably a fact of the highest possible interest that all of these vegetable products which are used by different and remote nations should contain identical proximate principles; but while we thus are led to admire the universality of physiological laws we should not lose sight of the peculiarities which distinguish each of these important articles of human food.

Medical Uses.—When tea was introduced into Europe by the Dutch about the middle of the 17th century, it became the subject of extravagant eulogy, was declared to be a remedy for all bodily ills, and a sure means of prolonging life. Among the virtues attributed to it were these: that it cured headache and difficulty of breathing, prevented stone and gravel, and the lassitude and laborious digestion of heavy eaters, dispelled distressing dreams, quickened the memory, and overcame drowsiness, so that, as one of its early historians phrases it, "whole nights might be spent in study without hurt to the body." An exaggeration of its virtues in a different manner is perhaps chargeable upon a late writer on Dietetics, when he intimates that the substitution of tea and coffee for malt and distilled liquors at ordinary meals has tended to limit the vice of drunkenness, and promote that "diffusion of mental industry and of mental acquirements which constitutes the most striking physiological phenomenon of the condition of the European races of mankind at the present day." But as, in point of fact, drunkenness is more prevalent now than in any former generation, it may quite as rationally be questioned whether the mental activity over-stimulated by tea and coffee has not instinctively sought a counter-poison in alcohol.

Among the Chinese, we are told, tea is held to be "cooling, peptic, exhilarating, stimulating, both laxative and astringent, diuretic, emmenagogue, and, in large concentrated doses, emetic. It is applied in a wash to the eyes, ulcers, and wounds of all kinds; but its excessive use as a drink renders people thin, anæmic, and weak-sighted. Tea is taken by the Chinese scholars and laborers to stave off the cravings of hunger until a convenient season arrives." The Chinese also prescribe tea, acidulated with vinegar, in *diarrhœa*, and give it as an antidote to the poisonous action of *tartar emetic* and *corrosive sublimate.* The small proportion of tannic acid contained in tea renders it too feeble a remedy in such cases, if stronger ones can be procured; but its stimulant and exhilarant action adapts it to be used as an antidote to *poisoning by opium.* A cup of hot tea is a familiar domestic remedy for the relief of nausea and oppression after too full a meal; to produce diaphoresis at the commencement of slight attacks of *muscular rheumatism*, *pulmonary catarrh*, or *sore throat*, and to banish the sense of fatigue and muscular soreness produced by excessive exertion, particularly when it is seasoned with some alcohol. It is one of the best remedies for *nervous headache;* and when cold, or acidulated, is a most refreshing drink in midsummer heats attended with excessive perspiration. It moderates also the copious *sweats* of hectic conditions. A strong infusion of green tea has been used by injection in *gonorrhœa*, *leucorrhœa*, and *gleet*, and as a wash in *conjunctivitis*, as a gargle in *sore throat*, etc. In China it is often used for certain of these purposes as a fine powder mixed with water, or in decoction rather than in infusion; and doubtless in these forms its operation is more energetic.

THEOBROMA.—CACAO.

Semen (s. Fabæ) cacao.—Cacao Fèves du Mexique, Fr.; *Kakaobohnen*, G.

The seeds of Theobroma cacao, *Lin.* Bentley and Trimen, Med. Plants, 38. *Nat. Ord.*—Sterculiaceæ.

Origin.—The cacao (often incorrectly called *cocoa*), or *chocolate tree*, is indigenous to Brazil and other parts of tropical America northward to Mexico, and is largely cultivated throughout the tropics. It is a medium-sized tree, with alternate, oblong-lanceolate or lance-ovate, acute, and entire leaves, and with pale pink, five-petaled flowers, which appear in clusters from the axils of old leaf-scars. The fruit is about six inches long, pear-shaped, with an elongated nipple-shaped apex, ten-furrowed and while unripe five-celled, and contains numerous seeds imbedded in a sweet pulpy mass.

Preparation.—Cacao seeds are prepared for use by removing them from the fruit, and simply drying them, in which case they retain their astringent and bitter taste; or they are subjected to a sweating process, by inclosing them in a box or burying them in the ground for two or three days, whereby they lose nearly all their astringency and bitterness, and change in color. The seeds of several other species of Theobroma, like Th. bicolor, *Humb.;* Th. guayanensis, *Willd.;* Th. sylvestre, *Mart.;* Th. ovatifolium, *Sessé;* and others are stated to be collected, prepared, and mixed with the seeds of the cacao. The consumption of cacao seeds in South America and Southwestern Europe has been estimated at over 100,000,000 pounds annually.

Description.—The seeds are one-half or three-quarters inch long, ovate or oblong, somewhat flattened, and vary in color, according to the manner in which they have been prepared, from brown-red to brown or grayish-brown. A prominent raphe runs along one edge of the seed from one end to the other, uniting the hilum and chalaza, and is divided at the latter into many branching nerves. The testa is thin, papery, and fragile. The embryo has the shape of the seed, and consists of a small conical radicle and two large oily cotyledons, which are strongly ribbed upon their face, and by the projecting folds of the inner seed coat, are divided from the back into numerous small irregular lobes, so that they readily break into many angular pieces. The odor of cacao seeds is slight, but on warming is agreeably aromatic; their taste is oily, aromatic, and bitterish.

Constituents.—The quantitative analyses by Lampadius, Tuchen (1857), and A. Mitscherlich (1859), vary greatly in their results. Lampadius found the seeds to yield about 12 per cent. of husks or shells, and about 88 per cent. of kernels, and the latter to contain about 53 per cent. of fat. Mitscherlich obtained from the seeds nearly 50 per cent. of fat, 14 to 18 per cent. of starch, 13 to 18 per cent. of proteids, 1.2 to 1.5 per cent. of theobromina, 3.5 per cent. of ash, and 0.6 per cent. of sugar. Tuchen found also about 3 per cent. of gluten, and isolated between 4.5 and 6.6 per cent. of *cocoa-red.* The latter is soluble in water and alcohol, precipitated by acetate of lead, and is generated in the seeds during the sweating process; it appears to be combined with a proteid, and when pure has a carmine-red color, does not change the color of litmus, and is insoluble in ether and fixed oils. *Oil of theobroma* is described on page 1002. The odorous principle of cacao appears to be somewhat volatile, but has not been isolated. *Theobromina*, $C_7H_8N_4O_2$ (molecular weight 180), was discovered by Woskresensky (1841), and was found by Bley (1842) to be present also in small proportion in cacao shells. The alkaloid is obtained from the infusion of cacao by precipitating it with acetate of lead, removing the excess of lead by sulphuretted hydrogen, evaporating and exhausting the residue with boiling alcohol, from which the alkaloid separates in minute colorless bitter crystals, which are sparingly soluble in water, alcohol, and ether; it yields with acids crystallizable salts, which are decomposed by water. Strecker converted theobromina into caffeina, by heating the silver compound of the former with methyliodide to 100° C. (212° F.).

Uses.—Cacao seeds are employed for preparing butter of cacao (p. 1001) by expressing them between heated iron plates. The press cake, ground, either by itself or with starchy substances, is sold as *cocoa*. The seeds ground together, while warm, with about their own weight of sugar, constitute *chocolate*. This is usually flavored with about one-half per cent. of cinnamon or other aromatics, and occasionally various amylaceous or mucilaginous substances are added to it. Chocolate also forms the base for exhibiting iron and other medicinal substances, and has been proposed as a pleasant vehicle in the preparation of lozenges containing santonin, etc.

Medical Action and Uses.—The dietetic uses of chocolate do not require any detailed notice in this place. Prepared with water or milk, it is employed as a substitute for coffee in Southern Europe and South America, Mexico and the West Indies, and to a less degree in other civilized countries. It is difficult to discern in it, when thus used, any of the stimulating qualities which belong to the theobromina it contains. It is to be preferred to the other agents mentioned when a nutritive rather than an excitant operation is desired; and hence it is familiarly employed during convalescence from acute diseases, and as a substitute for tea or coffee in the diet of persons whose nervous system is liable to be deranged by them. Chocolate prepared with milk, and seasoned by the addition of a modicum of coffee, is less stimulating than the latter, and more palatable than chocolate alone.

The physiological action of theobromina has been investigated by Mitscherlich. Fifteen grains of it dissolved in water and administered hypodermically to rabbits, occasioned grinding of the teeth, slowing of the respiration even to a third or fourth of the normal rate, reduction of the temperature, increased frequency and diminished force of the pulse, and convulsions of spinal origin. When the poison was more slowly absorbed the animals lost their muscular power gradually. There was no diuresis nor any thirst or loss of appetite. Occasionally there was retching or vomiting. In frogs the lungs and bladder were distended. Death appeared to be due to paralysis of the vagus or spinal cord, and, when the poison was rapidly absorbed, spinal convulsions hastened the end. When it occurred promptly there was long-continued irritability of the voluntary muscles and persistence of the peristaltic movements of the intestine; when the poisoning took place more gradually, the heart and voluntary muscles lost their irritability; the ventricles were contracted, the auricles, the great veins, the small vessels in every part of the body, especially in the mucous and serous membranes, the brain, liver, and kidneys were strongly congested, and extravasations of blood were frequently found in the mucous and peritoneal coats of the bladder, and more rarely in the stomach and duodenum. The blood had a dark-red color, which became lighter on exposure to the air. Mitscherlich concluded that theobromina is poisonous in the same manner as caffeina, but that it is poisonous and fatal in much smaller doses, and also that it is absorbed from the stomach as well as from the subcutaneous connective tissue.

Theobromina does not appear to have been used therapeutically, but the identity of its action with that of theina and caffeina renders it probable that it may be substituted for them in appropriate cases, but in smaller doses.

THERIACA, *Br.*—TREACLE.

The uncrystallized residue of the refining of sugar (see page 1360).

THUJA.—ARBOR VITÆ.

Thuya, *Arbre de vie*, Fr.; *Lebensbaum*, G.

The small branches of Thuja occidentalis, *Lin.*

Nat. Ord.—Coniferæ.

Origin.—The arbor vitæ, also called *white cedar*, is a tree attaining under favorable circumstances a height of fifty feet. It grows in cedar swamps in Canada and the northern section of the United States, and is met with southward along the Alleghanies. It has been introduced into Europe as an ornamental tree.

Description.—The branchlets are two-edged and flat from the appressed scale-like leaves, which are placed in four rows, closely imbricate, about one-eighth inch long, rhombic-ovate, obtusely pointed, and bear upon the back an elevated roundish gland. The odor is strongly balsamic, and the taste pungently aromatic, camphoraceous, and bitter.

The allied Thuja orientalis, *Lin.*, which is indigenous to Asia, is sometimes cultivated as an ornamental tree. It is distinguished from the preceding by the erect branches, and by the absence of the glands on the back of the leaves.

Constituents.—The volatile *oil of arbor vitæ* was examined by Bonastre (1825) and Schweizer (1844). Hübschmann (1846) obtained about 1 per cent. of the weight of the branchlets. The volatile oil is colorless or greenish-yellow, has the density 0.925, and is a mixture of two oxygenated oils boiling near 195° and 205° C. (383° and 400° F.); it is readily soluble in alcohol, and when treated with potassa or with sulphuric acid, acquires a black color. Kawalier (1854–1858) obtained from arbor vitæ, in addition to the volatile oil, a gelatinous compound, sugar, two resins, tannin, pinipicrin, and thujin. *Pinipicrin*, $C_{22}H_{18}O_{11}$, was discovered by Kawalier (1853) in the leaves and bark of *Pinus sylvestris*. It is a yellow bitter powder, which becomes soft at 55° C. (131° F.), fuses to a transparent liquid at 100° C. (212° F.), is not precipitated by lead salts, dissolves in water, alcohol, and spirit of ether, and is insoluble in pure ether. *Thujin*, $C_{20}H_{22}O_{12}$, crystallizes in small lemon-yellow tables, has an astringent taste, dissolves in water and alcohol, acquires with alkalies a deep yellow and red-brown, and with ferric chloride a dark green color, and is precipitated by acetate and subacetate of lead. When heated with dilute hydrochloric acid, it is converted into sugar, and *thujigenin*, $C_{14}H_{12}O_7$, and *thujetin*, $C_{14}H_{14}O_8$, both of which are almost insoluble in cold water, and when in alcoholic solution acquire a handsome blue-green color with ammonia. Thujin, boiled with hydrate of barium, yields sugar and *thujetic acid*, $C_{28}H_{22}O_{13}$, which is insoluble in water. These compounds are probably related to *quercitrin* and its derivatives.

Medical Action and Uses.—Arbor vitæ somewhat resembles savine in its qualities, and particularly by irritating the skin when its fresh leaves or an ointment made from them is applied to it. Like savine, it has been found useful in repressing the fungous granulations of *ulcers*, in removing *warts*, and in an ointment as a palliative of chronic *rheumatism*. Internally it has been given with alleged benefit in *amenorrhœa* and *pulmonary catarrh*, and for destroying intestinal *worms*. For the latter purpose its distilled oil has also been found efficient.

THUS AMERICANA, *Br.*—COMMON FRANKINCENSE.

The concrete turpentine of Pinus tæda, *Lin.* (see page 1384).

Medical Uses.—This turpentine may be used for the various purposes to which other turpentines are adapted. In England it forms a constituent of the officinal pitch plaster, under the name of common frankincense.

TINCTURÆ.—TINCTURES.

Teintures, Fr.; *Tinkturen*, G.

Tinctures are solutions of medicinal non-volatile or only partially volatile substances in liquids other than water and glycerin. Solutions of volatile substances in water are known as *medicated waters*, and similar solutions in alcohol as *spirits*. The menstrua employed in the preparation of tinctures are alcohol of different strengths, spirit of ether or spirit of nitrous ether, and aromatic spirit of ammonia or ammoniated alcohol. According to the menstrua employed, tinctures are distinguished as *ammoniated*, *ethereal*, and *alcoholic*, and that class of tinctures, in the preparation of which diluted alcohol or a still weaker spirit has been used, is sometimes designated as *hydro-alcoholic*. By far the greatest number of tinctures are made with an alcoholic menstruum. The employment of spirit of nitrous ether in tinctures is confined to a few unofficinal preparations.

Alcoholic menstruum.—Most tinctures of the United States Pharmacopœia are prepared with diluted alcohol, of the British Pharmacopœia with proof spirit, and of the French and German Pharmacopœias with alcohol of about 60 per cent. or of specific gravity 0.893. While it is desirable to keep the alcoholic strength of tinctures as low as possible, it is evidently improbable that one and the same menstruum should be equally well adapted for the preservation of liquid preparations of drugs having the most varied composition; and that improvements in this respect are needed is shown by the unsightly deposits occurring in some, and the change into gelatinous masses occurring in other tinctures. In most cases these obvious changes are prevented by the employment of a stronger alcoholic menstruum.

Strength of tinctures.—The United States and British Pharmacopœias have adopted the proportion of one part of the drug to eight measured parts of the finished tincture. There are, however, numerous and very important exceptions to this rule, and notably among tinctures of narcotic and other powerful drugs. The French and German Pharmacopœias prepare their tinctures almost without exception in such a manner that one part of the drug is represented by either five or ten parts (by weight) of the tincture, or five or ten parts of the menstruum are used for one part of the drug, maceration being resorted to in their preparation.

Preparation.—Tinctures of resins, oleoresin, balsams, and of most gum resins and extractive drugs are best prepared by maceration. Nearly all other drugs are conveniently extracted by percolation, which process is fully described on pages 584, etc., and has been generally adopted by the *U. S. Pharmacopœia*; if the process is properly conducted, the drug will be practically exhausted long before the requisite amount of tincture has been obtained. The chief objections that can be raised against this process are, that the manipulation must vary with the nature of the drug, and that a certain amount of alcohol will be retained in the powder. The former is of no weight with the pharmacist, who recognizes his duty of intimately acquainting himself with the characteristics and peculiarities of each drug passing through his hands; and the second objection will be of little moment, if weaker menstrua are gradually and judiciously employed, as indicated on page 585.

The *British Pharmacopœia* avoids the second objection by expressing the contents of the percolator as soon as the requisite quantity of menstruum has been used. In most of its formulas the preparation of a pint (imperial) of tincture is directed, and the following explains the manipulations which have been adopted: Macerate the material for forty-eight hours in fifteen fluidounces of the menstruum, in a closed vessel, agitating occasionally; then transfer to a percolator, and when the fluid ceases to pass, continue the percolation with the remaining five ounces of menstruum. Afterwards subject the contents of the percolator to pressure, filter the product, mix the liquids, and add sufficient menstruum to make one pint.

The *German Pharmacopœia* prepares all tinctures by maceration or digestion. The drugs are either coarsely powdered or cut into thin slices, after which, together with the menstruum, they are introduced into a bottle, which should be only partly filled, so as to permit the frequent agitation of the contents. If *maceration* is directed, the temperature is intended to be between 15° and 20° C. (59° and 68° F.), while *digestion* is conducted at a temperature of 35° or 40° C. (95° or 104° F.); in this latter case the mouth of the bottle is closed with a bladder perforated with a pin. After eight days, the cold liquid is decanted and the residue subjected to pressure; the liquids thus obtained are mixed, set aside for a day or two, and then filtered, care being taken to prevent the evaporation of alcohol. The liquid which has been lost by evaporation during these manipulations is not permitted to be replaced.

The *French Codex* directs some of its tinctures to be made by maceration, others by displacement. For the latter process the directions are similar to those of the United States Pharmacopœia, except that the powder is not moistened previously to its introduction into the percolator—a very important omission.

Preservation.—All tinctures should be perfect solutions, and to retain them entirely transparent, the evaporation of the volatile portions should be prevented. Tinctures are best kept in well-stoppered bottles, in a room where the temperature is not subject to great variations. The size of the bottles should be adapted to the quantities of the tincture that are likely to be used within a reasonable length of time.

TINCTURA ACONITI RADICIS, *U. S.*—TINCTURE OF ACONITE ROOT.

Tinctura aconiti, Br., P. G.—*Tincture of aconite*, E.; *Teinture de racine d'aconit*, Fr.; *Eisenhuttinktur*, G.

Preparation.—Take of Aconite Root in fine powder twelve troyounces; Alcohol a sufficient quantity. Moisten the powder with six fluidounces of alcohol, pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until two pints of tincture are obtained. *U. S.*

Tincture of aconite, *Br.*, is made from coarsely powdered aconite root two and a half ounces (avoird.), and sufficient rectified spirit to obtain one pint (imperial); tincture of aconite, *P. G.*, by digesting one part of bruised aconite root in ten parts of alcohol sp. gr. 0.893.

The tincture has a yellowish-brown color and is precipitated by water. Formerly *tincture of aconite leaves* (two troyounces to one pint of diluted alcohol) was officinal; it was much weaker than the present tincture, and could be given in larger doses.

Medical Uses.—Tincture of aconite root is the best form for the administration of this powerful medicine. The *dose* of the American preparation is from one to five minims; of the British, from five to fifteen minims.

TINCTURA ALOES, *U. S.*, *Br.*—TINCTURE OF ALOES.

Teinture d'aloès, Fr.; *Aloetinktur*, G.

Preparation.—Take of Socotrine Aloes in fine powder a troyounce; Liquorice three troyounces; Alcohol half a pint; Distilled Water a pint and a half. Macerate for seven days, and filter through paper. *U. S.*

The formulas of other Pharmacopœias require: Socotrine aloes one and a half ounce, extract of liquorice one and a half ounce (avoird.), proof spirit sufficient for one pint (imper.), *Br.* Aloes one part, 60 per cent. alcohol five parts, *F. P.* Aloes one part, alcohol five parts, *P. G.*

The tincture has a dark blackish-brown color.

Medical Uses.—This preparation is rarely used as a purgative, for which purpose not less than half an ounce of it would be necessary. As a laxative one or two fluidrachms may be taken after food. It has been applied topically as a dressing for indolent *ulcers*, *excoriations*, *bedsores*, *fissures*, and *cutaneous eruptions.* It enters into various preparations of old repute for their virtues in such affections, *e. g.*, Turlington's balsam, Friars' balsam, etc., and has more recently been employed, for similar purposes, with glycerin, by evaporating from four to eight parts of the tincture of aloes, and then gradually adding thirty parts of glycerine.

TINCTURA ALOES ET MYRRHÆ, *U. S.*—TINCTURE OF ALOES AND MYRRH.

Elixir proprietatis Paracelsi, P. G.—*Elixir de propriété*, Fr.; *Aloëelixir*, G.

Preparation.—Take of Socotrine Aloes in moderately fine powder, Myrrh in moderately fine powder, each, three troyounces; Alcohol a sufficient quantity. Mix the powders, and, having moistened the mixture with two fluidounces of alcohol, pack it moderately in a conical percolator, and gradually pour alcohol upon it until two pints of tincture are obtained. This tincture may also be prepared by macerating the powders with two pints of alcohol for seven days, and filtering through paper. *U. S.*

The formula of the German Pharmacopœia requires: Coarsely powdered aloes and myrrh of each two parts, and saffron one part, to be macerated for eight days with twenty-four parts of alcohol sp. gr. 0.834, and two parts of diluted sulphuric acid sp. gr. 1.115.

The color of this tincture is deep reddish-brown; if prepared with saffron, it is of a rich orange-brown. It is precipitated by water.

Medical Uses.—As a purgative capable of especially stimulating the pelvic organs, this preparation has been employed under the name of *Elixir proprietatis*, ever since it was invented by Paracelsus, and as peculiarly fitting for *constipation* in females associated with *amenorrhœa* or irregular menstruation. This state is commonly a result of general atony, and can only be radically cured by remedies addressed to the general system. The *dose* is from one to two fluidrachms.

TINCTURA ARNICÆ, *U. S.*, *Br.*—TINCTURE OF ARNICA.

Teinture d'arnica, Fr.; *Arnikatinktur*, G.

Preparation.—Take of Arnica six troyounces; Alcohol a pint and a half; Water half a pint; Diluted Alcohol a sufficient quantity. Mix the alcohol and water, and, having moistened the arnica slightly with a portion of the mixture, bruise it thoroughly in a mortar. Then pack it firmly in a cylindrical percolator, and pour upon it the remainder of the mixture, and afterwards diluted alcohol, until two pints of tincture are obtained. *U. S.*

The British Pharmacopœia directs one ounce of arnica *root* in coarse powder and sufficient rectified spirit to obtain one pint (imperial).

Tincture of arnica of the French and German Pharmacopœias is nearly identical with that prepared by the first formula. If a weaker alcohol be employed, a darker colored tincture is obtained containing more extractive matter, but less of the resinous and oily constituents.

Medical Uses.—In Germany tincture of arnica is universally employed as the sovereign domestic remedy for *wounds*, *bruises*, and all manner of *local pains*, which it benefits quite as much through the alcohol as through the essential oil that it contains. It is applied diluted with water as a lotion, or upon compresses; but is not often prescribed internally.

TINCTURA ASSAFŒTIDÆ, *U. S.*, *Br.*—TINCTURE OF ASAFETIDA.

Teinture d'ase-fétide, Fr.; *Stinkasanttinktur*, G.

Preparation.—Take of Asafœtida bruised four troyounces; Alcohol two pints. Macerate for seven days, and filter through paper. *U. S.*

The proportions of other Pharmacopœias are: Asafœtida two and a half ounces (avoird.), rectified spirit sufficient for one pint (imperial), *Br.* Asafœtida one part, alcohol five parts, *F. P.*, *P. G.*

The tincture has a yellowish brown-red color, and is rendered milky on the addition of water.

Medical Uses.—Owing to its repulsive taste, tincture of asafetida is seldom given by the mouth, although the *dose* is commonly stated to be from thirty minims to a fluidrachm. It is more convenient and useful in an enema, with water alone, or with other appropriate adjuncts, for the relief of *flatulence*, and for obtaining the influence of the drug in *hysterical* attacks. From half a fluidounce to one fluidounce may be used in this mannner.

TINCTURA AURANTII, *U. S.*, *Br.*—TINCTURE OF ORANGE PEEL.

Teinture d'écorce d'oranges amères, Fr.; *Pomeranzenschalentinktur*, G.

Preparation.—Take of Bitter Orange Peel in moderately fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with two fluidounces of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

Other Pharmacopœias direct: Bitter orange peel two ounces (avoirdupois), proof spirit sufficient for one pint (imperial), *Br.* Bitter orange peel one part, alcohol specific gravity 0.893 five parts, *F. P.*, *P. G.*

The tincture has a yellowish-brown color.

Medical Uses.—Tincture of orange peel is employed almost exclusively as a flavoring ingredient in mixtures. The *dose* is one or two fluidrachms.

TINCTURA AURANTII RECENTIS, *Br. Add.*—TINCTURE OF FRESH ORANGE PEEL.

Preparation.—Take of Bitter Orange, Rectified Spirit, each a sufficiency. Carefully cut from the orange the colored part of the rind in thin slices, and macerate six ounces of this in a pint of the spirit for a week, with frequent agitation. Then pour off the liquid, press the dregs, mix the liquid products, and filter; finally, add sufficient spirit to make one pint. *Br.*

Medical Uses.—The tincture of fresh orange peel contains a larger proportion of the volatile oil, and has a more agreeable flavor than that made from the dry rind. The *dose* is one or two fluidrachms.

TINCTURA BELLADONNÆ, *U. S.*, *Br.*—TINCTURE OF BELLADONNA.

Teinture de belladonne, Fr.; *Belladonnatinktur*, G.

Preparation.—Take of Belladonna Leaves recently dried and in fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with two fluidounces of diluted alcohol, pack it firmly in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The proportions directed by other Pharmacopœias are: Belladonna leaves one ounce (avoirdupois), proof spirit sufficient for one pint (imperial), *Br.* Belladonna leaves one part, 60 per cent. alcohol sufficient to obtain five parts, *F. P.* Fresh belladonna leaves with the flowering branchlets five parts, alcohol six parts, *P. G.*

The color of this tincture is greenish-brown or brown-green, according to the strength of the alcohol.

Medical Uses.—The British tincture is about half as strong as the American. Yet the *dose* of the former is stated (Br. Ph.) to be from five to twenty minims, and of the latter (U. S. Disp.) from fifteen to thirty drops. It is prudent to give, at first, only the minimum dose of either, and gradually to increase the quantity until the specific effects of the drug appear.

TINCTURA BENZOINI, *U. S.*—TINCTURE OF BENZOIN.

Tinctura benzoës, P. G.—*Teinturede benjoin*, Fr.; *Benzoëtinktur*, G.

Preparation.—Take of Benzoin in moderately coarse powder six troyounces; Alcohol two pints. Macerate for seven days, and filter through paper. *U. S.*

Take of benzoin one part; alcohol five parts. Macerate. *F. P.*, *P. G.*

The tincture is brownish-red, and is precipitated by water.

Medical Uses.—The tincture of benzoin was formerly in more general use than at present, both internally and externally. By the former method it was employed in chronic mucous profluvia of the *bronchial* and *urinary organs*, and even in chronic *diarrhœa* and *dysentery*, in the same cases, in short, for which copaiba has more recently been recommended. As a local application, by means of the atomizer, it may sometimes be administered with benefit in chronic *laryngeal* and *bronchial catarrh*. Externally, it is useful both as a stimulant and a protective for *ulcers*, and even for slight fresh *wounds*. But it is more applicable to irritable and indolent sores, as *bed-sores*, ulcers tending to gangrene, *sore nipples*, *chapped hands* and *lips*, and to slight lesions of the same sort about the *anus*. Mixed with water or rose-water it may be used to remove *freckles* and slight papular and other *eruptions*, as well as to preserve the freshness and suppleness of the skin. It is the medicinal ingredient of the usual forms of court plaster, and too often renders this preparation irritating rather than healing. The *dose* of tincture of benzoin is from thirty minims to a fluidrachm.

TINCTURA BENZOINI COMPOSITA, *U. S.*, *Br.*—COMPOUND TINCTURE OF BENZOIN.

Tinctura balsamica, *Balsamum commendatoris*, *Elixir traumaticum.*—*Teinture balsamique*, *Baume du commandeur de Permes*, Fr.; *Persischer Wundbalsam*, G.

Preparation.—Take of Benzoin in coarse powder three troyounces; Socotrine Aloes in coarse powder half a troyounce; Storax two troyounces; Balsam of Tolu a troyounce; Alcohol two pints. Macerate for seven days, and filter through paper. *U. S.*

Take of Benzoin in coarse powder two ounces; Prepared Storax one and a half ounce; Balsam of Tolu one-half ounce (avoirdupois); Socotrine Aloes one hundred and sixty grains; Rectified Spirit sufficient for one pint (imperial). Macerate for seven days, and filter. *Br.*

The French preparation is made with 80 per cent. alcohol seven hundred and twenty parts; angelica root ten parts; St. Johnswort twenty parts; myrrh ten parts; olibanum ten parts; aloes ten parts; balsam of tolu sixty parts; and benzoin sixty parts.

The older Pharmacopœias had still more complicated formulas.

The tincture is intended to take the place of numerous preparations formerly employed, as *Wade's*, *Vervain's*, *Saint Victor's*, *Jesuits'*, *Friars'*, *Turlington's*, *Persian*, and *Swedish balsam*. It is of a deep brown color, and is precipitated by water.

Medical Uses.—The uses of the compound tincture are essentially the same as those of the simple tincture of benzoin; but the former is in most cases the more efficient of the two. Especially is this true of its use in affections of the air-passages and lesions of the skin. For such ailments it was for centuries in high repute under various names, as Friars' balsam, Turlington's balsam, etc., until it was displaced by the influence of doctrinal principles in therapeutics. Those who considered the cure of disease of more consequence than the justification of a doctrine, adhered to its use, and the medicine survived the theory. It is needless to particularize the cases in which this preparation may be beneficially used; they are, as already stated, those mentioned under the head of the simple tincture. The *dose* is from thirty minims to a fluidrachm.

TINCTURA BUCHU, *Br.*—TINCTURE OF BUCHU.

Teinture de bucco, Fr.; *Buckutinktur*, G.

Preparation.—Take of Buchu Leaves in coarse powder two and a half ounces (avoirdupois); Proof Spirit one pint (imperial). Prepare the tincture by the process described on page 1396. *Br.*

This tincture has a greenish-brown color.

Medical Uses.—A medicine intended to allay irritated conditions of the urinary passages should seldom be prepared with alcohol; or if it is so, it should be administered in a large proportion of water. The convenience of dispensing buchu under certain circumstances may justify this preparation, but on purely therapeutical grounds it is ineligible. The *dose* of the tincture is one or two fluidrachms.

TINCTURA CALUMBÆ, *U. S.*, *Br.*—TINCTURE OF COLUMBO.

Tinctura colombo.—*Teinture de colombo*, Fr.; *Kolombotinktur*, G.

Preparation.—Take of Columbo in moderately fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with a fluidounce of diluted alcohol, transfer it to a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The proportions directed by other Pharmacopœias are: Colombo two and a half ounces (avoirdupois), proof spirit sufficient for one pint (imperial), *Br.* Colombo one part, sixty per cent. alcohol five parts, *F. P.*

The alcoholic strength of the last formula is preferable, since precipitation is more effectually prevented. The tincture has a brown-yellow color.

Medical Uses.—This tincture possesses all the virtues of columbo, and may be given for the same purposes. It is chiefly employed as a stomachic tonic during convalescence from acute diseases, and in feeble states of digestion from other causes. It may also be added to bitter infusions where a special stimulant action is desired. The *dose* is one or two fluidrachms.

TINCTURA CAMPHORÆ COMPOSITA, *Br.* See TINCTURA OPII CAMPHORATA.

TINCTURA CANNABIS, *U. S.*—TINCTURE OF HEMP.

Tinctura cannabis indicæ, Br., P. G.—*Tincture of Indian hemp*, E.; *Teinture de chanvre indien*, Fr.; *Indischhanftinktur*, G.

Preparation.—Take of Extract of Indian Hemp three hundred and sixty grains; Alcohol a pint. Dissolve the extract in the alcohol, and filter through paper. *U. S.*

Other Pharmacopœias direct: Extract of Indian hemp one ounce (avoirdupois), rectified spirit one pint (imperial), *Br.* Extract of Indian hemp one part, alcohol nineteen parts, *P. G.* Indian hemp one part, alcohol five parts, *F. P.*

This tincture has a dark green color, and becomes milky with water.

Medical Uses.—The tincture of Indian hemp may be employed for the same purposes as the extract of that plant, but is ineligible on account of the precipitation of its resin by water. The primary *dose* is about twenty minims.

TINCTURA CANTHARIDIS, *U. S.*, *Br.*—TINCTURE OF CANTHARIDES.

Tinctura cantharidum, P. G.—*Teinture de cantharides*, Fr.; *Spanischfliegentinktur*, G.

Preparation.—Take of Cantharides in fine powder a troyounce; Diluted Alcohol a sufficient quantity. Moisten the powder with half a fluidounce of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The proportions directed by other Pharmacopœias are: Cantharides a quarter of an ounce (avoirdupois), proof spirit one pint (imperial), *Br.* Cantharides one part, alcohol ten parts, *F. P.*, *P. G.*

Made by the first two formulas, the tincture is yellowish-brown, and contains much inert extractive. The last formula yields a greenish-yellow preparation.

Medical Uses.—This preparation is convenient for use in the comparatively rare cases in which cantharides are internally administered. It may be prescribed in doses of twenty drops and upwards until vesical irritation is produced. The American is twice as strong as the British tincture, the dose of which, however, is officially stated to be from five to twenty minims. Tincture of cantharides should be administered largely diluted in a mucilaginous vehicle. The external uses of this preparation include numerous cases in which a more prolonged and sustained irritation, amounting sometimes to rubefaction, is required than can be obtained by more immediate irritants. Although sometimes applied in liniments to the whole surface of the body, it is manifestly less appropriate to such a purpose than stimulants which act more promptly and for a shorter time; its proper use is as a substitutive stimulant in local *torpor*, *congestions*, *inflammations*, and *pains*, in *neuralgia* of certain nerves, *alopecia*, *frostbite*, *fistulous ulcers*, etc. The following liniment is useful in alopecia; ℞. Cologne water f℥j, tincture of cantharides f℥iss, tinctures of rosemary and lavender of each 10 drops. The scalp should be gently rubbed every day with this lotion applied on a sponge or piece of flannel.

TINCTURA CAPSICI, *U. S.*, *Br.*—TINCTURE OF CAPSICUM.

Teinture de piment des jardins, Fr.; *Spanischpfeffertinktur*, G.

Preparation.—Take of Capsicum in fine powder a troyounce; Diluted Alcohol a sufficient quantity. Moisten the powder with half a fluidounce of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

Other Pharmacopœias direct: Capsicum three-quarters of an ounce (avoirdupois), proof spirit sufficient for one pint (imperial), *Br.* Capsicum one part, alcohol ten parts, *P. G.*

The tincture has a light reddish-orange color.

Medical Uses.—This tincture can be used for most of the purposes for which capsicum has been recommended, and especially as an addition to gargles, rubefacient liniments, and mixtures intended to stimulate the stomach exhausted by alcoholic excesses. It may be prescribed in *doses* of one or two fluidrachms appropriately diluted.

TINCTURA CARDAMOMI, *U. S.*—TINCTURE OF CARDAMOM.

Teinture de cardamome, Fr.; *Kardamomentinktur*, G.

Preparation.—Take of Cardamom in fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with two fluidounces of diluted alcohol, pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

It is of a light yellowish-brown color.

Medical Uses.—The simple is much less used than the compound tincture of cardamom. It may, however, be prescribed as a carminative, in the *dose* of one or two fluidrachms.

TINCTURA CARDAMOMI COMPOSITA, *U. S.*, *Br.*—COMPOUND TINCTURE OF CARDAMOM.

Teinture de cardamome composée, Fr.; *Zusammengesetzte Kardamomentinktur*, G.

Preparation.—Take of Cardamom in moderately fine powder three hundred and sixty grains; Caraway in moderately fine powder one hundred and twenty grains; Cinnamon in moderately fine powder three hundred grains; Cochineal in moderately fine powder sixty grains; Clarified Honey two troyounces; Diluted Alcohol a sufficient quantity. Mix the powders, and, having moistened the mixture with half a fluidounce of diluted alcohol, pack it in a cylindrical percolator, and gradually pour diluted alcohol upon it until two pints and six fluidounces of tincture are obtained. Lastly, mix this with the clarified honey, and filter through paper. *U. S.*

The ingredients directed in the British Pharmacopœia are: Cardamom seeds freed from the pericarps, and caraway fruit, each a quarter of an ounce; raisins freed from their seeds two ounces; cinnamon bark half an ounce (avoirdupois); cochineal sixty grains; proof spirit sufficient for one pint (imperial).

Both tinctures have a red color.

Off. Prep.—Decoct. aloes comp.; Mist. ferri arom.; Mist. sennæ comp.; Tinct. chloroformi comp., *Br.*

Medical Uses.—This tincture, on account of its brilliant color and carminative properties, is, when mixed with sweetened hot water, a favorite remedy for flatulent *colic*. It is a customary addition to mixtures intended to relieve similar affections. The *dose* is one or two fluidrachms.

TINCTURA CASCARILLÆ, *Br.*—TINCTURE OF CASCARILLA.

Teinture de cascarille, Fr.; *Kaskarilltinktur*, G.

Preparation.—Take of Cascarilla Bark two and a half ounces (avoirdupois); Proof Spirit one pint. The tincture is to be prepared by the process given on page 1396.

The French and German Pharmacopœias employ cascarilla one part, to 60 per cent. alcohol five parts. The tincture has a reddish-brown color.

Medical Uses.—Although not generally used in this country, it is not unworthy of being employed in cases requiring a tonic and stimulant operation. It is especially useful in *dyspeptic* gastro-intestinal derangements due to atony, and is beneficially associated in these affections and others with compound tincture of cinchona. The *dose* is from half a fluidrachm to two fluidrachms.

TINCTURA CASTOREI, *U. S.*, *Br.*—TINCTURE OF CASTOR.

Teinture de castoréum, Fr.; *Bibergeiltinktur*, G.

Preparation.—Take of Castor bruised two troyounces; Alcohol two pints. Macerate for seven days, express, and filter through paper. *U. S.*

Other Pharmacopœias direct: Castor one ounce (avoird.), rectified spirit sufficient for one pint (imperial), *Br.* Castor one part, alcohol ten parts, *F. P.* The German Pharmacopœia directs two tinctures, one from American, the other from Siberian castor, using ten parts of alcohol spec. grav. 0.893, for one part of the drug. The tincture has a brown color, and becomes milky on the addition of water.

Medical Uses.—Tincture of castor is seldom employed; but, in the obligatory variation of medicines used in the treatment of hysterical disorders, it may occasionally find its place, particularly in enemas. The latter method is peculiarly appropriate when a hysterical attack occurs about the *menstrual period*, with symptoms of utero-ovarian irritation, and flatulent distension of the bowels. The ataxic state of *low fevers* may be treated in the same manner, but with less prospect of doing good than by the use of asafetida, valerian, opium, or simply alcohol. *Dose*, from half a fluidrachm to two fluidrachms.

TINCTURA CATECHU, *U. S.*, *Br.*—TINCTURE OF CATECHU.

Teinture de cachou, Fr.; *Katechutinktur*, G.

Preparation.—Take of Catechu in moderately fine powder three troyounces; Cinnamon in moderately fine powder two troyounces; Diluted Alcohol a sufficient quantity. Mix the powders, and, having moistened the mixture with a fluidounce of diluted alcohol, pack it in a conical glass percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The formulas of other Pharmacopœias direct: Pale catechu two and a half ounces, cinnamon bark one ounce (avoird.), proof spirit sufficient for one pint (imperial), *Br.* Catechu one part, 60 per cent. alcohol five parts, *F. P.*, *P. G.* The tincture has a dark red-brown color.

Medical Uses.—Tincture of catechu is used internally chiefly for the purpose of diminishing diarrhœa. When the latter affection is acute, the tincture is generally administered in chalk mixture; when chronic, it is often given with port wine. Externally it is useful as a dressing for indolent *ulcers* of soft tissues, and particularly of the *nipples* and *anus*. Diluted with water it may be injected into the rectum or vagina in chronic *fluxes* of those organs. The *dose* is from thirty minims to two fluidrachms.

TINCTURA CHIRATÆ, *Br.*—TINCTURE OF CHIRETTA.

Teinture de chirette, Fr.; *Chirettatinktur*, G.

Preparation.—Take of Chiretta cut small and bruised two and a half ounces (avoird.); Proof Spirit one pint (imperial). Prepare the tincture by the process described on page 1396. *Br.*

The tincture is of a greenish-brown color.

Medical Uses.—The medicinal qualities of this preparation are closely analogous to those of colombo. It is but little used in this country. *Dose*, from thirty minims to two fluidrachms.

TINCTURA CHLOROFORMI COMPOSITA, *Br.*—COMPOUND TINCTURE OF CHLOROFORM.

Preparation.—Take of Chloroform two fluidounces; Rectified Spirit eight fluidounces; Compound Tincture of Cardamom ten fluidounces. Mix. *Br.*

(See also Spiritus chloroformi.)

Medical Uses.—This is the most convenient form for administering chloroform internally. The *dose* is from twenty to forty minims. It is chiefly used for allaying flatulent, biliary, and renal *colics*, but has also been employed in *delirium tremens* and in *mania à potu.*

TINCTURA CINCHONÆ, *U. S.*—TINCTURE OF CINCHONA.

Tinctura cinchonæ flavæ, Br.; *Tinctura chinæ*, P. G.—*Tincture of yellow cinchona*, E.; *Teinture de quinquina*, Fr.; *Chinatinktur*, G.

Preparation.—Take of Yellow Cinchona in moderately fine powder six troyounces; Alcohol, Water, each a sufficient quantity. Mix three measures of alcohol with one of water. Moisten the powder with two fluidounces of the mixture, pack it firmly in a conical glass percolator, and gradually pour the mixture upon it until two pints of tincture are obtained. *U. S.*

Other Pharmacopœias employ: Yellow cinchona four ounces (avoird.), proof spirit sufficient for one pint (imper.), *Br.* Yellow cinchona one part, 60 per cent. alcohol sufficient for five parts, *F. P.* Pale cinchona one part, alcohol specific gravity 0.893 five parts, *P. G.* The tincture has a reddish-brown color, and, if not sufficiently strong in alcohol, deposits a sediment of cinchonic red containing kinates of the alkaloids. Mr. A. B. Taylor (1865) found a menstruum composed of two measures of alcohol and one measure each of water and glycerin, capable of preventing this precipitation for several months.

Medical Uses.—Tincture of cinchona is seldom given alone, but generally as an addition to tonic mixtures, infusions, etc., and especially for modifying the taste of solutions of quinia. But for these and all other purposes the compound tincture is preferable. *Dose*, one or two fluidrachms.

TINCTURA CINCHONÆ COMPOSITA, *U. S.*, *Br.*—COMPOUND TINCTURE OF CINCHONA.

Huxham's tincture of bark, E.; *Teinture de quinquina composée*, Fr.; *Zusammengesetzte Chinatinktur*, G.

Preparation.—Take of Red Cinchona in moderately fine powder four troyounces; Bitter Orange Peel in moderately fine powder three troyounces; Serpentaria in moderately fine powder three hundred and sixty grains; Alcohol, Water, each a sufficient quantity. Mix three measures of alcohol with one of water. Having mixed the powders, moisten them with four fluidounces of the menstruum, pack them firmly in a conical glass percolator, and gradually pour on the menstruum until two pints and a half of tincture are obtained. *U. S.*

The British Pharmacopœia directs the exhaustion of pale cinchona two ounces, bitter orange peel one ounce, serpentary root one-half ounce (avoirdupois), saffron sixty grains, and cochineal thirty grains, with sufficient proof spirit to obtain one pint (imperial).

The tincture of the German Pharmacopœia is also known as *Elixir roborans Whyttii*, and is composed of pale cinchona six parts, orange peel and gentian root each two parts, Chinese cinnamon one part, alcohol specific gravity 0.893 fifty parts.

Under the names of elixir of calisaya and compound elixir of cinchona, sweetened aromatic tinctures of cinchona have been employed, and numerous formulas for the same have been published differing not only in the aromatics used, but also in other respects, and notably in this, that many of these preparations are made with some of the cinchona alkaloids instead of with the bark. The American Pharmaceutical Association (1873 and 1875) adopted the following formulas:—

ELIXIR OF CALISAYA BARK.—Tincture of cinchona three fluidounces; simple elixir thirteen fluidounces.

COMPOUND ELIXIR OF CINCHONA.—Compound tincture of cinchona three fluidounces; simple elixir thirteen fluidounces.

Simple Elixir.—Spirit of orange two fluidrachms; spirit of cinnamon ten minims; alcohol four fluidounces; syrup and water, of each six fluidounces. This is used as the base for all other elixirs, and if colored red by tincture of cochineal is called *red elixir*.

Spirit of Orange is made by dissolving one fluidounce of oil of sweet orange in fifteen fluidounces of stronger alcohol.

Medical Uses.—The one disease, or morbid condition rather, in which this preparation of cinchona is superior to all others, is the *typhoid state*, whatever may be the original affection during which it is developed. In doing good, the cinchona is aided by the serpentaria and alcohol of the compound, if not, as was once believed, by the saffron also (Br. Ph.). It should be given in small and repeated, and largely diluted *doses* of from one to two fluidrachms.

TINCTURA CINNAMOMI, *U. S.*, *Br.*—TINCTURE OF CINNAMON.

Teinture de cannelle, Fr.; *Zimmttinktur*, G.

Preparation.—Take of Cinnamon in fine powder three troyounces; Alcohol, Water, each a sufficient quantity. Mix two measures of alcohol with one of water. Moisten the powder with a fluidounce of the mixture, pack it moderately in a conical percolator, and gradually pour the mixture upon it until two pints of filtered liquid are obtained. *U. S.*

Other Pharmacopœias direct: Cinnamon two and a half ounces (avoird.), proof spirit sufficient for one pint (imperial), *Br.* Cinnamon one part, alcohol (80 per cent.) sufficient for five parts, *F. P.* Cinnamon one part, alcohol specific gravity 0.893 five parts, *P. G.* The tincture has a red-brown color, and sometimes gelatinizes when made with diluted alcohol.

Medical Uses.—The agreeable taste and slight astringency of this preparation render it a suitable addition to mixtures intended to check recent diarrhœa. It may be added to lime-water to control *nausea* and *vomiting*. *Dose*, half a fluidrachm to two fluidrachms.

TINCTURA COCCI, *Br.*—TINCTURE OF COCHINEAL.

Teinture de cochenille, Fr.; *Cochenilletinktur*, G.

Preparation.—Take of Cochineal in powder two and a half ounces (avoird.); Proof Spirit one pint (imperial). Macerate for seven days in a closed vessel, with occasional agitation; strain, press, filter, and add sufficient proof spirit to make one pint. *Br.*

Medical Uses.—It is used exclusively for coloring tinctures, ointments, and mixtures.

TINCTURA COLCHICI, *U. S.*—TINCTURE OF COLCHICUM.

Tinctura colchici seminum, Br.—*Tincture of colchicum seeds*, E.; *Teinture de semences de colchique*, Fr.; *Zeitlosentinktur*, G.

Preparation.—Take of Colchicum Seed in moderately fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with a fluidounce of diluted alcohol, pack it in a cylindrical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The proportions directed by other Pharmacopœias are: Colchicum seed two and a half ounces (avoird.), proof spirit sufficient for one pint (imperial), *Br.* Colchicum seed one part, alcohol sp. gr. 0.893 five parts, *F. P.*, *P. G.*

Medical Uses.—The British tincture is of the same strength as the American. Both possess the proper virtues of colchicum, and may be used as well as the wine. The difference of alcoholic strength between them and the wine can make no perceptible difference in the effects of such doses as are practically employed. The *dose* of either tincture is from ten to thirty minims.

TINCTURA CONII, *U. S.*, *Br.*—TINCTURE OF CONIUM.

Teinture de ciguë, Fr.; *Schierlingstinktur*, G.

Preparation.—Take of Conium Leaves recently dried and in fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with two fluidounces of diluted alcohol, pack it firmly in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The British Pharmacopœia very properly prepares this tincture from the fruit, which, however, is used in the ripe state. Two and a half ounces of the bruised fruit are employed with sufficient proof spirit to obtain one pint (imperial).

Medical Uses.—Tincture of conium is not regarded as an eligible preparation, inasmuch as the quantity of it capable of producing definite effects contains sufficient alcohol to counteract the sedative action of the conium. It is supplanted by the juice of conium. *Dose*, from twenty to sixty minims.

TINCTURA CROCI, *Br.*—TINCTURE OF SAFFRON.

Teinture de safran, Fr.; *Safrantinktur*, G.

Preparation.—Take of Saffron one ounce (avoird.); Proof Spirit, one pint (imperial). Prepare the tincture by the process described on page 1396. *Br.*

Take of saffron one part; alcohol (sp. gr. 0.893 *P. G.*) ten parts. Macerate for ten days, express and filter. *F. P.*, *P. G.*

The tincture is of a rich orange-yellow color.

Medical Uses.—Tincture of saffron is rarely given alone internally. It is chiefly employed to impart a pleasing color to mixtures. *Dose*, one or two fluidrachms.

TINCTURA CUBEBÆ, *U. S.*, *Br.*—TINCTURE OF CUBEB.

Teinture de cubèbes, F.; *Kubebentinktur*, G.

Preparation.—Take of Cubeb in moderately fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with a fluidounce of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The British Pharmacopœia uses two and a half ounces (avoird.) of powdered cubebs and sufficient proof spirit to obtain one pint (imperial).

The tincture has a brownish color. It is too weak in alcohol for dissolving all the volatile oil contained in good cubebs.

Medical Uses.—Tincture of cubeb is chiefly of use in *gleets*, but sometimes also as a carminative. The *dose* is from half a fluidrachm to two fluidrachms.

TINCTURA DIGITALIS, *U. S.*, *Br.*—TINCTURE OF DIGITALIS.

Teinture de digitale, Fr.; *Fingerhuttinktur*, G.

Preparation.—Take of Digitalis recently dried and in fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with two fluidounces of diluted alcohol, pack it firmly in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

Other Pharmacopœias direct: Digitalis two and a half ounces (avoird.), proof spirit sufficient for one pint (imper.), *Br.* Digitalis one part, 60 per cent. alcohol ten parts, *F. P.* Fresh digitalis leaves five parts, alcohol six parts, *P. G.* The tincture is of a brown-green color.

Medical Uses.—The special virtues of digitalis are possessed by this preparation, which is more used than any other to obtain the action of the drug upon the heart. Its convenience rather than its superiority has probably led to this custom. Friction of the abdomen and of other parts of the body with tincture of digitalis, has sometimes been followed by diuresis, in dropsy. *Dose*, from ten to twenty minims three or four times a day.

TINCTURA ERGOTÆ, *Br.*—TINCTURE OF ERGOT.

Tinctura secalis cornuti, P. G.—*Teinture de seigle ergoté*, Fr.; *Mutterkorntinktur*, G.

Preparation.—Take of Ergot in coarse powder five ounces (avoird.); Proof Spirit one pint (imperial). Prepare the tincture by the process described on page 1396. *Br.*

Other Pharmacopœias use: Ergot one part, sixty per cent. alcohol five parts, *F. P.* Ergot one part, alcohol sp. gr. 0.893 ten parts, *P. G.* The tincture has a red-brown color.

Medical Uses.—The stimulant action of the alcohol in this preparation probably renders it less eligible than the wine or the fluid extract of ergot. The *dose* is from ten minims to a fluidrachm.

TINCTURA FERRI ACETATIS, *Br.*—TINCTURE OF ACETATE OF IRON.

Teinture d'acétate de fer, Fr.; *Essigsaure Eisentinktur*, G.

Preparation.—Take of Solution of Persulphate of Iron two and a half fluidounces; Acetate of Potash two ounces (avoird.); Rectified Spirit a sufficiency. Dissolve the acetate of potash in ten fluidounces, and add the persulphate of iron to eight fluidounces of the spirit; then mix the two solutions in a two-pint bottle, and shake them well together, repeating the agitation several times during an hour. Put the tincture, with the precipitated salt contained in it, upon a filter, and when the liquid has ceased to run through, put as much rectified spirit upon the filter as will make the filtered product measure one pint. *Br.*

On mixing solutions of ferric sulphate and potassium acetate, the mixture assumes a dark, blood-red color from the formation of ferric acetate. $Fe_2 3SO_4 + 6KC_2H_3O_2$ yields $Fe_2 6C_2H_3O_2 + 3K_2SO_4$. The sulphate of potassium which is produced at the same time, being insoluble in alcohol, is precipitated, and the filtrate will be an alcoholic solution of potassium acetate. The tincture is very apt to spoil on exposure to light, or to a somewhat elevated temperature, depositing brown basic ferric acetate; it should be kept in a dark and cool place.

Other forms of Ferric Acetate.—Liquor ferri acetici, *P. G.*, is made by mixing 10 parts of solution of tersulphate of iron (sp. gr. 1.318) with 30 parts of distilled water, and adding to it, with constant stirring, 8 parts of ammonia water previously diluted with 160 parts of distilled water. The precipitate is washed on a linen strainer, drained and pressed until it weighs 5 parts, when it is mixed with 6 parts of acetic acid (sp. gr. 1.040), and frequently stirred in a cool place. After several days the liquid is filtered; it should weigh 10 parts.

Ferri acetas.—The clear solution, as obtained in the preceding process by decanting, instead of filtering from the insoluble matter, is evaporated at a temperature of about 60° C. (140° F.) until a dry mass remains.

Tinctura ferri acetici ætherea, *P. G.* Take of solution of acetate of iron 9 parts; alcohol 2 parts; acetic ether 1 part. Mix.

Tests.—The above preparations, after being precipitated by an excess of ammonia, yield a filtrate which is not precipitated by sulphuretted hydrogen (*zinc*, etc.), barium chloride (*sulphate*); or, after having been acidulated with nitric acid, by nitrate of silver; and, on being evaporated at the boiling temperature, does not leave any fixed residue.

Medical Uses.—This preparation is reputed by English authorities to be not only an excellent chalybeate for general purposes, but also one of the best of the *styptic* ferruginous preparations for internal administration. It should be given largely diluted with water, and taken in small and repeated doses. The *dose* is from five to thirty minims.

TINCTURA FERRI CHLORIDI, *U. S.*—Tincture of Chloride of Iron.

Tinctura ferri perchloridi, Br.; *Tinctura ferri sesquichloridi.*—*Tincture of perchloride of iron*, E.; *Teinture de perchlorure de fer*, Fr.; *Eisenchloridtinktur*, G.

Preparation.—Take of Solution of Chloride of Iron half a pint; Alcohol a pint and a half. Mix them, and preserve the mixture in a well-stopped bottle. *U. S.*

Take of Strong Solution of Perchloride of Iron five fluidounces; Rectified Spirit fifteen fluidounces. Mix. Its spec. grav. is 0.992. *Br.*

The two tinctures are nearly of the same iron strength, yet they differ in this, that two pints of that made by the first formula contain half a troyounce of free muriatic acid. The tincture, particularly when exposed to the light, has the ferric chloride partly reduced to ferrous chloride, and, if free acid be present, gradually acquires an ethereal odor. Dr. Rob. Battey and Mr. J. C. Wharton (1870) occasionally observed the tincture to deposit white crystals of sulphate of calcium, which were probably derived from impurity in the acid.

Tests.—Impurities may be detected in the tincture by the same tests as in the solution (see p. 830). The ferric oxide, obtained from one fluidounce of the tincture, and ignited, should weigh nearly 29 grains.

Allied Preparations.—Tinctura ferri chlorati, *P. G.*, is a solution of 25 parts of recently prepared *ferrous* chloride in 225 parts of alcohol, sp. gr. 0.893, and 1 part of hydrochloric acid. It has a yellowish-green color.

Tinctura ferri chlorati ætherea, *P. G.*, s. *Tinctura tonico-nervina Bestucheffii*, s. *Liquor anodynus martiatus.*—One part of solution of ferric chloride, spec. grav. 1.482 (containing 43.5 per cent. Fe_2Cl_6) is dissolved in 14 parts of spirit of ether, the solution exposed to the sunlight until colorless, and afterwards kept in partially filled bottles in a shady place. During the bleaching process the ferric is reduced to ferrous chloride, chloride of ethyl and a little aldehyd being generated through the influence of the nascent chlorine. On exposure to air the salt is partly oxidized to basic ferric chloride.

Physiological Action.—Tincture of chloride of iron is, of all ferruginous compounds, except the solutions of the chloride and of the persulphate, the one that exerts the most powerful local action as a styptic, and indeed as a caustic upon delicate tissues. Even when largely diluted it constringes the mouth and fauces. A diuretic action is attributed to it, which is probably due to the ether which it contains. It is very apt to attack the teeth, unless properly diluted and taken through a tube. One or two cases are reported of strangury caused by its external application.

Medical Uses.—Like the solution of chloride of iron, this preparation may be used as a local styptic, but it is less efficient than the former preparation. It is better suited for internal administration in all cases of passive *hemorrhage*, and especially in that from the uterus. It is eminently serviceable when hemorrhage depends upon imperfect coagulability of the blood, associated with a lax condition of the solids and general debility. For these reasons, doubtless, it is very efficient in *purpura hemorrhagica*. It is probably the best preparation that can be employed in chronic *albuminuria*, although the utility of other ferruginous preparations in the same affection proves that they do not act by their astringency as much as by their reconstituent power in the blood. Indeed, the form in which the tincture is ordinarily given in renal disorders, "Basham's mixture," no longer holds iron as a chloride, but as an acetate. Possibly, the free acids of this preparation act as diuretics. The formula for this solution is as follows: ℞. Tr. ferri chloridi, f℥ss; acid. acetic. dil. f℥j; liq. ammoniæ acet. f℥ivss; tr. aurant. cort. f℥iss; glycerinæ, f℥ss.—M. S.—A tablespoonful, largely diluted, two or three times a day.

In various chronic mucous fluxes, including *leucorrhœa*, *blenorrhœa*, *bronchorrhœa*, *diarrhœa*, and also in passive *sweats*, this preparation is often of essential service, both by its constringing action and its reconstituent operation. It is scarcely less efficient in *vesical catarrh*, especially when it is associated with paralysis of the bladder. Doubtless the double action just indicated renders it an efficient remedy in cases of *seminal losses*, due to excessive or unnatural stimulation of the genital organs. To its astringency must probably be ascribed its remarkable efficacy in *idiopathic erysipelas*, and its alleged utility in other forms of the same affection. In regard to the first-named disease, the virtues of the medicine are incontestable whenever it is administered in sufficient doses, *i. e.*, of from twenty to thirty drops every two hours, both night and day. In many cases of traumatic erysipelas its utility is equally well established. In *diphtheria* this tincture is one of the most efficient topical applications to the parts on which the exudation is seated; and its internal administration in appropriate doses, such as from five to fifteen drops every half hour or hour, has produced better results than any other medicine. When thus administered, the special topical use of the medicine may be dispensed with. As an application to *chilblains* it is sometimes used. It has also been employed, in large and repeated doses, in acute articular *rheumatism;* but while the results show that it is tolerated in most instances, and appears to be beneficial in a small proportion of mild cases, yet the proportion of cardiac complications occurring during its administration seems to have been unnecessarily large.

This tincture may be applied in the same manner as the solution of chloride of iron, for arresting *hemorrhage*, whether external or internal. It may be inhaled as an atomized solution in cases of pulmonary hemorrhage. For the latter purpose a solution of one part of the tincture to ten parts of water may be used.

The *dose* of this medicine is from ten to thirty drops largely diluted with water.

TINCTURA GALLÆ, *U. S.*, *Br.*—TINCTURE OF NUTGALL.

Tinctura gallarum, P. G.—*Tincture of galls*, E.; *Teinture de noix de galle*, Fr.; *Galläpfeltinktur*, G.

Preparation.—Take of Nutgall in moderately fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with a fluidounce of diluted alcohol, pack it in a glass percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The strength directed by other Pharmacopœias is as follows: Nutgall two and a half ounces (avoird.); proof spirit sufficient for one pint (imperial). *Br.* Nutgall one part; sixty per cent. alcohol five parts. *F. P.*, *P. G.*

The tincture is of a yellowish-brown color, and, when long kept, gradually deposits gallic acid.

Medical Uses.—Tincture of nutgall is seldom given internally, but is sometimes used, diluted with water, as a lotion in relaxed conditions of the *mouth* and *fauces*, of the *rectum* and of the *vagina*. *Dose*, from thirty minims to two fluidrachms.

TINCTURA GENTIANÆ COMPOSITA, *U. S.*, *Br.*—COMPOUND TINCTURE OF GENTIAN.

Preparation.—Take of Gentian in moderately fine powder two troyounces; Bitter Orange Peel in moderately fine powder a troyounce; Cardamom in moderately fine powder half a troyounce; Diluted Alcohol a sufficient quantity. Mix the powders, and, having moistened the mixture with a fluidounce and a half of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The British Pharmacopœia prepares one pint (imperial) of tincture from gentian one and a half ounce, bitter orange peel three-quarters of an ounce, and one-quarter of an ounce (avoird.) of cardamom seeds deprived of the pericarps, using sufficient proof spirit.

The *teinture de gentiane composée* or *elixir stomachique amer*, F. P., is prepared from 100 parts of gentian, 30 parts of sodium carbonate, and 3000 parts of 60 per cent. alcohol.

TINCTURA GENTIANÆ, *P. G.* Tincture of gentian, *E.*; Teinture de gentiane, *Fr.*; Enziantinktur, *G.*—It is made by macerating gentian one part in 60 per cent. alcohol five parts, *F. P.*, *P. G.*

These tinctures have a brown-yellow color.

Medical Uses.—This tincture is a very agreeable bitter, and an efficient stomachic in cases of *feeble digestion*. It is especially adapted to improve the tone of the stomach exhausted by the abuse of alcoholic drinks. The *dose* is one or two fluidrachms.

TINCTURA GUAIACI, *U. S.*—TINCTURE OF GUAIAC.

Tinctura guajaci, P. G.—*Teinture de résine de gaïac*, Fr.; *Guajaktinktur*, G.

Preparation.—Take of Guaiac in moderately coarse powder six troyounces; Alcohol a sufficient quantity. Mix the powder thoroughly with an equal bulk of dry sand, pack the mixture moderately in a conical percolator, and, having covered it with a layer of sand, gradually pour alcohol upon it until two pints of tincture are obtained. *U. S.*

Take of guaiac one part; alcohol five parts. Macerate for eight days, and filter. *F. P., P. G.*

Since guaiac resin dissolves completely in alcohol, with the exception of the impurities, the tincture may be conveniently made by maceration. It is of a dark brownish-red color, is precipitated by water, and colored green or blue by ferric chloride and other agents (see page 684).

Medical Uses.—This tincture may be used in most of the cases to which other preparations of guaiacum are adapted, but especially in chronic fibrous *rheumatism* and scanty or painful *menstruation.* It has been especially recommended in *tonsillitis.* The ammoniated tincture is in general to be preferred, and may be used as a *gargle* in the proportion of a fluidrachm to two fluidounces of water. Both tinctures, being decomposed by water, should be administered in mucilage or syrup. *Dose*, one or two fluidrachms several times a day.

TINCTURA GUAIACI AMMONIATA, *U. S.*, *Br.*—AMMONIATED TINCTURE OF GUAIACUM.

Teinture de gaïac ammoniacale, Fr.; *Ammoniakalische Guajaktinktur*, G.

Preparation.—Take of Guaiac in moderately coarse powder six troyounces; Aromatic Spirit of Ammonia two pints. Macerate for seven days, and filter through paper. *U. S.*

Guaiacum resin in powder four ounces (avoird.); aromatic spirit of ammonia sufficient for one pint (imperial). *Br.* Powdered guaiacum resin three parts; alcohol ten parts; ammonia water five parts. *P. G.*

DEWEES'S TINCTURE OF GUAIACUM.—Digest for a few days powdered guaiacum resin four ounces, carbonate of sodium or potassium ninety grains, powdered pimento one ounce, in diluted alcohol one pint. Add spirit of ammonia, if required, in proportion of one or two drachms to each four fluidounces of the tincture.

Medical Uses.—The uses of this preparation are the same as those of the simple tincture. It may be applied locally to the inflamed throat by means of a brush. The ammonia it contains may possibly promote the curative effects of the resin. At all events, this tincture is generally preferred. *Dose*, one or two fluidrachms.

TINCTURA HELLEBORI, *U. S.*—TINCTURE OF HELLEBORE.

Teinture d'ellébore noir, Fr.; *Nieswurzeltinktur*, G.

Preparation.—Take of Black Hellebore in moderately fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with a fluidounce of diluted alcohol, pack it in a cylindrical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

Take of powdered black hellebore one part; displace with 80 per cent. alcohol five parts. *F. P.*

TINCTURA HELLEBORI VIRIDIS, *P. G.*, is made from one part of the root of Helleborus viridis, and ten parts of alcohol specific gravity 0.893.

Medical Uses.—This tincture contains all the virtues of black hellebore, and is the best form for administering it. It is, however, seldom used, except in *amenorrhœa* or *dysmenorrhœa* produced by cold; and even in those affections, its harsh operation renders it usually ineligible. For these reasons, probably, black hellebore and its preparations are omitted in the British Pharmacopœia. *Dose*, from thirty to sixty minims.

TINCTURA HUMULI, *U. S.*—TINCTURE OF HOPS.

Tinctura lupuli, Br.; *Teinture de houblon*, Fr.; *Hopfentinktur*, G.

Preparation.—Take of Hops in moderately coarse powder five troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with two fluidounces of diluted alcohol, pack it very firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The British tincture of hop is made from two and a half ounces (avoird.) of hop, with sufficient proof spirit to obtain one pint (imperial).

Air-dry hops may be conveniently reduced to powder, by grinding them together with some clean sand in an ordinary drug mill. When unground, they are unsuited for percolation, and so bulky, that in preparing the tincture by maceration most of the liquid is absorbed, necessitating the frequent agitation of the mixture and afterwards its forcible expression. The tincture is of a yellowish-brown color.

Medical Uses.—The proportion of hops, or of lupulin, in the average dose of this tincture is too small to produce much effect beyond that of the alcohol it contains. A draught of malt liquor would generally be preferable. The *dose* is from one to three fluidrachms.

TINCTURA HYOSCYAMI, *U. S.*, *Br.*—TINCTURE OF HYOSCYAMUS.

Teinture de jusquiame, Fr.; *Bilsenkrauttinktur*, G.

Preparation.—Take of Hyoscyamus Leaves recently dried and in fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with two fluidounces of diluted alcohol, pack it firmly in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The British Pharmacopœia directs hyoscyamus leaves in coarse powder two and a half ounces (avoird.), and sufficient proof spirit to obtain one pint (imperial). In France the tincture is prepared by percolating one part of the powdered leaves with sufficient 60 per cent. alcohol until five parts of percolate are obtained. The tincture has a greenish-brown color.

Medical Uses.—The tincture contains all the virtues of hyoscyamus, and may be administered in the *dose* of a fluidrachm.

TINCTURA IODINII, *U. S.*—TINCTURE OF IODINE.

Tinctura iodi, Br., P. G.—*Teinture d'iode*, Fr.; *Jodtinktur*, G.

Preparation.—Take of Iodine a troyounce; Alcohol a pint. Dissolve the iodine in the alcohol. *U. S.*

The proportions directed by other Pharmacopœias are: Iodine half an ounce; iodide of potassium a quarter of an ounce (avoird.); rectified spirit one pint (imperial). *Br.* Iodine one part; alcohol twelve parts. *F. P.* Iodine one part; alcohol ten parts. *P. G.*

The tincture has a deep red-brown color, and yields a precipitate of iodine on being mixed with water. The iodine gradually reacts with the alcohol at ordinary temperatures, and more rapidly at a somewhat elevated temperature, resulting in the formation of hydriodic acid and other compounds, which prevent the precipitation by water of some of the iodine. According to Guibourt, after the tincture has been kept on hand for about eighteen months, it is scarcely rendered turbid by water. The tincture should therefore be made in moderate quantities only, and should be kept in well-stoppered bottles to prevent the evaporation of alcohol.

Off. Prep.—Vapor iodi, *Br.*

TINCTURA IODI DECOLORATA, *P. G.*—Ten parts each of iodine, hyposulphite of sodium, and water are digested until solution has been effected, when sixteen parts of ammoniated alcohol and seventy-five parts of alcohol are added. After setting the mixture aside for two or three days, it becomes colorless and is ready for use. It has a somewhat ethereal and feebly ammoniacal odor, and contains *iodide of ammomium*, *iodide of ethyl* (C_2H_5I), and *hydriodate of triethylamina* ($C_6H_{15}NHI$); the latter compound is gradually converted into iodide of ethyl and triethylamina. In addition to these compounds the tincture contains also a little iodide and sulphate of sodium, which are not present if the tincture is made as originally proposed (1869) by Dr. C. O. Curtman (iodine ten drachms, alcohol thirteen fluidounces, stronger ammonia water three fluidounces). In the latter case, however, about twenty-seven days are required for effecting complete decoloration. The formula adopted by the German Pharmacopœia is that proposed by Hager (1871).

TINCTURA IODINII COMPOSITA, *U. S.*—COMPOUND TINCTURE OF IODINE.

Teinture iodique composée, Fr.; *Jodtinktur mit Jodkalium*, G.

Preparation.—Take of Iodine half a troyounce; Iodide of Potassium a troyounce; Alcohol a pint. Dissolve the iodine and iodide of potassium in the alcohol. *U. S.*

This tincture resembles the simple tincture of iodine in appearance, but differs from it in being miscible with water without causing precipitation. The British *tinctura iodi* likewise contains potassium iodide, but in insufficient quantity to prevent its precipitation by water, at least when recently made.

Medical Uses.—In the British Pharmacopœia but one tincture is recognized, which corresponds to the compound tincture, *U. S.* A sufficient reason for this arrangement is, that the latter preparation, and the compound aqueous solution of iodine (*Br.*), are sufficient for internal administration, while the simple tincture is not strong enough for many important external applications of iodine. As the compound tincture is not precipitated by water, and is also more permanent than the simple tincture, as well as less irritating and more absorbable, it is greatly to be preferred for internal use. The *dose* is from ten to thirty drops, largely diluted with water or some mild liquid.

TINCTURA JALAPÆ, *U. S.*, *Br.*—TINCTURE OF JALAP.

Teinture de jalap, Fr.; *Jalapentinktur*, G.

Preparation.—Take of Jalap in fine powder six troyounces; Alcohol, Water, each a sufficient quantity. Mix two measures of alcohol with one of water. Then moisten the powder with two fluidounces of the mixture, pack it moderately in a cylindrical percolator, and gradually pour the mixture upon it until two pints of tincture are obtained. *U. S.*

This corresponds closely with the tincture of the French Codex. That of the British Pharmacopœia is made with two and a half ounces (avoirdupois) of coarsely powdered jalap, and sufficient proof spirit to obtain one pint (imperial).

Medical Uses.—This tincture is seldom used except as an addition to other purgative liquids. The *dose* is from half a fluidrachm to two fluidrachms.

TINCTURA KINO, *U. S.*, *Br.*—TINCTURE OF KINO.

Teinture de kino, Fr.; *Kinotinktur*, G.

Preparation.—Take of Kino in fine powder three hundred and sixty grains; Alcohol, Water, each, a sufficient quantity. Mix two measures of alcohol with one of water. Then mix the powder thoroughly with an equal bulk of dry sand, and, having introduced the mixture into a conical glass percolator, gradually pour the menstruum upon it until half a pint of tincture is obtained. *U. S.*

Take of Kino in coarse powder two ounces (avoirdupois); Rectified Spirit one pint. Macerate for seven days in a closed vessel, with occasional agitation, filter, and add sufficient alcohol to make one pint. *Br.*

Take of kino one part, alcohol five parts. Macerate and filter. *P. G.*

Tincture of kino is conveniently prepared by maceration, and has a dark brown-red color. Made with alcohol and properly preserved, it will remain limpid; but if made by the first formula it will gradually lose its astringency, and become gelatinous. According to P. P. Fox (1877), this may be prevented without increasing the alcoholic strength by replacing one-half of the water with an equal measure of glycerin, a fact noticed by Haselden as early as 1860. The employment of magnesia, logwood, and other foreign substances, with the same end in view, is objectionable and unnecessary.

Medical Uses.—This tincture is used for most of the internal purposes of kino in the *dose* of one or two fluidrachms. In watery mixtures it is ineligible, from its tendency to gelatinize.

TINCTURA KRAMERIÆ, *U. S.*, *Br.*—TINCTURE OF RHATANY.

Tinctura ratanhæ, P. G.—*Teinture de ratanhia*, Fr.; *Ratanhatinktur*, G.

Preparation.—Take of Rhatany in moderately fine powder six troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with two fluidounces of diluted alcohol, pack it in a cylindrical glass percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The proportions directed by other Pharmacopœias are: Rhatany two and a half ounces (avoirdupois); proof spirit sufficient for one pint (imperial). *Br.* Rhatany one part; sixty per cent. alcohol five parts. *F. P.*, *P. G.*

This tincture has a red-brown color, and after having been kept in partly filled bottles deposits rhatany red and occasionally gelatinizes. It is, therefore, best prepared in small quantities.

Medical Uses.—This is the form in which rhatany is perhaps more frequently used than any other astringent in the treatment of subacute *diarrhœa.* For this purpose it is usually added to the chalk mixture. Diluted with water it forms a very useful mouth wash when the *gums* are spongy. It has also been reputed serviceable in atonic *menorrhagia*, and in other forms of passive *hemorrhage.* The *dose* is one or two fluidrachms.

TINCTURA LARICIS, *Br. Add.*—TINCTURE OF LARCH.

Teinture d'écorce de mélèze, Fr.; *Lärchenrindentinktur*, G.

Preparation.—Take of Larch Bark in coarse powder two and a half ounces (avoirdupois); Rectified Spirit one pint. Prepare one pint (imperial) of tincture by the formula given on page 1396. *Br.*

The tincture has a red-brown color, and should be carefully preserved like other astringent tinctures.

Medical Uses.—Tincture of larch bark is not employed in this country. It has been used in England as a remedy for passive *hemorrhages*, *purpura*, and *chronic bronchitis*. The *dose* is from twenty to thirty minims.

TINCTURA LAVANDULÆ COMPOSITA, *Br.* See SPIRITUS LAVANDULÆ COMPOSITUS.

TINCTURA LIMONIS, *Br.*—TINCTURE OF LEMON PEEL.

Teinture de zeste de limon, Fr.; *Citronenschalentinktur*, G.

Preparation.—Take of Fresh Lemon Peel sliced thin two and a half ounces (avoird.); Proof Spirit one pint. Macerate for seven days in a closed vessel, with occasional agitation; strain, press, and filter; then add sufficient proof spirit to make one pint (imperial). *Br.*

Medical Uses.—Tincture of lemon peel is used for flavoring mixtures, etc. *Dose*, a fluidrachm.

TINCTURA LOBELIÆ, *U. S.*, *Br.*—TINCTURE OF LOBELIA.

Teinture de lobélie, Fr.; *Lobeliatinktur*, G.

Preparation.—Take of Lobelia in fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with two fluidounces of diluted alcohol, pack it firmly in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The proportions of other Pharmacopœias are: Lobelia two and a half ounces (avoirdupois); proof spirit sufficient for one pint. *Br.* Lobelia one part; 60 per cent. alcohol sufficient for five parts. *F. P.* Lobelia one part; alcohol specific gravity 0.893 ten parts. *P. G.*

The tincture is of a green-brown color.

Medical Uses.—Lobelia is most frequently prescribed under the form of this tincture. Its *dose* as an expectorant is from ten minims to a fluidrachm. In asthmatic attacks one or two fluidrachms should be administered every half hour or hour.

TINCTURA LOBELIÆ ÆTHEREA, *Br.*—ETHEREAL TINCTURE OF LOBELIA.

Preparation.—Take of Lobelia in coarse powder two and a half ounces (avoirdupois); Spirit of Ether one pint. Macerate for seven days in a closed vessel, with occasional agitation; then strain, press, filter, and add sufficient spirit of ether to make one pint (imperial). *Br.*

It is of a brownish-green color.

Medical Uses.—This preparation is perhaps more efficient than the simple tincture in *asthma*. The *dose* is from ten to thirty minims.

TINCTURA LUPULINÆ, *U. S.*—TINCTURE OF LUPULIN.

Teinture de lupuline, Fr.; *Lupulintinktur*, G.

Preparation.—Take of Lupulin four troyounces; Alcohol a sufficient quantity. Pack the lupulin in a narrow cylindrical percolator, and gradually pour alcohol upon it until two pints of tincture are obtained. *Br.*

The lupulin, consisting of unbroken cellular glands, should be percolated very slowly to insure its complete exhaustion. The tincture has a yellowish-brown color, and is precipitated by water. Dr. Dyce Duckworth (1868) suggested an *ammoniated tincture of lupulin*, to be prepared by macerating for a week two ounces of lupulin in sufficient aromatic spirit of ammonia to obtain one pint (imperial).

Medical Uses.—This preparation is probably stronger than the tincture of hop (Tr. lupuli, *Br.*), but its virtues are not very conspicuous. *Dose*, one or two fluidrachms.

TINCTURA MYRRHÆ, *U. S.*, *Br.*—TINCTURE OF MYRRH.

Teinture de myrrhe, Fr.; *Myrrhentinktur*, G.

Preparation.—Take of Myrrh in moderately coarse powder three troyounces; Alcohol a sufficient quantity. Introduce the powder into a conical percolator, press it moderately, and gradually pour alcohol upon it until two pints of tincture are obtained. *U. S.*

The proportions directed by other Pharmacopœias are: Myrrh two and a half ounces (avoirdupois); rectified spirit sufficient for one pint (imperial). *Br.* Myrrh one part; alcohol five parts. *F. P.*, *P. G.*

The tincture is of a brownish-yellow color, and yields a precipitate of resin on the addition of water. E. B. Shuttleworth (1871) suggested the utilization of the gum left on preparing the tincture, for making a mucilage, by dissolving it in boiling water, straining, and allowing to settle. The adhesive properties are increased by the addition of a small quantity of molasses.

Medical Uses.—Tincture of myrrh is seldom used internally, but it may be prescribed in doses of from thirty minims to a fluidrachm. It is chiefly used as a stimulant, astringent, and protective agent in the treatment of *aphthæ*, *spongy gums*, *relaxed uvula*, aphthous affections of the *vagina*, etc. In these cases it is generally diluted with water, which precipitates its resin.

TINCTURA NUCIS VOMICÆ, *U. S.*, *Br.*—TINCTURE OF NUX VOMICA.

Tinctura strychni, P. G.—*Teinture de noix vomique*, Fr.; *Krähenaugentinktur*, G.

Preparation.—Take of Nux Vomica in fine powder eight troyounces; Alcohol a sufficient quantity. Mix the powder with a pint of alcohol, and digest for twenty-four hours, in a close vessel, with a gentle heat; then transfer the mixture to a cylindrical percolator, and gradually pour alcohol upon it until two pints of tincture are obtained. *U. S.*

Take of Nux Vomica two ounces (avoirdupois); Rectified Spirit a pint. Apply steam to the nux vomica until it is thoroughly softened, then dry rapidly, and reduce it to fine powder. Prepare one pint (imperial) of tincture by the formula on page 1396. *Br.*

Rasped nux vomica one part; 80 per cent. alcohol five parts. *F. P.* Nux vomica one part; alcohol specific gravity 0.893 ten parts. *P. G.*

Tinctura strychni ætherea, *P. G.*—Coarsely powdered nux vomica one part; spirit of ether ten parts. Macerate for eight days, express, and filter.

These tinctures have a yellowish color, and become milky when mixed with water. The tough nature of the drug necessitates its prolonged maceration or digestion with the menstruum, and the firm packing in case the tincture is prepared by percolation. G. W. Kennedy (1870) observed the separation of crystals of strychnia from a tincture which had been prepared with nux vomica, yielding an aqueous infusion of an alkaline reaction.

Medical Uses.—This is a very convenient form for the exhibition of nux vomica, especially in small doses, although it is of uncertain strength. It is particularly adapted for use in *atonic dyspepsia.* *Dose*, from five to twenty minims.

TINCTURA OPII, *U. S.*, *Br.*—Tincture of Opium.

Tinctura opii simplex, P. G.; *Tinctura thebaica*, *Tinctura meconii.*—*Laudanum*, E.; *Teinture d'opium*, *Teinture thébaïque*, Fr.; *Einfache Opiumtinktur*, G.

Preparation.—Take of Opium dried and in moderately fine powder two troyounces and a half; Water, Alcohol, each a pint; Diluted Alcohol a sufficient quantity. Macerate the opium with the water for three days, with frequent agitation; then add the alcohol, and continue the maceration for three days longer. Introduce the mixture into a percolator, and, when the liquid has ceased to pass, pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

Take of Opium in coarse powder one and a half ounce (avoird.); Proof Spirit one pint. Macerate for seven days in a closed vessel, with occasional agitation, then strain, press, filter, and add sufficient proof spirit to make one pint (imperial). It contains the soluble matter of thirty-three grains of opium nearly in one fluidounce. *Br.*

Digest powdered opium four parts, in alcohol sp. gr. 0.893, and distilled water, each nineteen parts. *P. G.* Macerate extract of opium ten parts, in alcohol sp. gr. 0.914 one hundred and twenty parts, and filter. *F. P.*

Each fluidrachm (U. S. measure) of these tinctures represents 4.3 grains (*Br.*), 4.7 grains (*U. S.*), and 5.6 grains (*P. G.*) of dry opium, and 4 grains (*F. P.*) of extract of opium. Calculating 60 per cent. as the yield of extract from dry opium, one grain of powdered opium is represented by 9 minims (*F. P.*), 10.75 minims (*P. G.*), 12.8 minims (*U. S.*), and 14 minims (*Br.*), U. S. measure, of these tinctures.

With due care, opium is readily exhausted by weak alcohol, about 60 per cent. of its constituents being soluble in that menstruum. To insure uniformity of strength in this important preparation, the opium employed in making it should be well dried, of full morphia strength, and sufficiently long macerated or digested in the menstruum to be completely disintegrated several days before it is transferred to a percolator or filter. The residue after drying should yield nothing to water, and dilute acids should dissolve from it only minute quantities of alkaloidal compounds. The color of the tincture is deep reddish-brown. It should be preserved in well-stopped bottles, to prevent the evaporation of the alcohol.

The term *laudanum* is still recognized by several European Pharmacopœias as a synonyme for opium. In connection with various epithets (antihystericum, diureticum, etc.) it was formerly employed to designate numerous solid compound preparations of opium; while the stronger liquid opiates were called *laudanum liquidum*, and distinguished by other epithets, tincture of opium, for instance, as *laudanum liquidum simplex*. However, in the United States and Great Britain the tincture is popularly known as laudanum.

Off. Prep.—Enema opii, Linimentum opii, *Br.*

Medical Uses.—The simple tincture of opium, or laudanum as it is distinctively called, possesses all the good and evil qualities of pure opium. Of the latter the most conspicuous is its tendency to nauseate. This operation is supposed to depend upon the narcotina which it contains, and which is removed in the process for making the deodorized tincture. The latter is therefore preferable for internal administration; but laudanum forms a convenient addition to liniments, poultices, and other external anodyne applications. It should be remembered that by being kept in imperfectly stoppered vials it becomes relatively stronger by the evaporation of its alcohol. The *dose* for an adult is about twenty-five drops, or thirteen minims, equivalent to about one grain of opium.

TINCTURA OPII ACETATA, *U. S.*—ACETATED TINCTURE OF OPIUM.

Preparation.—Take of Opium dried and in moderately fine powder two troyounces; Distilled Vinegar twelve fluidounces; Alcohol half a pint. Rub the opium with the distilled vinegar; then add the alcohol, and, having macerated for seven days, express, and filter through paper. *U. S.*

The yield by this process is a little over twenty fluidounces. Each fluidrachm contains the soluble portion of six grains of opium. The tincture has a dark reddish-brown color, and should be cautiously preserved.

Medical Uses.—Acetated tincture of opium has most of the disadvantages of laudanum, without the advantages of vinegar of opium. It appears to be a superfluous opiate, and is but little used. *Dose*, ten minims or twenty drops.

TINCTURA OPII AMMONIATA, *Br.*—AMMONIATED TINCTURE OF OPIUM.

Teinture d'opium ammoniacale, Fr.; *Ammoniakalische Opiumtinktur*, G.

Preparation.—Take of Opium in coarse powder one hundred grains; Saffron cut small, Benzoic Acid, each one hundred and eighty grains; Oil ot Anise one fluidrachm; Strong Solution of Ammonia four fluidounces; Rectified Spirit sixteen fluidounces. Macerate for seven days in a well-closed vessel, with occasional agitation; then strain, press, filter, and add sufficient rectified spirit to make one pint (imperial). *Br.*

This is a slight modification of the formula formerly recognized by the Edinburgh Pharmacopœia. The preparation was known as *elixir paregoricum scoticum*, and in Scotland employed as paregoric elixir. It contains the opium alkaloids in a free state, dissolved by the aid of alcohol and of an excess of ammonia. 90 minims of it represent very nearly one grain of opium.

Medical Uses.—This preparation, sometimes called Scotch Paregoric, is composed of nearly the same ingredients as ordinary paregoric, except that in it ammonia takes the place of the camphor in that preparation. The *dose* is from half a fluidrachm to a fluidrachm.

TINCTURA OPII CAMPHORATA, *U. S.*—CAMPHORATED TINCTURE OF OPIUM.

Tinctura camphoræ composita, Br.; *Tinctura opii benzoica*, P. G.; *Elixir paregoricum.—Paregoric elixir*, E.; *Elixir parégorique*, Fr.; *Benzoësäurehaltige Opiumtinktur*, G.

Preparation.—Take of Opium dried and in moderately fine powder, Benzoic Acid, each sixty grains; Camphor forty grains; Oil of Anise a fluidrachm; Clarified Honey two troyounces; Diluted Alcohol two pints. Macerate for seven days, and filter through paper. *U. S.*

Other Pharmacopœias direct: Opium in coarse powder, benzoic acid, each forty grains; camphor thirty grains; oil of anise half a fluidrachm; proof spirit one pint (imperial). *Br.* Extract of opium, benzoic acid, oil of anise, each three parts; camphor two parts; 60 per cent. alcohol six hundred and fifty parts. *F. P.* Powdered opium one part; benzoic acid four parts; camphor and oil of anise, each two parts; alcohol specific gravity 0.893 one hundred and ninety-two parts. *P. G.*

One grain of opium is represented in 256 (*U. S.*) and 230 (*Br.*) minims (U. S. measure) of the tincture, and in 200 grains of the French and German preparations. The tincture is of a brownish-yellow color, and, on the addition of water, turns milky. It is an ingredient in Mistura glycyrrhizæ comp., *U. S.*

The following formulas were adopted by the Philadelphia College of Pharmacy (1833) for the nostrums named:—

BATEMAN'S PECTORAL DROPS.—Digest for twenty-four hours rasped red saunders two troyounces in four gallons of diluted alcohol, filter, and add powdered opium, catechu, and camphor each two troyounces, oil of anise four fluidrachms. Digest for ten days and filter. It is of the same opium strength as the above tincture (*U. S.*).

GODFREY'S CORDIAL.—Dissolve carbonate of potassium two and one-half troyounces in water twenty-six pints; add sugarhouse molasses sixteen pints; heat the mixture over a gentle fire until it simmers, remove the scum; add tincture of opium one and one-half pint, alcohol two pints, and oil of sassafras four fluidrachms previously mixed together. Each fluidounce represents nearly one and one-quarter grain of opium.

Medical Uses.—Camphorated tincture of opium is in common use to relieve *abdominal pains* produced by flatus or by irritability of the stomach or bowels, and for allaying *cough* when there is no active inflammation of the respiratory organs. The *dose* for an adult is one or two fluidrachms; and for an infant from five to twenty drops. It is usually administered in sweetened water.

TINCTURA OPII DEODORATA, *U. S.*—DEODORIZED TINCTURE OF OPIUM.

Preparation.—Take of Opium dried and in moderately fine powder two troyounces and a half; Ether, Alcohol, each half a pint; Water a sufficient quantity. Macerate the opium with half a pint of water for twenty-four hours, and express; then repeat the operation twice with the same quantity of water. Mix the expressed liquids, and, having evaporated the mixture to four fluidounces, allow it to cool, and shake it in a bottle repeatedly with the ether. Pour off the ethereal solution when it has separated by standing, and evaporate the remaining liquid until all traces of ether have disappeared. Mix the residue with twenty fluidounces of water, and filter the mixture through paper. When the liquid has ceased to pass, add enough water, through the filter, to make the filtered liquid measure a pint and a half. Lastly, add the alcohol, and mix them together. *U. S.*

On agitating the concentrated aqueous infusion of opium with ether, narcotina and the odorous principle, together with a little coloring matter, are removed. The remaining aqueous liquid is freed from ether by heat, properly diluted with water, filtered, and preserved by the addition of alcohol. T. G. Davis (1877) proposed to shorten the process by boiling the opium with three portions of water, each time for half an hour, expressing, evaporating to four fluidounces, mixing with an equal bulk of alcohol, filtering from the gummy precipitate, washing the filter with alcohol, evaporating to four fluidounces, and then finishing the product as directed by the Pharmacopœia.

This tincture is of the same opium strength as laudanum, but rather lighter in color, is nearly identical with *denarcotized tincture of opium*, and takes the place of several preparations which were at one time introduced as *elixirs* of opium. A somewhat similar preparation, but containing chloroform and acetic ether, is Squibb's

LIQUOR OPII COMPOSITUS.—The opium is exhausted with water, the infusion concentrated, precipitated by alcohol, the clear liquid evaporated to a small bulk equal in weight to that of opium, and agitated with ether. The aqueous liquid freed from the ether is diluted with one part of its own weight of water, filtered, mixed with one part of stronger alcohol, and diluted with water to five parts. A portion of this is assayed, and the whole liquid is then mixed with the remaining ingredients in such proportions that 30 cubic centimeters or one fluidounce shall contain four grains of morphia, 1 cubic centimeter of chloroform, 2 c. c. acetic ether, and 13 c. c. of stronger alcohol, the remaining liquid being water. (For details see *Amer. Journ. Pharm.*, 1870, p. 47.)

BATTLEY'S SEDATIVE DROPS.—Three ounces of extract of opium are dissolved in thirty ounces of hot water, and the solution filtered and mixed with six ounces of alcohol. This preparation is of about double the strength of those above described.

Medical Uses.—The nauseating effects of laudanum are supposed to be absent from this preparation, which is of the same strength. It may be given in the *dose* of fifteen minims, or drops.

TINCTURA PYRETHRI, *Br.*—TINCTURE OF PELLITORY.

Teinture de pyrèthre, Fr.; *Bertramwurzeltinktur*, G.

Preparation.—Take of Pellitory Root in coarse powder four ounces (avoird.); Rectified Spirit one pint. Prepare one pint (imper.) of tincture by the general formula on page 1396. *Br.*

Medical Uses.—Tincture of pellitory is not given internally, but is a convenient substitute for the root of the plant as an application to painful cavities in *carious teeth*, and as a local stimulant in *paralysis* of the *tongue*, *velum*, and *pharynx*.

TINCTURA QUASSIÆ, *U. S.*, *Br.*—TINCTURE OF QUASSIA.

Teinture de quassie, Fr.; *Quassiatinktur, G.*

Preparation.—Take of Quassia in moderately fine powder two troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with a fluidounce of diluted alcohol, pack it in a percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

Other Pharmacopœias direct: Quassia wood in chips three-quarters of an ounce (avoird.); proof spirit sufficient for one pint (imper.). *Br.* Quassia one part; 60 per cent. alcohol five parts. *F. P.*

The tincture has a light brownish-yellow color.

Medical Uses.—It is occasionally employed during convalescence from low fevers and other exhausting acute diseases, as well as in various atonic *dyspeptic conditions* of gastric origin; but it is less frequently prescribed alone than as an addition to the infusion of quassia or of other bitter tonics, or associated with their tinctures. The average *dose* is about one fluidrachm. It is sometimes given in enema to destroy rectal *ascarides.*

TINCTURA QUINIÆ, *Br.*—TINCTURE OF QUINIA.

Preparation.—Take of Sulphate of Quinia one hundred and sixty grains; Tincture of Orange Peel one pint (imper.). Dissolve the sulphate of quinia in the tincture with the aid of a gentle heat; then allow the solution to remain for three days in a closed vessel, shaking it occasionally, and then filter. *Br.*

Medical Uses.—This preparation might very properly have been left to magistral prescription. Each fluidrachm contains one grain of sulphate of quinia.

TINCTURA QUINIÆ AMMONIATA, *Br. Add.*—AMMONIATED TINCTURE OF QUINIA.

Preparation.—Take of Sulphate of Quinia one hundred and sixty grains; Solution of Ammonia two and a half fluidounces (imperial); Proof Spirit seventeen and a half fluidounces. Dissolve the sulphate of quinia in the spirit with a gentle heat, and add the solution of ammonia. *Br.*

Medical Uses.—This association of quinia and ammonia is supposed to be indicated in *neuralgia* and other *nervous affections* due to a want of nervous energy. The *dose* is from half a fluidrachm to one fluidrachm.

TINCTURA RHEI, *U. S.*, *Br.*—TINCTURE OF RHUBARB.

Teinture de rhubarbe, Fr.; *Rhabarbertinktur*, G.

Preparation.—Take of Rhubarb in moderately coarse powder three troyounces; Cardamom in moderately fine powder half a troyounce; Diluted Alcohol a sufficient quantity. Mix the powders, and, having moistened the mixture with a fluidounce of diluted alcohol, pack it moderately in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

Take of Rhubarb in coarse powder two ounces (avoird.); Cardamom Seeds freed from the pericarps and bruised, Coriander Fruit bruised, Saffron, each one-quarter ounce; Proof Spirit one pint. Proceed in the manner directed on page 1396. *Br.*

In France the tincture is prepared of rhubarb one part, and 60 per cent. alcohol five parts.

The tincture is of a deep reddish-brown color, and on standing deposits orange-yellow granular crystals, consisting mainly of chrysophanic acid. The addition of glycerin to the tincture will only partly prevent this precipitation.

TINCTURA RHEI AQUOSA, *P. G.*—Take of rhubarb cut into thin pieces 100 parts, powdered borax, carbonate of potassium, each 10 parts, add boiling distilled water 850 parts, and after fifteen minutes alcohol 100 parts, macerate for one and a quarter hour, express slightly, filter, and add cinnamon water 150 parts.

The following compound tinctures of rhubarb are sometimes called for; the formulas are those of the U. S. Pharmacopœia for 1850.

TINCTURA RHEI ET ALOES s. *Elixir sacrum.*—Take of rhubarb bruised ten drachms, aloes six drachms, cardamom four drachms, diluted alcohol two pints. Macerate for fourteen days, express and filter.

TINCTURA RHEI ET GENTIANÆ s. *Tinct. rhei amara.*—Take of rhubarb bruised two troyounces, gentian bruised four drachms, diluted alcohol two pints. Proceed as above.

Under the name of *sweet tincture of rhubarb* a preparation has been used containing about one-half the rhubarb of the officinal tincture with variable quantities of liquorice root, anise, and occasionally other aromatics and sugar.

Medical Uses.—Tincture of rhubarb is seldom used alone, but generally to qualify the action of saline purgatives, or in *gouty* or other feeble states of the system requiring a stimulant as well as a laxative medicine. Its *dose* is from half a fluidounce to a fluidounce as a purgative. As a stomachic it may be given in the dose of about a fluidrachm.

TINCTURA RHEI ET SENNÆ, *U. S.*—TINCTURE OF RHUBARB AND SENNA.

Preparation.—Take of Rhubarb in moderately coarse powder a troyounce; Senna in moderately coarse powder one hundred and twenty grains; Coriander in moderately coarse powder, Fennel in moderately coarse powder, each sixty grains; Liquorice in moderately coarse powder thirty grains; Raisins deprived of their seeds six troyounces; Diluted Alcohol three pints. Macerate for seven days, express, and filter through paper. *U. S.*

This tincture is known as *Warner's gout cordial*, and has a reddish-brown color.

Medical Uses.—This tincture does not appear to possess any advantage over an extemporaneous union of the tincture of rhubarb with that of senna (*Br.*). But as the American Pharmacopœia does not include the latter, the compound has a definite value. It is adapted to the same cases as tincture of rhubarb, and is probably more efficient than that preparation. *Dose*, half a fluidounce to two fluidounces.

TINCTURA SABINÆ, *Br.*—TINCTURE OF SAVIN.

Teinture de sabine, Fr.; *Sadebaumtinktur*, G.

Preparation.—Take of Savin Tops dried and coarsely powdered two and a half ounces (avoird.); Proof Spirit one pint. Prepare the tincture according to the formula on page 1396. *Br.*

Proof spirit appears to be hardly strong enough for dissolving the volatile oil and resin contained in savin. The tincture has a brown-green color.

Medical Uses.—As the American Pharmacopœia contains no liquid preparation of savin, except the oil, this one may be employed internally in all cases in which that mode of administering savin is appropriate. *Dose*, from twenty minims to a fluidrachm.

TINCTURA SANGUINARIÆ, *U. S.*—TINCTURE OF BLOODROOT.

Teinture de sanguinaire, Fr.; *Blutwurzeltinktur*, G.

Preparation.—Take of Bloodroot in moderately fine powder four troyounces; Alcohol, Water, each a sufficient quantity. Mix three measures of alcohol with one of water. Moisten the powder with a fluidounce of the mixture, pack it in a conical percolator, and gradually pour the menstruum upon it until two pints of tincture are obtained. *U. S.*

The tincture has a rich brownish-red color.

Medical Uses.—The tincture of bloodroot contains all the virtues of the plant. It may be given in *doses* of from thirty to sixty minims as an "alterative" and expectorant, and as an emetic in doses of from one to four fluidrachms.

TINCTURA SCILLÆ, *U. S.*, *Br.*—TINCTURE OF SQUILL.

Teinture de scille, Fr.; *Meerzwiebeltinktur*, G.

Preparation.—Take of Squill in moderately coarse powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with a fluidounce of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

Other Pharmacopœias direct: Squill two and a half ounces (avoirdupois); proof spirit sufficient for one pint (imperial). *Br.* Squill one part; alcohol specific gravity 0.893 five parts. *F. P.*, *P. G.*

The tincture is of a yellowish color.

TINCTURA SCILLÆ KALINA.—Macerate for eight days squill eight parts, caustic potassa one part, in alcohol specific gravity 0.893 fifty parts, express, and filter. It has a brownish color.

Medical Uses.—Tincture of squill is perhaps better adapted than squill in substance for the treatment of *dropsy*. It is generally associated with other medicines, as in the following efficient formula: ℞. Tincture of digitalis fʒij–fʒiij; tincture of squill f℥ss; compound spirit of juniper f℥ij; sherry wine f℥x; acetate of potassium ʒj. M. S. A tablespoonful, largely diluted, three times a day. Tincture of squill is said to have produced diuresis when applied to the skin with friction. The *dose* is from ten to twenty minims.

TINCTURA SENEGÆ, *Br.*—TINCTURE OF SENEGA.

Teinture de polygala de Virginie, Fr.; *Senegatinktur*, G.

Preparation.—Take of Senega Root in coarse powder two and a half ounces (avoirdupois); Proof Spirit one pint. Proceed according to the directions on page 1396. *Br.*

The tincture has a yellowish-brown color.

Medical Uses.—This preparation is probably less efficient than the syrup of seneka in affections of the air-passages, and than the fluid extract as a stimulant of the uterine functions. The alcohol it contains renders it peculiarly unsuitable in the former, and probably impairs its virtues in the latter cases, while it tends to produce a local irritant action upon the stomach. Its *dose* is from thirty minims to two fluidrachms.

TINCTURA SENNÆ, *Br.*—TINCTURE OF SENNA.

Elixir salutis.—Teinture de séné aromatique, Fr.; *Sennatinktur*, G.

Preparation.—Take of Senna broken small two and a half ounces (avoirdupois); Raisins freed from seeds two ounces; Caraway Fruit bruised, Coriander Fruit bruised, each one-half ounce; Proof Spirit one pint. Prepare one pint (imperial) of tincture according to the formula on page 1396. *Br.*

It is used in preparing Mistura sennæ comp., *Br.*

The formulas of some old Pharmacopœias directed rhubarb or jalap in addition to the senna.

Medical Uses.—It is convenient as an addition to cathartic infusions, and particularly to the compound infusion of senna, or "black draught;" or along with the tincture of rhubarb in cases that require a stimulating purge, especially in persons of a gouty habit. The *dose* is from one to three or four fluidrachms.

TINCTURA SERPENTARIÆ, *U. S.*, *Br.*—TINCTURE OF SERPENTARIA.

Teinture de serpentaire, Fr.; *Schlangenwurzeltinktur*, G.

Preparation.—Take of Serpentaria in moderately fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with a fluidounce of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

Take of Serpentary Root two and a half ounces (avoirdupois); Proof Spirit one pint. Proceed in the manner directed on page 1396. *Br.*

The tincture has a brownish-yellow color.

Medical Uses.—In the low forms of febrile disease for which serpentaria is employed, the tincture is the most appropriate form of administering it. It may be associated advantageously in such cases with the compound tincture of cinchona. *Dose*, one or two fluidrachms.

TINCTURA STRAMONII, *U. S.*, *Br.*—TINCTURE OF STRAMONIUM.

Teinture de semences de stramoine, Fr.; *Stechapfelsamentinktur*, G.

Preparation.—Take of Stramonium Seed in moderately fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with a fluidounce of diluted alcohol, pack it in a percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

Other proportions are: Stramonium seed two and a half ounces (avoirdupois); proof spirit sufficient for one pint (imperial). *Br.* Stramonium seed one part; alcohol specific gravity 0.893 ten parts. *P. G.*

The tincture has a brownish-yellow color.

Medical Uses.—Although less frequently used than other preparations of stramonium, the tincture is probably one of the best, whether for internal administration or as a topical anodyne. It would seem appropriate for inhalation, when atomized, in cases of *spasmodic asthma;* and in the liquid form it has been used with marked advantage for the relief of *dysmenorrhœa.* It may be given internally for the relief of *neuralgia*, and used locally for that affection, and for *muscular rheumatism*, in anodyne liniments. Even in subacute and chronic *articular rheumatism* it may be employed in the same way with advantage. The average *dose* of the tincture is fifteen minims.

TINCTURA SUMBUL, *Br.*—TINCTURE OF SUMBUL.

Teinture de sumbul, Fr.; *Moschuswurzeltinktur*, G.

Preparation.—Take of Sumbul Root in coarse powder two and a half ounces (avoird.); Proof Spirit one pint. Proceed according to formula on page 1396. *Br.*

Medical Uses.—This tincture probably possesses all the virtues of sumbul. Its *dose* is from ten to thirty minims.

TINCTURA TOLUTANA, *U. S.*, *Br.*—TINCTURE OF TOLU.

Teinture de baume de Tolu, Fr.; *Tolubalsamtinktur*, G.

Preparation.—Take of Balsam of Tolu three troyounces; Alcohol two pints. Macerate the balsam with the alcohol until it is dissolved; then filter through paper. *U. S.*

Take of Balsam of Tolu two and a half ounces (avoird.); Rectified Spirit a sufficiency. Macerate the balsam in fifteen fluidounces of the alcohol in a closed vessel until it is dissolved; then filter and add sufficient spirit to make one pint (imperial). *Br.*

The tincture has a yellowish color, and becomes milky on the addition of water.

Off. Prep.—Syrupus tolutanus, *U. S.;* Trochisci acidi tannici, Troch. morphiæ, Troch. morphiæ et ipecacuanhæ, Troch. opii, *Br.*

Medical Uses.—This preparation is used for little else than to flavor cough mixtures; it is ineligible even for that purpose, since it is decomposed by water. Its flavor, however, remains after the removal of its resin, and in this manner the agreeable officinal syrup is formed. *Dose*, one or two fluidrachms.

TINCTURA VALERIANÆ, *U. S.*, *Br.*—TINCTURE OF VALERIAN.

Teinture de valériane, Fr.; *Baldriantinktur*, G.

Preparation.—Take of Valerian in moderately fine powder four troyounces; Diluted Alcohol a sufficient quantity. Moisten the powder with a fluidounce of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained. *U. S.*

The proportions of other Pharmacopœias are: Valerian two and a half ounces (avoird.); proof spirit sufficient for one pint. *Br.* Valerian one part; 60 per cent. alcohol five parts. *F. P.*, *P. G.* The tincture has a brown color.

TINCTURA VALERIANÆ ÆTHEREA, *P. G.*—Macerate valerian one part in spirit of ether five parts. It is of a brownish-yellow color.

Medical Uses.—The tincture is much less frequently employed than the other preparations of valerian, although in certain cases it is more efficacious, those, namely, in which a prompt and efficient operation is required. Such cases are the *typhoid state* with predominance of ataxic phenomena, and *delirium tremens*. On the other hand, in purely nervous disorders, especially of an hysterical kind, it is far less eligible than the infusion, the oil, the ammoniated tincture, or even the fluid extract of valerian. The *dose* is one or two fluidrachms.

TINCTURA VALERIANÆ AMMONIATA, *U. S.*, *Br.*—AMMONIATED TINCTURE OF VALERIAN.

Teinture de valériane ammoniacale, Fr.; *Ammoniakalische Baldriantinktur*, G.

Preparation.—Take of Valerian in moderately fine powder four troyounces; Aromatic Spirit of Ammonia two pints. Macerate for seven days, express, and filter through paper. *U. S.*

Take of Valerian Root in coarse powder two and a half ounces (avoird.); Aromatic Spirit of Ammonia one pint. Macerate for seven days in a closed vessel, strain, press, filter, and add sufficient of the menstruum to make one pint (imperial). *Br.*

Medical Uses.—This preparation may be employed in all the disorders in which the simple tincture is eligible, but it is perhaps best adapted to cases of a purely nervous description in which its use need not be prolonged. It may be given in *doses* of from thirty to sixty or more minims in sweetened water or mucilage, but never in milk. A non-officinal preparation, the elixir of valerianate of ammonia, operates in the same manner, but much less energetically. It is suited to cases of *nervous headache*, and of general nervousness with *insomnia*, produced by exhaustion of mind or body. *Dose*, one or two fluidrachms.

TINCTURA VERATRI VIRIDIS, *U. S.*, *Br.*—TINCTURE OF AMERICAN HELLEBORE.

Tincture of green hellebore, E.

Preparation.—Take of American Hellebore in moderately fine powder sixteen troyounces; Alcohol a sufficient quantity. Moisten the powder with four fluidounces of alcohol, pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until two pints of tincture are obtained. *U. S.*

Take of Green Hellebore Root in coarse powder four ounces (avoird.); Rectified Spirit sufficient. Prepare one pint (imper.) of tincture by the formula on page 1396. *Br.*

This tincture has a reddish-brown color, and becomes turbid on the addition of water. It should not be confounded with *Tinctura hellebori viridis* (see page 1412).

Medical Uses.—The American is more than twice as strong as the British tincture, and may be given to adults in *doses* of six or eight drops every three hours, and cautiously increased until nausea is felt or the pulse begins to fall. The dose of the British tincture is from "five to twenty minims." It may be remarked here, as was implied in the account given of American hellebore itself, that while some of our native physicians exalt this medicine to the rank of a panacea, others condemn its use altogether as scientifically illogical and practically dangerous. Among the latter we desire to be reckoned.

TINCTURA ZINGIBERIS, *U. S.*, *Br.*—TINCTURE OF GINGER.

Teinture de gingembre, Fr.; *Ingwertinktur*, G.

Preparation.—Take of Ginger in fine powder eight troyounces; Alcohol a sufficient quantity. Moisten the powder with two fluidounces of alcohol, pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until two pints of tincture are obtained. *U. S.*

Other Pharmacopœias direct: Ginger two and a half ounces (avoird.); rectified spirit sufficient for one pint (imper.). *Br.* Ginger one part; 80 per cent. alcohol five parts. *Fr.* Ginger one part; alcohol sp. gr. 0.893 five parts. *P. G.* The tincture is yellowish-brown, and is rendered milky by water. Diluted alcohol yields a turbid tincture.

TINCTURA ZINGIBERIS FORTIOR, *Br.*—STRONG TINCTURE OF GINGER.

Preparation.—Take of Ginger in fine powder ten ounces; Rectified Spirit a sufficiency. Pack the ginger tightly in a percolator, and pour over it carefully half a pint of the spirit. At the expiration of two hours add more spirit, and let it percolate slowly until one pint of tincture has been collected. *Br.*

This has about one-half the strength of the fluid extract of ginger (page 605), and is used in preparing Pilulæ scammonii comp. and Syrup zingiberis, *Br.*

Medical Uses.—These tinctures suffice for nearly all the purposes to which ginger can be applied, either internally or externally. The British is twice as strong as the American tincture. The latter may be prescribed in *doses* of from fifteen to sixty minims; the former in the *dose* of from five to thirty minims.

TORMENTILLA, *U. S.*—TORMENTIL.

Rhizoma tormentillæ, P. G.—*Tormentille*, Fr.; *Tormentillwurzel*, G.

The rhizome of Potentilla tormentilla, *Sibthorp* (Tormentilla erecta, *Lin.*, s. T. officinalis, *Curtis*). Bentley and Trimen, Med. Plants, 101.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—The tormentil plant grows in open woodlands and grassy places throughout Europe and Northern Asia, and flowers from May to August. It resembles our cinquefoil, but has numerous ascending or weak stems, with trifoliate and frequently opposite, sessile upper leaves, and long-peduncled yellow tetramerous flowers.

Description.—Tormentil attains a length of three inches, but as usually seen is less than two inches long, about half an inch thick, irregularly cylindrical or obconical, occasionally branched, and has the surface covered with numerous roundish protuberances, and between these, with depressions, from which remnants of thin wiry rootlets project. The rhizome has externally a dark grayish red-brown color, is hard, breaks with a nearly smooth, somewhat resinous fracture, is internally light or deeper brownish-red, and consists of a thin bark, of a large pith, and of one or two circles of yellowish wood wedges, separated by broad medullary rays. In the fresh state, tormentil has a faint roselike odor, but after drying it is inodorous, and has a strongly astringent taste.

Constituents.—Meissner (1822) obtained from tormentil 17.5 per cent. of tannin, 18 per cent. of *tormentil red*, soluble in alcohol and ether, not in water; and smaller quantities of wax, resin, mucilage, etc. Scheele has proved the presence of oxalate of calcium. Bowman (1869) estimated the amount of tannin with gelatin at between 24 and 30 per cent. Rembold (1867) corroborated the previous observations of Grischow and Bahlmann concerning the presence of a small quantity of *ellagic acid;* found the *tormentil red* to be probably identical with the allied red compound of rhatany and horsechestnut, since with potassium hydrate it yields protocatechuic acid and phloroglucin; established the presence of notable quantities of *kinovic acid*, $C_{24}H_{38}O_4$, and obtained the *tormentil-tannic acid* of the composition $C_{26}H_{22}O_{11}$. The tannin is precipitated by gelatin, gives with ferric chloride a blue-green reaction, and yields tormentil red, but no sugar, on being boiled with dilute sulphuric acid.

Medical Action and Uses.—This drug is almost obsolete even in Europe, and is hardly known in this country. It is a pure and powerful astringent, which can be used, like tannic acid and the plants that contain it, for constringing relaxed tissues, diminishing *fluxes*, arresting passive *hemorrhages*, etc. The *dose* of the powder is five grains or more. A decoction or infusion is prepared with from one to four drachms of it in half a pint of water, which may be taken in tablespoonful doses, or applied topically.

TOXICODENDRON, *U. S.*—POISON OAK.

Folia toxicodendri, P. G.—*Sumach vénéneux*, Fr.; *Giftsumach*, G.

The leaves of Rhus toxicodendron, *Lin.* *Nat. Ord.*—Terebinthaceæ.

Origin.—The poison oak is indigenous to Canada and the greater portion of the United States westward to the Rocky Mountains. It attains a height of about three feet, and has an erect stem, or, if growing in close proximity to trees or walls, it becomes a climber, supporting itself by adventitious roots, and ascends to the height of thirty or forty feet. This climbing shrub, Rhus radicans, *Lin.*, is now regarded merely as a variety of the erect form, but is popularly distinguished as *poison ivy.* Both forms, when wounded, emit a milky juice, which turns black on exposure; they have the small pale greenish pentamerous flowers in axillary paniculate racemes, and produce small dry drupaceous fruits of a whitish color. The juice may be employed as an indelible ink, but is soluble in ether. The leaves are employed, and should be collected from May to July while the shrub is in bloom. The plant has been introduced into Europe, and has become naturalized there.

Description.—The leaves are on petioles four or five inches long, and are trifoliate, with the terminal leaflet prominently stalked, ovate or oval, acuminate, and with a wedge-shaped base. The lateral leaflets are sessile, four or five inches long, pointed, rounded at the base, and obliquely ovate in shape, the lower part being broadest. The leaflets are either entire or variously notched, coarsely toothed or lobed, smooth above, downy beneath, and after drying thin and papery. The leaves are inodorous, and have a somewhat astringent, saline, and acrid taste.

Constituents.—Khittel (1858) found in the leaves of poison oak tannin, producing a green-black precipitate with ferric salts, fixed oil, wax, mucilage, and other principles commonly found in plants. He believed the poisonous properties of the plant to be due to a volatile alkaloid. But we found (1865) the exhalations of this plant to have an acid reaction, and the leaves to contain notable quantities of ammonia, but no other alkaloid, or only minute traces of such a compound. The poisonous *toxicodendric acid* is volatile, has a strongly acid reaction, neutralizes bases completely, and yields with an excess of oxide of lead a soluble salt having a strong alkaline reaction. The aqueous solution of the acid produces with the lead acetates heavy white precipitates, yields with nitrate of silver, on boiling, a black precipitate of oxide of silver, and separates metallic gold from a warm solution of chloride of gold. Its neutral salts produce with mercurous salts a white precipitate changing to black when heated. Potassium permanganate is readily reduced both by the acid and its salts. Toxicodendric acid resembles both formic and acetic acids, in some of its reactions, but it fails to produce a red color with neutral ferric salts. Applied to the skin, either in solution or in the state of vapor, the acid produces vesicular eruption.

Allied Plants.—RHUS DIVERSILOBA, *Tor. & Gr.* (Rh. lobata, *Hook.*), is a straggling or climbing shrub of the Pacific coast of North America, and has the leaves with three or five more or less deeply lobed or pinnatifid leaflets.

Rhus venenata, *D.C.* (Rh. vernix, *Lin.*)—This species grows in swampy localities in Canada and the United States, and is known as *poison sumach*, *poison dogwood*, and *poison elder*. It is a shrub twelve to eighteen feet high, and has very glabrous leaves with about eleven oval or obovate-oblong, abruptly pointed, and entire leaflets. The fruit is yellowish.

Rhus pumila, *Mich.*, is a procumbent shrub of Western South Carolina, and has pubescent pinnate leaves, with about eleven oval or oblong, coarsely toothed, and somewhat acuminate leaflets. The fruit is red and softly hairy.

All the species named are poisonous, and their properties are probably due to the same principle.

Pharmaceutical Preparations.—The expressed juice of the fresh leaves preserved by alcohol probably possesses all the virtues of the drug.

Tinctura toxicodendri, *P. G.*—Five parts of the fresh leaves bruised are macerated for eight days with six parts of alcohol, and the liquid expressed and filtered.

Physiological Action.—Poison oak was well known to the aborigines, and early described by travellers in North America, both as a poison and as a medicinal agent. The emanations of the living plant produce an eczematous eruption upon the skin; and it is alleged that a dog exposed to them died with a general swelling of the body. Herbivorous animals devour its leaves with impunity; but dogs are poisoned by its juice, losing their power of muscular co-ordination and strength, and dying with dilated pupils without coma or convulsions. On man it acts externally as an irritant, some persons being much more susceptible than others to its influence. Even air impregnated with the exhalations of the leaves is sufficient to produce an eczematous inflammation of the skin. This is characterized by violent itching, redness, and swelling, followed by heat, pain, fever, and vesication, which, upon the face and genitals particularly, may be attended with extreme tumefaction. These symptoms begin between a few hours and several days after the application of the poison, and are usually at their height on the fourth or fifth day, after which desquamation commences. But sometimes they continue actively for a longer time. The juice of the plant applied to the skin will, in the course of forty-eight hours, produce a blister which is soon surrounded with vesicles, and later a similar eruption may take place upon distant parts of the body without the primary blisters having been ruptured. The eruption is attended with severe burning and itching. Usually, however, the more distant irritation is due to the discharge from the primary one being conveyed elsewhere by the hands. But there are some cases of poisoning by this plant, taken internally, which are attended with a vesicular eruption of the skin. Internally, it gives rise to a species of intoxication with vertigo, confusion of the senses, dilatation of the pupils, a sense of constriction of the temples, chilliness, nausea, thirst, a slow, small, and irregular pulse, diaphoresis and diuresis, debility, faintness, trembling, and convulsions. Two children, who between them had eaten a pint of the berries, became drowsy and stupid, then delirious, and convulsed.

Various remedies have been employed to palliate the inflammation caused by poison oak. One of the best is alum-curd, which is appropriate at all stages of the process. Before the blisters have fully formed or have discharged their contents, lead-water is useful, but a weak solution of ammonia or of soda is perhaps still more so. When the blisters are fully formed, or have been ruptured, a solution of perchloride or of persulphate of iron carefully applied to the vesicated skin will arrest the progress of the inflammation. Grindelia squarrosa has also been used for this purpose (see p. 683).

Medical Uses.—The inflammation of the skin which poison oak excites led to its being employed substitutively in chronic *cutaneous affections*, but ineffectually. It has been alleged (Trousseau) to be efficacious in the treatment of *paraplegia* from concussion of the spinal marrow, and other affections of this organ without lesion of tissue; it is said to occasion no inconvenience, and to strengthen rather than enfeeble digestion. Sometimes a slight degree of strangury is observed. It has also been used to cure *incontinence of urine* depending upon atony of the bladder. The *dose* of the powdered leaves is stated to be five grains, which should be gradually increased to sixty grains. On the whole, the medicinal virtues of this plant are too uncertain to inspire any confidence in it.

TRAGACANTHA, *U. S.*, *Br.*—TRAGACANTH.

Gummi tragacantha.—Gomme adragante, Fr.; *Traganth*, G.

The gummy exudation from Astragalus verus and from other species of Astragalus. Bentley and Trimen, Med. Plants, 73.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The genus Astragalus comprises numerous herbaceous, suffruticose, and shrubby species, and is characterized by its flowers having ten stamens, nine of which are united into a bundle, and by having the lower suture of their legumes inflexed so as to make the fruit apparently two-celled. The subgenus *Tragacantha* has the stipules united with the permanent petioles which become thorny. According to Boissier and Haussknecht, the principal species yielding tragacanth are Astragalus adscendens, *Bois. et Haussk.*, A. brachycalyx, *Fisch.*, A. microcephalus, *Willd.*, A. pycnocladus, *Bois. et Haussk.*, A. stromatodes, *Bunge*, A. kurdicus, *Bois.*, A. cylleneus, *Bois. et Heldreich;* also, A. verus, *Olivier*, and A. creticus, *Lamark.* All are low shrubs, indigenous to a portion of the territory lying between Eastern Persia and Greece.

The secretion of tragacanth is due to a transformation of the cell walls, with their incrusting layers, of the pith and medullary rays contained in the stem and older branches, as was first observed by Hugo von Mohl (1857), whose observations were corroborated by Wigand (1861). The altered tissue is confined in the plant with considerable tension, and oozes out with some force on breaking a branch or making an incision.

Collection.—Tragacanth exudes either spontaneously or from punctures and longitudinal incisions made into the stem and older branches. From such incisions flake tragacanth is obtained; while the spontaneously exuding gum forms irregularly globular or somewhat conical pieces. The rapidity with which the gum exudes chiefly determines the shape in which it ultimately hardens, and the time which elapses before it is sufficiently hard for collection influences the color of the product, which is white if congealed rapidly, and more or less yellowish and brown if hardened slowly. Tragacanth enters commerce from the ports of Asia Minor and from the Persian Gulf.

Properties.—Tragacanth consists of different layers, either laid upon one another and spirally twisted, or confluent into tear-like masses, or extended into curved, narrow, or broad bands, varying in width between one-quarter of an inch and one inch, and sometimes four or five inches long. These bands are rarely made up of a single layer, but usually are marked with several parallel ridges indicating the various strata which are laterally united into broader pieces. This form of tragacanth is known as *flake tragacanth* or *leaf gum*, and is the more valuable the whiter and more translucent it is. Smyrna tragacanth is mostly in rather broad and thick flakes, which are yellowish or of a brownish tint. Thin, ribbon-like, and white flakes are produced in Kurdistan and Persia, but are sometimes distinguished in commerce as Syrian tragacanth. Another variety is *vermiform tragacanth*, also called *vermicelli.* It consists of very narrow, variously coiled, and contorted string-like pieces, the different coils of which are most frequently confluent. *Common tragacanth* or *sorts* is the product obtained by spontaneous exudation, and forms subglobular, conical, or variously shaped tear-like pieces, with the surface rounded and more or less irregular; it is usually of a brownish or brown color, and rather waxy in appearance.

Tragacanth is hard, tough, difficult to powder, inodorous and tasteless, insoluble in alcohol and ether, and forms with fifty parts of water a thick jelly-like mucilage. When diffused in a much larger quantity of water it forms a ropy liquid which may be passed through a filter, leaving behind an insoluble residue. When left in contact with an aqueous solution of iodine, tragacanth acquires a blue color from the presence of starch.

Composition.—The soluble gum contained in tragacanth is, like arabin, precipitated by alcohol and oxalate of ammonium, but its solution is not gelatinized by ferric chloride or borax. The insoluble gum is known as *bassorin*, *traganthin* and *adraganthin*. It is soluble in hydrochloric acid and in ammonia, and is stated to have the composition $C_{12}H_{20}O_{10}$. But, according to Giraud (1876), tragacanth consists essentially of *pectose* or a closely allied principle, which, on being digested with water, is gradually converted into a soluble compound, *pectin*, which is precipitated by alcohol. He regards it as very improbable that tragacanth should originate from a transformation of cellulose, since this body is ordinarily converted into dextrin and sugar, which compounds are not met with in tragacanth. According to this author, the average composition of tragacanth is 20 per cent. water, 60 per cent. pectin compound, 8 to 10 per cent. soluble gum, 3 per cent. cellulose, 2 or 3 per cent. starch, 3 per cent. of mineral constituents, and a trace of nitrogenous matter. By drying, tragacanth loses about 15 per cent. of moisture.

Allied Gums. CHERRY GUM.—The different species of cherry and plum trees frequently yield gummy exudations which harden to irregular nodulous masses, are of a more or less brown color, translucent, and dissolve imperfectly in water. According to Guérin, the insoluble portion of this gum is not identical with bassorin.

BASSORA or KUTERA GUM is a Persian product of unknown origin, and is met with in yellowish or brownish, semitransparent, and tasteless masses, which swell considerably with water. It is used in Smyrna for adulterating the cheaper varieties of tragacanth, and is then usually broken into smaller pieces of about the same size as the tragacanth. Such broken pieces are angular, and are said to be sometimes artificially whitened with white lead. This fraud may be readily detected by treating the gum with cold dilute nitric acid, when the presence of lead in the solution may be established without difficulty.

CASHEW GUM, *gomme acajou*, is an exudation of Anacardium occidentale (see page 171), is brown-yellow, translucent, somewhat iridescent, and partly soluble in water. See also Hog gum, page 5.

Off. Prep.—Confectio opii, *Br.;* Mucilago tragacanthæ, *U. S.*, *Br.;* Pulv. opii comp., Pulv. tragacanthæ comp., *Br.;* Trochisci, *U. S.*

Medical Action and Uses.—Tragacanth is demulcent and nutritious. It was apparently unknown to the Greek physicians until the 4th or 5th century, and was then used to allay *cough* and *hoarseness* and promote *expectoration*, and, in a word, for all the affections in which gum Arabic has been employed. Its difficult solubility renders it less eligible than the latter gum in most instances. On the other hand, the greater tenaciousness of its mucilage fits it to be a better protective in some local affections, as in *burns*.

TRILLIUM.—BETHROOT.

Birthroot, Wakerobin.—Trillium, Fr., G.

The rhizome of Trillium erectum, *Lin.* *Nat. Ord.*—Liliaceæ.

Origin.—Bethroot is generally stated to be obtained from *Trillium pendulum*, which is now regarded as a white flowering variety of *Tr. erectum*, but the drug as met with in the market is evidently derived from different plants, and it is not unlikely that in different localities bethroot is collected from such species of trillium as may be most abundant. All the species have a simple stem, mostly about a foot high, bearing at its apex a single hexandrous flower, and beneath it a whorl of three leaves, which are reticulate-palmately veined and usually broadly ovate or rhomboid in shape. The fruit is a triangular-ovate, three-celled and many-seeded, dark purple or red berry. The different species grow in moist thickets and shady woods in various parts of the United States and Canada. Two of the species have the dark-purple flower sessile between the leaves, namely, Tr. sessile, *Lin.*, with erect petals and sessile leaves, and Tr. recurvatum, *Beck*, with recurved petals and stalked leaves. Two species have white flowers on erect peduncles and petiolate leaves, namely, Tr. nivale, *Riddell*, with the leaves and petals obtuse; and Tr. erythrocarpum, *Mich.*, with pointed leaves and petals, and the latter striped with purple near the base. Tr. cernuum, *Lin.*, and Tr. stylosum, *Nutt.*, have white or rose-colored flowers on peduncles, which are deflexed under the leaves, the last-named species being distinguished by the partly united styles. Tr. erectum, *Lin.*, bears a nodding and finally deflexed flower, with dark-purple spreading petals, or in the variety *album* (Tr. pendulum, *Muhl.*) with greenish-white or yellowish petals. The variety *declinatum* has a horizontal peduncle and white or pink-colored petals. Tr. grandiflorum, *Salisb.*, has a large white or rose-colored suberect flower.

Description.—Bethroot is a subglobular, oblong, or nearly obconical and oblique rhizome, which is truncate at the lower end, and terminates above with a short tuft of sheathing leaf bases. The rhizome is an inch or an inch and a half long, half or three-quarters of an inch in diameter, slightly flattened, finely but distinctly annulate, and particularly in the upper portion beset with circular rows of straw-colored or pale-brownish rootlets, or with the short remnants of the same. Bethroot is externally of a yellowish orange-brown color, internally whitish or more frequently yellowish or light-brown, and upon transverse section is seen to be composed of rather spongy parenchyma and of small scattered fibro-vascular bundles, which are circular, elongated, or irregularly curved, and more numerous towards the circumference than near the centre. It is inodorous, or nearly so, and has a sweetish, astringent, afterwards bitter and acrid taste.

Constituents.—On moistening a section of bethroot with solution of iodine, the tissue assumes a uniform blue color with the exception of the wood bundles, proving the presence of starch in the parenchyma. From an investigation by Prof. E. S. Wayne (1856) it appears that, on evaporating the tincture and diluting with water, fatty and resinous matter and perhaps a little volatile oil are separated, and that from the aqueous liquid tannin and coloring matter are precipitated by acetate and subacetate of lead, while the acrid principle remains in solution. On removing the excess of lead by sulphuric acid and filtering, the acrid principle, or probably a decomposition product of it, is deposited as a gelatinous mass, soluble in alcohol, but insoluble in water, and producing with it on agitation a permanent foam. The principle deserves further investigation.

Medical Action and Uses.—This is one of the plants used as a medicine by the American aborigines. Its acrid principle causes it to irritate the mouth and throat when chewed, and increase the flow of saliva. It is reputed to be astringent, tonic, and alterative, and to have a special action upon the uterine system, controlling *menorrhagia*, and quickening the contractions during *parturition*. For the latter reason it received the name of "birthwort." In large doses the root is alleged to be emetic, and the bruised herb has been applied with supposed advantage to unhealthy *ulcers* and to *tumors*. Trillium erectum appears to be the most active species. The *dose* of its dried and powdered root is stated at one drachm.

TRIMETHYLAMINA.—TRIMETHYLAMINA.

Triméthylamine, Fr.; *Trimethylamin*, G.

Formula $(CH_3)_3N$. Molecular weight 59.

Origin and Preparation.—This compound, frequently incorrectly called *propylamin*, with which it is isomeric, has been obtained from ergot (*secalina*), from the leaves of Beta vulgaris and Chenopodium vulvaria, from the flowers of Arnica montana, Pyrus communis, Sorbus aucuparia, and Cratægus oxyacantha, and from cod-liver oil, bone oil, and guana. It is also produced on heating codeia with potassa, but is most economically obtained from herring-pickle, which contains this alkaloid in considerable quantity, and owes to it its peculiar odor. A mixture of herring-pickle and lime is subjected to distillation, the alkaline distillate is neutralized with hydrochloric acid and evaporated, and the saline residue is treated with absolute alcohol, which leaves ammonium chloride undissolved. The alcoholic solution is evaporated, the residue redissolved in a little water, and again carefully distilled with lime. If the vapors are first passed through an empty bottle before they are condensed by means of ice or conducted into water, several less volatile alkaloids are separated in the bottle.

Properties.—In its pure state trimethylamina is a colorless, thin, and strongly alkaline liquid, having the peculiar odor of herring-pickle, and boiling at 9.8° C. (49.6° F.). At ordinary temperatures it is a colorless inflammable gas. It is readily soluble in water and alcohol, and an aqueous solution of it is met with in commerce as *propylamin*. The chloroplatinate of trimethylamina crystallizes in well-defined orange-colored octohedrons, and contains 37.21 per cent. of platinum.

Propylamina, C_3H_9N, when pure, is a colorless, strongly refracting, inflammable liquid, of an ammoniacal odor, boiling at 50° C. (122° F.), and yielding with platinic chloride a double salt, which crystallizes in orange-yellow clinorhombic plates.

HYDROCHLORATE OF TRIMETHYLAMINA is obtained on neutralizing the alkaloid with hydrochloric acid and evaporating. It crystallizes in white or colorless prisms, is nearly inodorous, has a saline pungent taste, is very deliquescent on exposure, and dissolves freely in water and alcohol.

Physiological Action. *On Animals.*—When from twenty to thirty grains of trimethylamin were injected under a rabbit's skin, in the course of an hour there occurred trembling with convulsive succussion, agitation, increased excito-motor action, with hyperæsthesia and quickened cardiac and respiratory movements. These phenomena were followed by a period of depression or collapse and a degree of motor paresis, with death by asphyxia. In frogs the same phenomena, essentially, were produced, and the heart-beats fell from 64 or 68 at the commencement of the experiment to 34, 20, and 12, and finally were suspended. Doses of from thirty to fifty grains introduced into a dog's stomach excite immediate vomiting. Smaller and repeated doses occasioned anxiety, distress, immobility, general muscular tremor, accelerated action of the heart, distaste for food, and marked emaciation; bloody urine was voided at the end of six days, charged with biliary and coloring matters; and there were great susceptibility, reflex excitability, and hyperæsthesia. In the rabbits killed by this substance there were found discoloration, gangrene, and emphysema at the point of hypodermic injection. The lungs were congested, and spots of subpleural ecchymosis existed. The heart contained large black clots in both cavities. The kidneys were congested, and the bladder was filled with non-albuminous urine of an ammoniacal odor. Husemann, however, in his experiments on rabbits, observed neither bloody urine nor congestion of the lungs or kidneys. Other experimenters (Dujardin-Beaumetz) state that as much as seventy-five grains of muriate of trimethylamin may be administered subcutaneously to rabbits without occasioning toxical phenomena, and that when the animals perished their death seemed always to be due to the caustic action of the salt upon the tissues. This observer attributes the depression and collapse of the animals to the pain produced by the caustic action of the compound. But this judgment is untenable. The mode of death in animals killed by this substance, given hypodermically or by the stomach, and especially the persistence of the heart's beats after the suspension of respiration, appear to prove that it does not act directly as a heart-poison, but indirectly, through the spinal marrow, first upon the respiratory muscles, and then upon the heart. In many experiments the excitability of the heart persisted for quite ten minutes after death.

On Man.—Applied to the sound skin, trimethylamin in its action is negative unless friction is employed, in which case it causes redness very much as ammonia does. Upon the mucous membrane it acts as a strong irritant, causing a lively sense of burning, with redness, and, if allowed to continue its action, it produces superficial ulceration. Its taste is ammoniacal and saline, and if taken in a large dose and undiluted it occasions a burning sensation in the throat, œsophagus, and stomach. Propylamin and muriate of trimethylamin agree in their effects: thirty or forty grains of the former, or ten grains of the latter, will reduce the pulse about ten beats in the minute, and under the influence of the muriate the temperature may fall one or two degrees F. In febrile rheumatism the decline of the pulse-rate and temperature is more decided. But the medicine causes neither diaphoresis, diuresis, colic, nor diarrhœa.

Medical Uses.—The disease in connection with which trimethylamin was first brought into notice, and the only one in which its importance as a medicine is recognized, is *articular rheumatism.* It does not appear what motives first led to its use in the treatment of this affection by Awenarius, of St. Petersburg, who, between 1854 and 1856, treated by its means more than two hundred and fifty rheumatic patients, and affirmed that it dissipated the pain of the acute disease from one day to another. Isolated statements attributing to it a similar efficacy were made in France previous to 1864; but in 1870 Lagrange confirmed them, and in 1873 Dujardin-Beaumetz gave the history of seven cases of acute articular rheumatism which were cured in a very short time by trimethylamin. The improvement in general was rapid, and sometimes great relief was experienced within twelve hours, the pain first and then the swelling subsiding, as well as the fever. Further experience led him to conclude that of all the remedies hitherto used in the treatment of acute articular rheumatism muriate of trimethylamin appears to be the most efficient. A number of physicians in France have sustained this conclusion by their own experience; a few have published a similar judgment in England, and also in Germany. The less favorable accounts of some others are attributed to their having made use of badly prepared and inert preparations of the medicine, or of those which did not contain a due proportion of the active ingredient. Trimethylamin is stated to have cured *chorea* promptly, when administered in divided doses to the extent of fifteen or twenty grains a day.

The *dose* of trimethylamin is from twenty to sixty minims diluted with an aromatic water and sweetened. It should be repeated every three or four hours.

Hydrochlorate of trimethylamin is given in doses of two or three grains, dissolved in a syrup, and repeated at similar intervals, so that not less than fifteen grains shall be taken during the day.

TRIOSTEUM, *U. S.*—FEVER-ROOT.

Feverwort, Horsegentian, Bastard ipecac, Tinker's weed, E.; *Racine de trioste,* Fr.; *Dreisteinwurzel,* G.

The root of Triosteum perfoliatum, *Lin.* *Nat. Ord.*—Caprifoliaceæ.

Origin.—This perennial herb is indigenous to the United States, and grows in woodlands, and flowers in June. The stem is from two to four feet high, soft-hairy, and has opposite spatulate-ovate and entire leaves, which are about four inches long, abruptly narrowed below, and connate at the base. The flowers are in axillary clusters, and have a five-lobed brown-purple corolla, about half an inch long. The ripe fruit is orange-colored, drupaceous, and contains three hard nutlets. All parts of the plant have a bitter taste, but only the rhizome and roots are employed. The more slender and rougher Tr. angustifolium, *Lin.*, which grows chiefly in the Western and Southern United States, is said to have similar properties.

Description.—The rhizome is horizontal, from six to twelve inches long, knotty-cylindrical, about three-quarters of an inch thick, somewhat branched, and on the upper side bears numerous cup-shaped scars of the over-ground stems, about one-quarter of an inch in diameter. The numerous spreading rootlets are inserted mainly on the lower side of the rhizome, and are at their base one-quarter or three-eighths of an inch thick, and five to ten inches long. Both the rhizome and roots are slightly wrinkled longitudinally; externally of a yellowish-brown color, internally white, and contain a hard, slightly bitter wood, with delicate medullary rays. The bark of the rhizome is thin, that of the roots rather thick, and has a bitter, somewhat nauseous taste. Fresh fever-root has a slight disagreeable odor, which is dissipated on drying.

Constituents.—On moistening a transverse section of the roots with solution of iodine, a deep blue color is imparted to the medullary rays and the cambium layer, but the bark acquires only a slightly blue tinge. Fever-root has not been subjected to analysis; its bitter principle is dissolved both by water and alcohol.

Medical Uses.—A decoction of this plant is said to have been used by some of the American aborigines in the treatment of fevers and female obstructions. The fresh root, in the dose of from twenty to thirty grains, and the extract in the dose of ten or fifteen grains, purge actively after the manner of jalap. The bark of the root is said to be emetic.

TRITICUM REPENS.—COUCHGRASS ROOT.

Rhizoma graminis, P. G.; *Radix graminis.—Quickgrass, Quickens, Quitch,* E.; *Petit chiendent,* Fr.; *Queckenwurzel, Grasswurzel,* G.

The rhizome of Triticum repens, *Lin.* *Nat. Ord.*—Graminaceæ.

Origin.—Couchgrass is a troublesome perennial weed, growing along roadsides and in cultivated grounds throughout the Northern Hemisphere. The plant has a long, jointed, whitish rhizome, with a tuft of fibrous rootlets at each joint. The culm is one or two or sometimes four feet high, and has compressed spikes three or four inches long, and four- to eight-flowered spikelets. The florets are variable, mostly awnless, and either pointed or rather obtuse. The rhizome should be gathered in spring.

Description.—Couchgrass root is met with in the market, deprived of the rootlets, and cut into short sections. It is about one-twentieth of an inch in diameter, of a straw-yellow color, smooth, hollow in the centre, inodorous, and of a sweet taste.

Constituents.—The latest analysis of couchgrass root is by Ludwig and H. Müller (1872, 1873), who obtained from it fruit-sugar, levulose, and a right-rotating sugar which is not identical with cane-sugar. A peculiar gum-like principle, *triticin*, was isolated, which resembles inulin in its optical behavior, and, like this, may be converted into levulose. It is obtained by exhausting the rhizome with 25 per cent. alcohol, precipitating the tincture with subacetate of lead, removing the excess of lead, precipitating by alcohol, and repeating the treatment with lead-salt, and alcohol. Mannite, which was stated by Berzelius to be present in the rhizome, has not been obtained by later investigators. The extract of couchgrass root may contain *lactic acid* as a product resulting from fermentation.

Pharmaceutical Preparations. — EXTRACTUM GRAMINIS, *P. G.*— Couchgrass root is digested with six parts of water for six hours, and the strained infusion evaporated to a syrupy consistence; this is diluted with four times its weight of cold water, filtered, and evaporated to the proper consistence.

Medical Action and Uses.—Couchgrass was employed by the ancients as a vulnerary and for the relief of dysury. They also believed that it removed stone, or at least gravel, from the bladder. In modern times it has been very generally regarded as emollient, antiphlogistic, and diuretic. Its infusion is a common medicinal drink in Parisian hospitals and private life, where it is regarded as adapted to relieve thirst, allay fever, and promote urination. It was formerly employed as a popular diet drink to "purify the blood" in the spring season, and doubtless assisted in purging, through the kidneys, the accumulated organic detritus of a long winter. It was also thought to be very efficient in relieving congestions of the liver and portal circulation arising under analogous circumstances, and in a less degree chronic bronchitis, skin diseases, gout, etc. It was even alleged to be capable of curing gastric cancer, and removing biliary calculi. In truth, it possesses no special medicinal virtues besides being, when given in infusion, an agreeable drink, which, owing to the sugar it contains, tends to increase the urinary secretion. It is best administered in a decoction prepared with from two to four ounces of the plant in two pints of water, and reduced one-half by boiling.

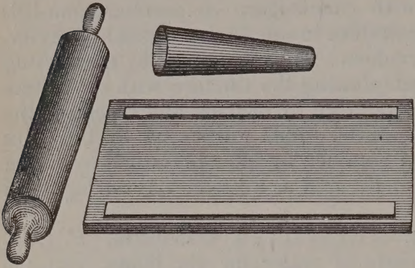
TROCHISCI.—TROCHES.

Tabellæ, F. P.—*Lozenges*, E.; *Tablettes, Pastilles*, F.; *Pastillen, Zeltchen*, G.

Troches are mixtures of medicinal substances with sugar or extract of liquorice, formed by the aid of mucilage into stiff, pasty masses, and divided into flat circular, oblong, rectangular, or stellate pieces, usually weighing about ten or twenty grains. A cylindrical shape has been adopted for a few of the officinal lozenges.

Preparation.—The dry ingredients are separately reduced to fine powders, and thoroughly mixed in a mortar or by sifting. Volatile oils, tinctures, and similar liquids should now be intimately incorporated with the powder, and the whole beaten into a rather firm mass by the addition of mucilage of tragacanth or of acacia. The mass is then rolled out into sheets of suitable thickness, and cut into the requisite number of pieces by a punch. A hard and smooth board or a polished marble slab, dusted over with finely powdered sugar, is well adapted for this purpose; and in order to keep the mass at a somewhat elevated temperature while being rolled out, the roller is sometimes made of iron or glass, and hollow in the interior, so that it may be filled with water of any desired temperature. When lozenges are ordered on extemporaneous prescriptions, the mass is usually rolled out into a square, rectangular, or rhombic cake, and then divided by means of a ruler and knife into the requisite number of pieces, all having the same size and shape. After lozenges have been cut they are spread out on a sieve or other surface, and exposed to a current of warm air until they are sufficiently dry.

Fig. 195.



Board, roller, and punch for making lozenges.

The amount of powdered tragacanth necessary for imparting the requisite adhesiveness, varies with the nature of the ingredients; one part of it is sufficient for 100 parts, and even more, of sugar and similar powders, if, after the addition of water, the mass is well beaten. A much larger proportion of tragacanth renders the lozenges, after some time, very hard and slowly soluble. If mucilage of acacia is employed instead of tragacanth, the lozenges become somewhat translucent, and a similar effect is produced by employing the white of eggs as the adhesive material. Some manufacturers employ a machine with movable dies for cutting lozenges of any desired shape, and for stamping them at the same time with the name of the principal ingredient.

If the lozenges are to be made of a cylindrical shape, the mass is rolled out into thin cylinders, in a manner similar to that of making pills, and then cut into shorter pieces having the requisite weight. The mass should be sufficiently firm not to flatten on drying, and the rolling-board, instead of being dusted with sugar, is greased with a little olive oil, to prevent the mass from adhering to it. For a description and sketch of an apparatus by F. C. Hill, suitable for making such lozenges, see *Amer. Journ. Phar.*, 1874, p. 402.

The German Pharmacopœia gives the following general directions for preparing lozenges: The whole amount of the medicinal substance is well mixed with the sugar, which has been previously moistened with alcohol of sp. gr. 0.893; or with a cacao-mass which has been softened by heat. The mass is properly rolled out and divided so that each lozenge shall contain a definite weight of the medicinal substance. The sugar or cacao-mass must be employed in such proportion that the weight of each lozenge shall be one gram.

One gram has also been adopted by the French Codex as the weight of lozenges.

ROTULÆ, *P. G.;* Sugar-lozenges, Sugar-drops, *E.;* Orbicules, *Fr.;* Zuckerplätzchen, *G.*—This form of lozenges is usually made by the confectioner, and the medication merely is left to the pharmacist. The lozenges are prepared by mixing, in a pan having a suitable lip, some granulated sugar with a sufficient quantity of water to form a pasty mixture; this is heated carefully to prevent empyreuma, until it begins to boil. An additional quantity of sugar is then stirred in to give the requisite consistence; 100 parts of sugar require about 12 or 15 parts of water. The semi-liquid mass is now poured out upon cold, polished sheet-iron in such a manner that each drop is kept separate, when, on touching the iron plate, it will congeal into a flattish, hemispherical body. *Chocolate drops* are made by a similar process.

ROTULÆ MENTHÆ PIPERITÆ, *P. G.;* Peppermint-drops, *E.;* Pastilles de menthe, *Fr.;* Pfefferminzkuchen, *G.*—One part of oil of peppermint is dissolved in 2 or 3 parts of alcohol, and the inner surface of a bottle uniformly moistened with the solution; 200 parts of sugar-drops are then introduced into the same bottle, and well agitated, so as to impregnate them uniformly with the liquid; afterwards they are exposed to the air for a few minutes, and, after the alcohol has evaporated, kept in a stoppered bottle.

By substituting other volatile oils for the oil of peppermint, lozenges of any desired flavor may be obtained.

TROCHISCI ACIDI TANNICI, *U. S.*, *Br.*—TROCHES OF TANNIC ACID.

Pastilles de tannin, Fr.; *Tanninpastillen*, G.

Preparation.—Take of Tannic Acid a troyounce; Sugar in fine powder ten troyounces; Tragacanth in fine powder one hundred and twenty grains; Orange Flower Water a sufficient quantity. Rub the powders together until they are thoroughly mixed; then with the orange flower water form a mass, to be divided into four hundred and eighty troches. Each lozenge contains one grain of tannic acid. *U. S.*

Take of Tannic Acid three hundred and sixty grains; Tincture of Tolu one-half fluidounce; Refined Sugar in powder twenty-five ounces (avoird.); Gum Acacia in powder one ounce; Mucilage of Gum Acacia two fluidounces; Distilled Water one fluidounce. Dissolve the tannic acid in the water; add, first, the tincture of tolu, previously mixed with the mucilage; then, the gum and the sugar, also previously well mixed. Form the whole into a proper mass; divide it into seven hundred and twenty lozenges, and dry these in a hot-air chamber with a moderate heat. Each lozenge contains half a grain of tannic acid. *Br.*

Medical Uses.—Tannic acid troches are suitable in relaxed states of the mucous membrane of the mouth, throat, and larynx, to allay *cough* produced by irritation of these parts. They may also be used in mild cases of *diarrhœa*, after a preliminary evacuation of the bowels.

TROCHISCI BISMUTHI, *Br.*—BISMUTH LOZENGES.

Pastilles de sous-nitrate de bismuth, Fr.; *Wismuthpastillen*, G.

Preparation.—Take of Subnitrate of Bismuth fourteen hundred and forty grains; Carbonate of Magnesia four ounces (avoirdupois); Precipitated Carbonate of Lime six ounces; Refined Sugar twenty-nine ounces; Gum Acacia in powder one ounce; Mucilage of Gum Acacia two fluidounces; Rose Water a sufficiency. Mix the dry ingredients, then add the mucilage, and form the whole into a proper mass with rose water. Divide the mass into seven hundred and twenty lozenges, and dry these in a hot-air chamber with a moderate heat. Each lozenge contains two grains of subnitrate of bismuth. *Br.*

The corresponding lozenges of the French Codex contain 0.10 gram (1.5 grain) of the subnitrate, but no magnesia.

Medical Uses.—This form of administering bismuth is very unprofitable, since bismuth does not act unless mechanically, and by diffusion.

TROCHISCI CATECHU, *Br.*—CATECHU LOZENGES.

Tabellæ cum catechu, F. P.—*Pastilles de cachou*, Fr.; *Katechupastillen*, G.

Preparation.—Take of Pale Catechu in powder seven hundred and twenty grains; Refined Sugar in powder twenty-five ounces (avoirdupois); Acacia in powder one ounce; Mucilage of Gum Acacia two fluidounces; Distilled Water a sufficiency. Mix the catechu, sugar, and gum, and add the mucilage and water to form a proper mass. Divide into seven hundred and twenty lozenges, and dry these in a hot-air chamber with a moderate heat. Each lozenge contains one grain of catechu. *Br.*

The lozenges of the French Codex contain 0.10 gram (1.5 grain) of catechu.

Medical Uses.—These troches, each containing one grain of catechu, are serviceable in the cases mentioned under Troches of tannic acid. They are generally employed to obviate the *hoarseness* or huskiness of the voice due to prolonged speaking or to slight pharyngeal or laryngeal catarrhs.

TROCHISCI CRETÆ, *U. S.*—TROCHES OF CHALK.

Pastilles de craie préparée, Fr.; *Kreidepastillen*, G.

Preparation.—Take of Prepared Chalk four troyounces; Gum Arabic in fine powder a troyounce; Nutmeg in fine powder sixty grains; Sugar in fine powder six troyounces. Rub them together until they are thoroughly mixed; then with water form a mass, to be divided into four hundred and eighty troches. Each lozenge contains four grains of prepared chalk. *U. S.*

Medical Uses.—Troches of chalk may be used to correct *acidity* of the stomach, and a slight tendency to *diarrhœa.*

TROCHISCI CUBEBÆ, *U. S.*—TROCHES OF CUBEB.

Pastilles de cubèbe, Fr.; *Kubebenpastillen*, G.

Preparation.—Take of Oleoresin of Cubeb half a fluidounce; Oil of Sassafras a fluidrachm; Liquorice in fine powder four troyounces; Gum Arabic in fine powder two troyounces; Sugar in fine powder three troyounces; Syrup of Tolu a sufficient quantity. Rub the powders together until they are thoroughly mixed; then add the oleoresin and oil, and incorporate them with the mixture. Lastly, with syrup of tolu form a mass, to be divided into four hundred and eighty troches. *U. S.*

This is a modification of the formula for *Spitta's lozenges*, from which it differs essentially in the substitution of oleoresin for powdered cubebs. The lozenges are usually made of a cylindrical shape, and each contains one-half a minim of oleoresin of cubebs.

Medical Uses.—These troches are chiefly useful in cases of subacute and chronic inflammations of the *pharynx* and *larynx*, especially when these parts are covered with viscid mucus.

TROCHISCI FERRI REDACTI, *Br.*—REDUCED IRON LOZENGES.

Pastilles de fer, *Tablettes chalybées*, Fr.; *Eisenpastillen*, G.

Preparation.—Take of Reduced Iron seven hundred and twenty grains; Refined Sugar in powder twenty-five ounces (avoirdupois); Gum Acacia in powder one ounce; Mucilage of Gum Acacia two fluidounces; Distilled Water one fluidounce, or a sufficiency. Mix the iron, sugar, and gum, and add the mucilage and water to form a proper mass. Divide into seven hundred and twenty lozenges, and dry these in a hot-air chamber with a moderate heat. Each lozenge contains one grain of reduced iron. *Br.*

Medical Uses.—It is not easy to discern the merits of this preparation. Reduced iron can be serviceable only when it is acidulated by the gastric acids; and that action is better secured by administering it in powder.

TROCHISCI FERRI SUBCARBONATIS, *U. S.*—TROCHES OF SUBCARBONATE OF IRON.

Pastilles d'oxide de fer, Fr.; *Eisenoxydpastillen*, G.

Preparation.—Take of Subcarbonate of Iron five troyounces; Vanilla thirty grains; Sugar in fine powder fifteen troyounces; Mucilage of Tragacanth a sufficient quantity. Rub the vanilla first with a part of the sugar into a uniform powder, and afterwards with the subcarbonate of iron and the remainder of the sugar, until they are thoroughly mixed. Then with mucilage of tragacanth form a mass, to be divided into four hundred and eighty troches. Each lozenge contains five grains of subcarbonate of iron. *U. S.*

Medical Uses.—The advantages of administering iron in this form are not very apparent, unless it be in the diseases of refractory children who may be tempted to take these lozenges by their agreeable flavor.

TROCHISCI GLYCYRRHIZÆ ET OPII, *U. S.*—TROCHES OF LIQUORICE AND OPIUM.

Trochisci opii, Br.—*Opium lozenges*, E.; *Pastilles d'opium*, *P. de réglisse opiacées*, Fr.; *Opiumpastillen*, G.

Preparation.—Take of Extract of Opium in fine powder twenty-four grains; Liquorice in fine powder two troyounces; Gum Arabic in fine powder a troyounce; Sugar in fine powder three troyounces; Oil of Anise fifteen minims. Rub the powders together until they are thoroughly mixed; then add the oil of anise, and incorporate it with the mixture. Lastly, with water form a mass, to be divided into four hundred and eighty troches. *U. S.*

Take of Extract of Opium seventy-two grains; Tincture of Tolu half a fluidounce; Refined Sugar in powder sixteen ounces; Gum Acacia in powder two ounces; Extract of Liquorice six ounces; Distilled Water a sufficiency. Add the extract of opium, first softened by means of a little water, and the tincture of tolu, to the extract of liquorice heated in a water-bath. When the mixture is reduced to a proper consistence remove it to a slab, add the sugar and gum, previously rubbed together, and mix thoroughly. Divide the mass into seven hundred and twenty lozenges, and dry these in a hot-air chamber with a moderate heat. *Br.*

The lozenge of the first formula (*U. S.*) contains one-twentieth, and that of the second formula (*Br.*) one-tenth grain of extract of opium. The lozenges of the United States Pharmacopœia are much used under the name of *Wistar's Cough Lozenges*, and are prepared of a cylindrical shape. Formerly they were made with opium instead of the extract of opium, and some manufacturers substitute for opium an equivalent quantity of morphia. Lozenges of the same shape and composition, but with the omission of opium or morphia, have been introduced as *liquorice lozenges*, and are similar to the *trochisci bechici nigri*, which are still recognized by some European Pharmacopœias, and usually contain a small quantity of orris root and balsam of tolu.

Medical Uses.—This popular medicine, known generally as *Wistar's Cough Lozenges*, is well adapted for use in *bronchitis* and *laryngitis*, attended with harassing cough, but without marked febrile reaction. Their efficiency is greatly increased in the more acute forms of the affections mentioned by the addition of a minute proportion of tartar emetic, not exceeding the fortieth of a grain, or of half a grain of ipecacuanha, to each lozenge. On an average, one lozenge may be taken every three hours; but in general it is better to use the third of a lozenge every hour.

TROCHISCI IPECACUANHÆ, *U. S.*, *Br.*—TROCHES OF IPECACUANHA.

Pastilles d'ipécacuanha, Fr.; *Brechwurzelpastillen*, G.

Preparation.—Take of Ipecacuanha in fine powder, Tragacanth in fine powder, each one hundred and twenty grains; Arrowroot in fine powder two troyounces; Sugar in fine powder eight troyounces; Syrup of Orange Peel a sufficient quantity. Rub the powders together until they are thoroughly mixed; then with syrup of orange peel form a mass, to be divided into four hundred and eighty troches. *U. S.*

Take of Ipecacuanha in powder one hundred and eighty grains; Refined Sugar in powder twenty-five ounces; Gum Acacia in powder one ounce; Mucilage of Gum Acacia two fluidounces; Distilled Water one fluidounce, or a sufficiency. Mix the powders, and add the mucilage and water to form a proper mass. Divide into seven hundred and twenty lozenges, and dry these in a hot-air chamber with a moderate heat. *Br.*

Each lozenge contains one-quarter of a grain of ipecacuanha. Made according to the German Pharmacopœia each lozenge contains the portion soluble in water of 0.005 gram (one-thirteenth of a grain) of ipecacuanha.

Medical Uses.—Ipecacuanha lozenges are useful in *laryngeal* and *bronchial inflammation* before secretion has been established. One lozenge, containing a quarter of a grain of ipecacuanha, may be taken every half hour until the dryness of the air-passages abates, or the stomach begins to be nauseated. On the other hand, they are often very serviceable in *humid asthma*, or that asthmatic affection which is often met with in cases of pulmonary emphysema complicated with obstructive disease of the heart; especially as they may conveniently be carried about by the patient, and used in anticipation of a paroxysm.

TROCHISCI MAGNESIÆ, *U. S.*—TROCHES OF MAGNESIA.

Trochisci magnesiæ ustæ, P. G.—*Pastilles absorbantes*, *P. de magnésie*, Fr.; *Magnesiapastillen*, G.

Preparation.—Take of Magnesia three troyounces; Nutmeg in fine powder sixty grains; Sugar in fine powder nine troyounces; Mucilage of Tragacanth a sufficient quantity. Rub the magnesia and the powders together until they are thoroughly mixed; then with mucilage of tragacanth form a mass, to be divided into four hundred and eighty troches. *U. S.*

Medical Uses.—The proportion of magnesia in these troches is too small, and that of sugar too large, to render them efficient antacid medicines, which they are generally supposed to be. Each troche, weighing twelve grains, contains about three grains of magnesia.

TROCHISCI MENTHÆ PIPERITÆ, *U. S.*—TROCHES OF PEPPERMINT.

Pastilles de menthe anglaises, Fr.; *Pfefferminzpastillen*, G.

Preparation.—Take of Oil of Peppermint a fluidrachm; Sugar in fine powder twelve troyounces; Mucilage of Tragacanth a sufficient quantity. Rub the oil of peppermint and the sugar together until they are thoroughly mixed;

then with mucilage of tragacanth form a mass, to be divided into four hundred and eighty troches. *U. S.*

See also *Rotulæ menthæ piperitæ*, page 1438.

Medical Uses.—Peppermint lozenges are employed to relieve *flatulence* and *colic*, and to prevent *sea-sickness*, and other forms of *nausea*. They are apt to excite gastric pain when too freely used.

TROCHISCI MORPHIÆ, *Br.*—Morphia Lozenges.

Pastilles de morphine, Fr.; *Morphinpastillen*, G.

Preparation.—Take of Hydrochlorate of Morphia twenty grains; Tincture of Tolu half a fluidounce; Refined Sugar in powder twenty-four ounces; Gum Acacia in powder one ounce; Mucilage of Gum Acacia a sufficiency; Distilled Water half a fluidounce. Dissolve the hydrochlorate of morphia in the water; add this solution to the tincture of tolu, previously mixed with two ounces of the mucilage; then add the gum and sugar, previously mixed, and more mucilage if necessary to form a proper mass. Divide into seven hundred and twenty lozenges, and dry these in a hot-air chamber with a moderate heat. *Br.*

The morphia lozenges of the German Pharmacopœia contain 0.005 gram ($\frac{1}{13}$ grain) of acetate of morphia.

Medical Uses.—Each of these lozenges contains about one-thirty-sixth of a grain of hydrochlorate of morphia. They are chiefly used to allay *laryngeal* and *bronchial irritation.*

TROCHISCI MORPHIÆ ET IPECACUANHÆ, *U. S.*, *Br.*—Troches of Morphia and Ipecacuanha.

Morphia and ipecacuanha lozenges, E.; *Pastilles de morphine et d'ipécacuanha*, Fr.; *Morphinpastillen mit Brechwurzel*, G.

Preparation.—Take of Sulphate of Morphia twelve grains; Ipecacuanha in fine powder forty grains; Sugar in fine powder ten troyounces; Oil of Gaultheria five minims; Mucilage of Tragacanth a sufficient quantity. Rub the powders together until they are thoroughly mixed; then add the oil of gaultheria, and incorporate it with the mixture. Lastly, with mucilage of tragacanth form a mass, to be divided into four hundred and eighty troches. *U. S.*

Take of Hydrochlorate of Morphia twenty grains; Ipecacuanha in fine powder sixty grains; Tincture of Tolu one-half fluidounce; Refined Sugar in powder twenty-four ounces; Gum Acacia in powder one ounce; Mucilage of Gum Acacia a sufficiency; Distilled Water one-half fluidounce. Dissolve the hydrochlorate of morphia in the water; add this solution to the tincture of tolu, previously mixed with two fluidounces of the mucilage; then add the ipecacuanha, gum, and sugar, previously mixed, and more mucilage if necessary to form a proper mass. Divide into seven hundred and twenty lozenges, and dry these in a hot-air chamber with a moderate heat. *Br.*

Medical Uses.—Each of these lozenges contains about one-fortieth of a grain of sulphate of morphia (one-thirty-sixth of a grain of hydrochlorate of morphia, *Br.*) and one-twelfth of a grain of ipecacuanha. They allay *cough* and promote expectoration.

TROCHISCI OPII, *Br.* See TROCHISCI GLYCYRRHIZÆ ET OPII.

TROCHISCI POTASSII CHLORATIS, *U. S.*, *Br.*—TROCHES OF CHLORATE OF POTASSIUM.

Pastilles de chlorate de potasse, Fr.; *Pastillen von Chlorsaurem Kali*, G.

Preparation.—Take of Chlorate of Potassium in fine powder five troyounces; Sugar in fine powder eighteen troyounces; Tragacanth in fine powder two troyounces; Vanilla thirty grains. Rub the Vanilla with a small quantity of the sugar into a uniform powder, and mix this thoroughly with the remainder of the powders, avoiding pressure; then with water form a mass, to be divided into four hundred and eighty troches. *U. S.*

Take of Chlorate of Potash in powder three thousand six hundred grains; Refined Sugar in powder twenty-five ounces; Gum Acacia in powder one ounce; Mucilage of Gum Acacia two fluidounces; Distilled Water one fluidounce, or a sufficiency. Mix the powders, and add the mucilage and water to form a proper mass. Divide into seven hundred and twenty lozenges, and dry these in a hot-air chamber with a moderate heat. *Br.*

By both the above formulas lozenges are obtained containing five grains of chlorate of potassium; those of the French Codex contain only 0.10 gram (1.5 grain) of the same salt.

Medical Uses.—Chlorate of potassium lozenges may be used in the treatment of *aphthæ*, and other forms of *ulcer* of the mouth and throat; but they are much less efficient than solutions of the chlorate.

TROCHISCI SANTONINI, *U. S.*—TROCHES OF SANTONIN.

Pastilles de santonine, Fr.; *Santoninpastillen*, G.

Preparation.—Take of Santonin in fine powder half a troyounce; Sugar in fine powder eighteen troyounces; Tragacanth in fine powder half a troyounce; Orange Flower Water a sufficient quantity. Rub the powders together until they are thoroughly mixed; then with orange flower water form a mass, to be divided into four hundred and eighty troches. *U. S.*

Santonin lozenges, *F. P.*, are colored red with carmine, and contain 0.01 gram ($\frac{1}{6}$ grain) of santonin. Those of the German Pharmacopœia are prepared with cacao mass of two kinds, one containing 0.05 gram ($\frac{3}{4}$ grain), the other 0.025 gram ($\frac{3}{8}$ grain) of santonin.

Medical Uses.—Each lozenge, *U. S. P.*, contains about half a grain of santonin. One may be given every three or four hours until three or four lozenges are taken, or until the sight begins to be affected, when a purgative dose of castor oil should be administered. They are employed chiefly for the destruction of *lumbricoid worms* and *ascarides*.

TROCHISCI SODII BICARBONATIS, *U. S.*, *Br.*—TROCHES OF BICARBONATE OF SODIUM.

Trochisci sodæ bicarbonatis, Br.; *Trochisci natri bicarbonici*, P. G.—*Bicarbonate of soda lozenges*, E.; *Pastilles de bicarbonate de soude*, *P. de Vichy*, *P. digestives*, Fr.; *Natronpastillen*, G.

Preparation.—Take of Bicarbonate of Sodium three troyounces; Sugar in fine powder nine troyounces; Nutmeg in fine powder sixty grains; Mucilage of Tragacanth a sufficient quantity. Rub the bicarbonate of sodium and the sugar together until they are thoroughly mixed; then with mucilage of tragacanth form a mass, to be divided into four hundred and eighty troches. *U. S.*

Take of Bicarbonate of Soda thirty-six hundred grains; Refined Sugar in powder twenty-five ounces; Gum Acacia in powder one ounce; Mucilage of Gum Acacia two fluidounces; Distilled Water one fluidounce. Mix the powders, and add the mucilage and water to form a proper mass. Divide into seven hundred and twenty lozenges, and dry these in a hot air chamber with a moderate heat. *Br.*

As directed by the different Pharmacopœias, these lozenges contain 5 grains (*Br.*), 3 grains (*U. S.*), 0.1 gram = 1.5 grain (*P. G.*), and 0.025 gram = $\frac{3}{8}$ grain (*F. P.*) of bicarbonate of sodium.

Medical Uses.—Soda lozenges are convenient and useful in cases of habitual *acidity* of the stomach.

TROCHISCI ZINGIBERIS, *U. S.*—TROCHES OF GINGER.

Pastilles de gingembre, Fr.; *Ingwerpastillen*, G.

Preparation.—Take of Tincture of Ginger two fluidounces; Tragacanth in fine powder half a troyounce; Sugar in fine powder twenty troyounces; Syrup of Ginger a sufficient quantity. Mix the tincture of ginger with the sugar, and, having exposed the mixture to the air until dry, reduce it to fine powder; to this add the tragacanth, and mix thoroughly. Lastly, with syrup of ginger form a mass, to be divided into four hundred and eighty troches. *U. S.*

Medical Uses.—Troches of ginger are used to relieve flatulent *colic*, and quicken laborious digestion.

TUSSILAGO.—COLTSFOOT.

Tussilage, *Pas d'âne*, Fr.; *Huflattig*, *Rosshuf*, G.

Tussilago farfara, *Lin.* *Nat. Ord.*—Compositæ, Eupatoriaceæ.

Origin and Description.—Coltsfoot is a perennial herb, which is indigenous to Europe and Northern Asia, has been naturalized in the United States from New England to Pennsylvania, and grows in damp clayey soil, and along ditches and brooks. All parts of the plant have been used, but the leaves and flowers have been generally employed. The *rhizome* is creeping, 12 to 18 inches long, branching, about one-tenth of an inch thick, with joints about two inches long, radicating on the nodes, and of a grayish-white or pale-brownish color. It is fragile when dry, has a thick whitish bark, yellowish porous wood wedges, and a prominent pith, is inodorous, and has a mucilaginous, bitterish, and astringent taste. The *leaves* appear after the flowers, and are radical, long-petiolate, four to six inches long and broad, roundish heart-shaped, angular-toothed, dark-green and smooth above, and white tomentose beneath. They are rather fleshy while fresh, and fragile after drying. The *flower-heads* are smaller than those of dandelion, make their appearance in early spring upon scaly scapes, and have a cylindrical involucre of lance-linear scales in a single row, numerous yellow narrowly ligulate pistillate ray florets in many rows, and about twenty tubular staminate disk florets. The pappus is long, silky-hairy, and white. The dried flowers and leaves are inodorous, and have a mucilaginous, bitterish, and somewhat astringent taste.

The rhizome of Asarum canadense is known in some parts of the United States as *coltsfoot root.*

Constituents.—All parts of coltsfoot contain *mucilage*, a *bitter principle* which has not been isolated, and *tannin*, producing a dark green precipitate with ferric salts.

Medical Action and Uses.—Coltsfoot was anciently renowned in pulmonary affections, and for their relief the smoke of its burning root was inhaled through a funnel; and even in modern times it was smoked in pipes for the same purpose by the peasantry of Sweden and Germany. It is demulcent and tonic through its mucilaginous and bitter constituents, and has been compared in its action to Iceland moss. It has been widely used in the treatment of chronic *bronchitis*, and for various *scrofulous* affections both internally and locally. It may be administered in decoction or infusion made with an ounce of the dried leaves to a pint of water. The expressed juice is also employed.

ULMUS, *U. S.*—SLIPPERY ELM BARK.

Ulmi cortex, Br.; *Cortex ulmi interior.*—*Elm bark*, E.; *Ecorce d'orme*, Fr.; *Ulmenrinde Rüsterrinde*, G.

The inner bark of Ulmus fulva, *Mich.* (*U. S.*); of Ulmus campestris, *Lin.* (*Br.*). Bentley and Trimen, Med. Plants, 232, 233.

Nat. Ord.—Urticaceæ, Ulmaceæ.

Origin.—The elms are trees with alternate, oblique, and slightly heart-shaped, serrate, and straight-veined leaves, and with lateral clusters of small polygamous flowers, having a bell-shaped four- to nine-lobed perianth, the same number of stamens, and two nearly sessile styles. The fruit is a one-celled and one-seeded samara, surrounded with a membranous wing, which is notched or cleft at the apex. The American officinal elm, known as *slippery elm* or *red elm*, is a small or medium-sized tree, which is usually from twenty to forty, and occasionally sixty feet high, with a diameter of one or two feet, and with a reddish wood. The leaves are four to eight inches long, elliptic-oblong, pointed and very rough above; the flowers are reddish pubescent, precede the leaves, and have the perianth six to nine-cleft; the samara is orbicular, and not ciliate. The tree grows in woods and rich soil from Canada westward to Lake Superior and southward to near the Gulf of Mexico, but is most abundant in the Western States. The *white elm*, Ulmus americana, *Lin.*, is taller, sixty to eighty feet high, bears an oval, on the margin densely ciliate samara, and is a favorite shade tree in New England.

The European officinal elm is probably a native of Western Asia and Eastern Europe, but now is naturalized or cultivated throughout the greater portion of Asia, Europe, and Northern Africa. It has likewise been introduced in some parts of New England. Its leaves are only about two and a half inches long, oval or obovate, and acute or somewhat pointed; the flowers are mostly pentamerous, and the samara is roundish-obovate, smooth, and has the seed placed near the apical notch. The European *black elm*, Ulmus effusa, *Willd.*, which has larger ovate or elliptical leaves and roundish-elliptic ciliate fruits, likewise furnishes some elm bark.

Description.—SLIPPERY ELM BARK is met with in commerce in flat pieces, consisting of the liber only, the cortical layer being removed before drying, and usually several feet long and four or six inches broad. It is about one-eighth of an inch thick, is externally of a very light cinnamon color or pale brownish-white, smooth, occasionally with small fragments of the corky layer adhering; and upon the inner surface grayish-white, finely ridged longitudinally from the prominent bast fibres, and usually more or less woolly from some detached bast fibres. The bark breaks or rather tears readily in a longitudinal direction, the fragments adhering together with the wavy bast fibres. It breaks with some difficulty in a transverse direction with a fibrous and mealy fracture, and when cut transversely, the bast fibres are seen arranged in tangential rows, imbedded in a loose parenchyma, and dissected by numerous fine medullary rays, giving to the transverse section a delicately checkered appearance. Slippery elm bark has a slight, but distinct odor resembling that of fenugreek, and a mucilaginous insipid taste. It is also met with as a coarse fibrous, and as a somewhat fine and uniform powder, both having a light fawn-color.

EUROPEAN ELM BARK.—It resembles the preceding, but is usually rather thinner, upon both surfaces of a cinnamon-color, nearly inodorous, and of a mucilaginous, bitterish, and astringent taste.

Constituents.—Both barks contain a considerable amount of mucilage, which, as obtained from the European elm, according to Braconnot (1846), resembles the mucilage of flaxseed. The mucilage of slippery elm bark is precipitated by acetate of lead, but alcohol separates from its solution a gelatinous liquid. European elm bark contains a small quantity of tannin yielding with ferric salts a greenish-brown precipitate, and a bitter principle, which has not been isolated. Starch is not present in the bast layer.

Off. Prep.—Decoctum ulmi, *Br.;* Mucilago ulmi, *U. S.*

Medical Action and Uses.—Slippery elm bark is highly demulcent, and in some degree nutritious. It is grateful to the taste, and does not readily disorder the stomach. Like the inner bark of the European elm (*U. campestris*), which is slightly astringent, it has been used with alleged advantage in chronic *cutaneous eruptions*, including some of syphilitic origin. It is also asserted to be a remedy for *tape-worm.* It is, however, chiefly employed in medicine to produce a mucilage (*Mucilago ulmi*) which is officinal. The fibrous bark, disintegrated so as to form a mass of flexible spongy tissue, is readily moulded into tents which are made use of to dilate the neck of the *uterus*, *fistulous openings*, etc., and which do not so readily become offensive as sponge tents.

UNGUENTA.—OINTMENTS.

Pommades, Onguents, Fr.; *Salben,* G.

Preparation.—Ointments are unctuous preparations of such a consistence that they may be easily rubbed on the skin, and when in contact with it are gradually liquefied. As made by the United States and British Pharmacopœias they consist chiefly of lard, which is combined in some cases with a small quantity (about one-fifth) of wax, yellow wax being very properly preferred by the first mentioned authority. In preparing ointment the wax is first melted by a moderate heat, and the lard added in small quantities, or previously heated to about the same temperature; the ingredients being thoroughly liquefied, the vessel is removed from the fire, and its contents beaten with a spatula, or transferred to a warm mortar, and then well stirred with the pestle to prevent the partial separation of the wax. The addition of aqueous liquids, which should not be too cold, is made in small quantities, and with continued stirring or beating, as soon as the ointment begins to assume an opaque appearance. In all cases the operation should be continued until the temperature of the ointment has been reduced to that of the surrounding atmosphere, and until the preparation is perfectly smooth and homogeneous. Solid substances may be incorporated in a similar manner, provided they have been previously reduced to an impalpable powder. But in most cases, and more particularly when the powder is heavy, much better and more uniform ointments are obtained by triturating the solid material until a powder is obtained, adding a small quantity of oil or of the ointment, and continuing the trituration until all signs of grittiness have disappeared; after which the remaining portion of the ointment may be gradually added and thoroughly incorporated. Salts and other substances which are soluble in water are often conveniently combined with the fatty base by dissolving them in a small quantity of hot water and incorporating this solution in a warm mortar, with the ointment gradually added. If extracts are to be added to ointments, they should be thoroughly softened in a warm mortar by trituration with a little water, before the fat is added. Alcoholic liquids, except when used in very small proportion, are less conveniently incorporated with ointments than concentrated aqueous solutions.

The European Pharmacopœias make no distinction between cerates and ointments, but mostly designate both classes as *unguenta*. In France the term *onguent* is usually confined to an ointment into the composition of which resinous substances enter, while ointments with a purely fatty base are designated as *pommades*. In Europe olive and almond oils melted together with some wax are frequently employed as the base for ointments, in preference to lard.

Preservation.—With few exceptions, ointments should be prepared extemporaneously when wanted for use. The fats should in all cases be free from incipient rancidity, and, if carefully prepared, the ointments may be kept for a limited time in well-closed vessels and in a cool place, at a temperature of about 15° C. (59° F.).

UNGUENTUM, *U. S.*—OINTMENT.

Unguentum simplex, Br.; *Unguentum adipis*, U. S. 1860.—*Simple ointment*, E.; *Pommade simple*, Fr.; *Wachssalbe*, G.

Preparation.—Take of Lard eight troyounces; Yellow Wax two troyounces. Melt the wax, and add the lard gradually; then stir the mixture constantly while cooling. *U. S.*

Take of White Wax two ounces, Prepared Lard three ounces, Almond Oil three fluidounces. Melt the wax and lard in the oil on a water-bath; then remove the mixture, and stir constantly while it cools. *Br.*

Off. Prep.—Ceratum zinci carbon., Ung. acidi carbolici, *U. S.;* Ung. antimonii tart., Ung. cadmii iodidi, Ung. creasoti, Ung. elemi, *Br.;* Ung. hydrarg. ammon., *U. S.*, *Br.;* Ung. hydrarg. iodidi rubri, *Br.;* Ung. hydrarg. oxidi flavi, Ung. hydrarg. oxidi rubri, *U. S.;* Ung. plumbi carb., *U. S.*, *Br.;* Ung. plumbi iodidi, *Br.*

Medical Uses.—Simple ointment, as it was formerly and more appropriately called, is used as a protective for sores and excoriations, and to facilitate the introduction of the finger, surgical instruments, etc., into the urethra, vagina, rectum, etc.

UNGUENTUM ACIDI CARBOLICI, *U. S.*—OINTMENT OF CARBOLIC ACID.

Pommade d'acide phénique, Fr.; *Phenolsalbe*, G.

Preparation.—Take of Carbolic Acid sixty grains; Ointment four hundred and twenty grains. Mix them thoroughly. *U. S.*

Medical Uses.—Carbolic acid ointment has been used in the treatment of *lupus* and other diseases of the skin; but carbolized oil is preferable as a dressing for wounds. It is probable that the proportion of carbolic acid in this ointment, twelve per cent., is excessive, since a five per cent. solution in oil has been found the safest, as well as the most efficient, surgical dressing.

UNGUENTUM ACIDI TANNICI, *U. S.*—OINTMENT OF TANNIC ACID.

Pommade de tannin, Fr.; *Tanninsalbe*, G.

Preparation.—Take of Tannic Acid thirty grains; Lard a troyounce. Rub the tannic acid with the lard, gradually added, until they are thoroughly mixed, avoiding the use of an iron spatula. *U. S.*

Medical Uses.—No ointment made with a vegetable astringent is as powerful as a solution of the same substance in water, or even in glycerin. Tannic acid ointment is no exception to the rule. This preparation may, however, be applied on tampons to the vagina, and may be introduced into the rectum, in relaxed states of these parts.

UNGUENTUM ACONITIÆ, *Br.*—OINTMENT OF ACONITIA.

Pommade d'aconitine, Fr.; *Aconitinsalbe*, G.

Preparation.—Take of Aconitia eight grains; Rectified Spirit half a fluidrachm; Prepared Lard one ounce. Dissolve the aconitia in the spirit, add the lard, and mix thoroughly. *Br.*

Medical Uses.—This powerful local anæsthetic is chiefly of use in *neuralgia* of the superficial nerves, especially those of the face and the back. It should be applied, by means of a short thick brush or small pledget of lint, over the points of emergence and terminal distribution of the affected nerves. It should not be allowed to touch denuded cutaneous surfaces or mucous membranes.

UNGUENTUM ANTIMONII, *U. S.*—ANTIMONIAL OINTMENT.

Unguentum antimonii tartarati, Br.; *Unguentum tartari stibiati*, P. G.; *Ung. stibiatum.*—*Ointment of tartarated antimony*, E.; *Pommade stibiée*, *P. d'Autenrieth*, Fr.; *Pockensalbe*, G.

Preparation.—Take of Tartrate of Antimony and Potassium in very fine powder one hundred grains; Lard four hundred grains. Rub the tartrate of antimony and potassium with the lard, gradually added, until they are thoroughly mixed. *U. S.*

The proportions employed by the British and German Pharmacopœias are the same; the French Codex directs one part of tartar emetic to three parts of benzoated lard.

Medical Uses.—Antimonial ointment is occasionally employed to produce its characteristic pustular eruption in cases requiring vigorous counter-irritation, but the painful ulcers and the sloughs it sometimes occasions, and the permanent scars that it often leaves behind, having caused it to be generally abandoned, there is no reason for a revival of its use. The officinal ointment appears to be superfluous.

UNGUENTUM AQUÆ ROSÆ, *U. S.*—OINTMENT OF ROSE WATER.

Unguentum leniens, P. G.—*Cold cream*, E., Fr., G.; *Cérat cosmétique*, *Crême froide*, Fr.

Preparation.—Take of Expressed Oil of Almond three troyounces and a half; Spermaceti a troyounce; White Wax one hundred and twenty grains; Rose Water two fluidounces. Melt together, by means of a water-bath, the oil, spermaceti, and wax; then gradually add the rose-water, and stir the mixture constantly while cooling. *U. S.*

Other Pharmacopœias direct: Almond oil 215, spermaceti 60, white wax 30, rose water 60, oil of rose 0.30, tincture of benzoin 15 parts (*F. P.*). Almond oil 32, spermaceti 5, white wax 4, rose-water 16 parts; oil of rose one drop to 50 grams (*P. G.*).

The successful preparation of this ointment depends mainly on the pains taken in incorporating the materials while cooling; to facilitate the process E. C. Marshall (1875) recommended the use of an ordinary egg-beater. The ointment should be very white, soft, and perfectly homogeneous. If well made it will retain these properties for some time, but gradually it becomes rancid.

Medical Uses.—Cold cream, as it is commonly called, is an agreeable and efficient protective in cases of *abrasions*, *ulcers*, *frostbite*, and other superficial lesions of the skin. The addition to it of a small proportion of glycerin, and also of benzoic acid, tends both to preserve the ointment longer and to render it more efficient. The ointment thus modified is one of the best means of protecting the hands and lips from being chapped.

UNGUENTUM ATROPIÆ, *Br.*—OINTMENT OF ATROPIA.

Pommade d'atropine, Fr.; *Atropinsalbe*, G.

Preparation.—Take of Atropia eight grains; Rectified Spirit one-half fluidrachm; Prepared Lard one ounce. Dissolve the atropia in the spirit, add the lard, and mix thoroughly. *Br.*

Medical Uses.—This preparation is, in most cases, preferable to belladonna ointment, on account of its superior cleanliness and the smaller quantity of it that is efficacious. It is chiefly used in superficial *neuralgia*, to relieve other *local pains*, and, applied to the perineum, to allay *urethral* and *rectal* irritation and spasm.

UNGUENTUM BELLADONNÆ, *U. S.*, *Br.*—OINTMENT OF BELLADONNA.

Pommade de belladone, Fr.; *Tollkirschensalbe*, G.

Preparation.—Take of Extract of Belladonna sixty grains; Water half a fluidrachm; Lard four hundred and twenty grains. Rub the extract with the water until uniformly soft, then gradually add the lard, and thoroughly mix them. *U. S.*

Other Pharmacopœias direct: Extract of belladonna 80 grains, prepared lard one ounce (avoird.) (*Br.*). Extract of belladonna one part, wax ointment nine parts (*P. G.*).

Medical Uses.—Belladonna ointment was originally used in all the cases of *local pain*, *spasm*, etc., for which atropia ointment is now prepared; and, where cleanliness is not imperative, it answers nearly as well. It is better suited than the ointment of the alkaloid for application to absorbing surfaces, as the urethra, vagina, rectum, and ulcerated parts.

UNGUENTUM BENZOINI, *U. S.*—OINTMENT OF BENZOIN.

(See page 101.)

UNGUENTUM CADMII IODIDI, *Br.*—OINTMENT OF IODIDE OF CADMIUM.

Pommade d'iodure de cadmium, Fr.; *Jodkadmiumsalbe*, G.

Preparation.—Take of Iodide of Cadmium in fine powder sixty-two grains; Simple Ointment one ounce. Mix thoroughly. *Br.*

Medical Uses.—This ointment is reputed to be stimulating and resolvent. It is used as a resolvent of enlarged *glands*, in the same manner as iodide of lead ointment. It has the advantage over the latter preparation of not staining the skin.

UNGUENTUM CANTHARIDIS, *U. S.*, *Br.*—OINTMENT OF CANTHARIDES.

Unguentum cantharidum, P. G.; *Ung. irritans*, *Ung. ad fonticulos.*—*Onguent de cantharides*, Fr.; *Spanischfliegensalbe*, G.

Preparation.—Take of Cantharides Cerate one hundred and twenty grains; Resin Cerate three hundred and sixty grains. Mix them thoroughly. *U. S.*

Take of Cantharides, Yellow Wax, of each one ounce; Olive Oil six fluidounces. Infuse the cantharides in the oil in a covered vessel for twelve hours; then place the vessel in boiling water for fifteen minutes, strain through muslin with strong pressure, add the product to the wax, previously melted, and stir constantly while the mixture cools. *Br.*

The ointment of the German Pharmacopœia is nearly identical with the latter. Cantharidin being readily soluble in fats, the ointment prepared by digesting cantharides in olive oil has the active principle more uniformly diffused than by incorporating powdered cantharides with the ointment. Cerate of extract of cantharides substituted for cantharides cerate in the first formula would furnish a better and equally reliable preparation.

The ointment has a greenish color.

Medical Uses.—Ointment of cantharides is intended to be used as a dressing for recently blistered surfaces, in order to prolong the discharge from them, and also to act as a rubefacient upon the sound skin when blistering it is not desirable. In this manner it may sometimes be applied in *muscular rheumatism*, in partial *paralysis*, and in *alopæcia*. But in all these cases various stimulant liniments are more suitable. In many cases, also, for which this ointment is appropriate, the plaster of Burgundy pitch with cantharides is much more efficient.

UNGUENTUM CETACEI, *Br.*—OINTMENT OF SPERMACETI.

Onguent blanc, Fr.; *Walrathsalbe*, G.

Preparation.—Take of Spermaceti five ounces; White Wax two ounces; Almond Oil one pint, or a sufficiency. Melt together with a gentle heat, remove the mixture, and stir constantly while it cools. *Br.*

Except in consistence, it resembles spermaceti cerate (p. 375).

Medical Uses.—This ointment, when freshly made, is an appropriate dressing for wounds, excoriations, and blisters. It is essentially the same as the Spermaceti cerate, U. S. Pharmacopœia.

UNGUENTUM CREASOTI, *U. S.*, *Br.*—OINTMENT OF CREASOTE.

Pommade de créosote, Fr.; *Kreosotsalbe*, G.

Preparation.—Take of Creasote half a fluidrachm; Lard a troyounce. Mix them thoroughly. *U. S.*

Take of Creasote one fluidrachm; Simple Ointment one ounce. Mix thoroughly. *Br.*

Medical Uses.—Creasote ointment is a protective, and, like creasote water, is a wholesome stimulant in numerous cases, including *burns*, *chilblains*, *ulcers* of various descriptions, and especially those which have flabby, fungous granulations, an ichorous secretion, a tendency to gangrene, or a connection with carious bone. Even for *cancerous* ulcers it forms an eligible dressing, especially after they have been washed with creasote water. Indeed, the applications of the latter, enumerated elsewhere, are, *mutatis mutandis*, those of creasote ointment.

UNGUENTUM ELEMI, *Br.*—OINTMENT OF ELEMI.

Unguentum (Balsamum) Arcæi, F. P.—*Onguent (Baume) d'Arcæus*, Fr.; *Elemisalbe*, G.

Preparation.—Take of Elemi a quarter of an ounce; Simple Ointment one ounce. Melt, strain through flannel, and stir constantly until the ointment solidifies. *Br.*

Elemi, Venice turpentine, suet, and lard, equal parts; melt and strain. *P. G.* The French ointment is nearly identical with this.

Medical Uses.—Ointment of elemi is a mild local stimulant, and as such may be used as a dressing for slightly indolent *ulcers*, and for maintaining the suppuration of issues and setons. Formerly an ointment known as *Balsamum Arcæi*, and containing elemi and larch turpentine in equal proportions, was used for the same purpose, and, except in trifling cases, probably with more effect.

UNGUENTUM GALLÆ, *U. S.*, *Br.*—OINTMENT OF NUT GALL.

Pommade de noix de galle, Fr.; *Galläpfelsalbe*, G.

Preparation.—Take of Nutgall in very fine powder sixty grains; Lard four hundred and twenty grains. Rub the nutgall with the lard, gradually added, until they are thoroughly mixed. *U. S.*

Take of Galls in fine powder eighty grains; Benzoated Lard one ounce. Mix thoroughly. *Br.*

Medical Uses.—Ointment of nutgall, like that of tannic acid, its active component, is appropriately applied to relaxed tissues, but especially to those of the vagina and rectum, to prevent or diminish *prolapsus* of these parts. In the latter case, when *piles* exist, an ointment composed of equal parts of the ointments of nutgall and stramonium and Goulard's cerate, is found to be a very efficient remedy.

UNGUENTUM GALLÆ CUM OPIO, *Br.*—OINTMENT OF GALLS AND OPIUM.

Preparation.—Take of Ointment of Galls one ounce; Opium in powder thirty-two grains. Mix thoroughly. *Br.*

Medical Uses.—This preparation is intended to fulfil the same indications as those of the compound ointment mentioned under *Unguentum gallæ;* but it is far less efficient as applied to the anus, and, owing to the large proportion of opium it contains, not without danger if introduced into the vagina or the rectum.

UNGUENTUM HYDRARGYRI, *U. S.*, *Br.*—OINTMENT OF MERCURY.

Unguentum hydrargyri cinereum, P. G.; *Unguentum mercuriale s. Neapolitanicum.—Mercurial ointment, Blue ointment*, E.; *Pommade (onguent) mercurielle, P. napolitane*, Fr.; *Graue Quecksilbersalbe*, G.

Preparation.—Take of Mercury twenty-four troyounces; Lard, Suet, each twelve troyounces. Rub the mercury with a troyounce of the suet, and a small portion of the lard, until the globules cease to be visible; then add the remainder of the lard, and of the suet softened with a gentle heat, and thoroughly mix them. *U. S.*

Take of Mercury, Prepared Lard, of each one pound; Prepared Suet one ounce. Rub them together until metallic globules cease to be visible. *Br.*

The ointment of the French Codex is of the same strength as the preceding; that of the German Pharmacopœia contains one-third its weight of mercury. With the exception of the French Codex, the Pharmacopœias have very properly discarded *weak mercurial ointment*, leaving the physician to order the dilution of the strong ointment as he may think necessary.

The extinguishment of the mercury, if the above directions are literally followed, requires such a long time that few pharmacists will undertake the trouble of preparing the ointment. It may be hastened by the addition of a little sulphur or soft turpentine, yet to both there are serious objections; to the former on account of forming an inert black sulphide, to the latter on account of its irritating properties. The substitution of wax, spermaceti, stearin, cacao butter, and of similar solid fats and allied compounds for part of the lard, answers the purpose but partially, and is more effectual with small than with larger quantities. The same is true if the mercury, finely divided by pressing it with a moderate force through chamois leather, is sprinkled on the semisolid fat, and incorporated without delay. On triturating mercury with a small quantity of liquid storax, or with a mixture of liquid storax and lard, it is rapidly extinguished to such an extent that the metallic globules are not visible under a power of two or three diameters. Tincture of tolu triturated with the mercury in the presence of a portion of the lard has a similar effect. But even such ointments have been objected to as being too irritating. Trituration with lard and oil of turpentine has also been recommended, but the latter does not evaporate as readily as has been supposed, and imparts to the ointment for a long time a turpentine odor. Some Pharmacopœias permit the extinguishment of mercury by means of one-sixth the weight of old mercurial ointment, adding subsequently the requisite amount of fats. In this case the operation is facilitated by the incipient or more advanced rancidity of the fat contained in the ointment, and a similar result may be obtained by using about 5 or 10 per cent. of rancid fat in place of an equal amount of lard.

The objection to all these additions has been their irritating properties. This cannot be urged against the use of ether as proposed by Renoult. On mixing the lard in the first formula given above with one troyounce of ether, and triturating this with the whole of the mercury, the metal will be readily extinguished, and the ointment may be finished by incorporating the softened suet. Glycerin and glycerite of starch have also been suggested for facilitating the extinguishment of the mercury.

A clean iron mortar is well adapted for the preparation of this ointment, though a small portion of the mercury will superficially combine with the iron. A wedgewood or marble mortar does not occasion even this slight loss.

The extinguishment of the mercury is most readily observed by the use of a lens of moderate power; or by rubbing a small portion of the ointment between folded paper, when no metallic globules should become visible to the naked eye. Rhigini observed that on triturating a little of the ointment in a marble mortar with a wooden pestle until the ointment has been absorbed, the pestle will have a bright metallic surface in case the mercury had not been completely extinguished.

On keeping mercurial ointment at a temperature at which it becomes soft, without liquefying, it will slowly alter in composition in such a manner that the lower strata contain a larger proportion of mercury than the upper ones. Hence it is necessary in warm weather to employ fat or a mixture of fats having a higher fusing point than lard, such as is directed by the U. S. Pharmacopœia.

When made with fresh and sweet fats, the ointment contains the mercury in a minutely divided condition. As rancidity commences and increases a portion of the mercury will be found in chemical combination, and this amount is increased at an elevated temperature. It follows from this that mercurial ointment should be kept in a cool place and in a well-closed jar, and that it may be still further protected by covering the surface of the ointment with paper which has been saturated with tincture of tolu or tincture of storax.

Off. Prep.—Linim. hydrargyri, Suppos. hydrargyri, Ung. hydrarg. comp., *Br.*

Medical Uses.—By means of this ointment duly rubbed upon the skin the constitutional effects of mercury can be secured, without as much risk of disordering the digestion of the patient as when mercury in any of its forms is given by the mouth. This was at one time the chief method of treating constitutional and even primary *syphilis*, and, in spite of its being "dirty, laborious, and troublesome," it is better than any other form of mercurial treatment, since "it cures the disease better, and does not damage the constitution half so much" (*Brodie*). The inunctions should be made upon different parts of the body successively, as the thighs, the flanks, the arms, the chest, and usually before a fire or in the direct sunlight. One or two drachms should be rubbed in daily; the patient should be clothed in flannel, sleep between blankets, and every two or three days cleanse the skin with a bath of warm water and soap. If he is able he should make the friction with his own hands; and if he cannot do this, the hands of the attendant making them should be protected by a caoutchouc glove or by a pig's bladder previously softened with warm water. In other cases, and especially when mercurial ointment is employed to supplement the internal use of mercurials, it may be spread upon a cloth and applied to a recently blistered surface. In cases of infantile syphilis a flannel roller smeared with ointment may be secured around the body of the patient.

All chronic superficial *swellings* resulting from inflammation have their absorption hastened by frictions made with mercurial ointment. This treatment is peculiarly appropriate in glandular and other swellings arising from syphilitic infection; but it is sometimes also used to promote the resolution of chronic engorgement of the *liver* or *spleen*. *Paronychia* may be prevented from suppurating by frictions with mercurial ointment made every hour, for five minutes at a time, while in the interval the part is kept enveloped in poultices. In subacute and chronic inflammation of the joints much benefit has been derived from enveloping the parts, previously blistered or not, in cloths spread with mercurial ointment, and keeping them at rest by means of appropriate splints. A like advantage sometimes accrues, in chronic or subacute *orchitis*, from enveloping the affected organ in a similar manner. But the simple ointment is less efficacious than that of the iodide of mercury. There can be no doubt that mercury applied in one form or another to an eruption of *smallpox* upon the face, during its papular stage, sometimes prevents the papules from maturating and leaving scars. The ointment may be spread, alone or rendered more tenacious by the admixture of starch, upon linen, with suitable apertures for the nostrils and mouth, and closely applied to the face like a mask. It has been used after the same manner in the treatment of *erysipelas* of the face, but, on the whole, without advantage, and frequently with the effect of causing salivation. It is also a palliative of *prurigo pudendi;* but in this case it is open to the same objection.

UNGUENTUM HYDRARGYRI AMMONIATI, *U. S.*, *Br.*—OINTMENT OF AMMONIATED MERCURY.

Unguentum hydrargyri præcipitati albi, P. G.—*Pommade de précipité blanc*, Fr.; *Weisse Quecksilbersalbe*, G.

Preparation.—Take of Ammoniated Mercury in very fine powder forty grains; Ointment a troyounce. Rub the ammoniated mercury with the ointment, gradually added, until they are thoroughly mixed. *U. S.*

Other proportions are: Ammoniated mercury sixty-two grains; simple ointment one ounce. *Br.* Ammoniated mercury one part; lard nine parts. *P. G.*

Medical Uses.—White precipitate ointment is used as a stimulant application in cases of chronic *blepharitis*, and of several cutaneous affections, especially in *psoriasis* of limited extent, and in those of parasitic origin, including *ringworm* of the scalp (porrigo scutulata). In *herpes circinatus*, *sycosis*, and *pityriasis* it is also employed. In *herpes zoster* it has been reported, on insufficient grounds, to be useful. It is more efficacious in chronic forms of circumscribed *eczema*, and of tubercular and squamous *syphilis*. It also, like other mercurial ointments, is a destroyer of *lice*. It has over the others the advantage of cleanliness, and it may be perfumed with some agreeable essential oil such as lavender or bergamot.

UNGUENTUM HYDRARGYRI COMPOSITUM, *Br.*—COMPOUND OINTMENT OF MERCURY.

Pommade mercurielle composée, Fr.; *Kampfer-Quecksilbersalbe*, G.

Preparation.—Take of Ointment of Mercury six ounces; Yellow Wax, Olive Oil, each three ounces; Camphor one and a half ounce. Melt the wax with a gentle heat, and add the oil; then, when the mixture is nearly cold, add the camphor in powder and the ointment of mercury, and mix the whole thoroughly together. *Br.*

The ointment has a greenish tint, and is softened by the camphor.

Medical Uses.—It is impossible to discover any sufficient reason for the existence of this preparation, which probably has the virtues, and no others, of simple mercurial ointment.

UNGUENTUM HYDRARGYRI IODIDI RUBRI, *U. S.*, *Br.*—OINTMENT OF RED IODIDE OF MERCURY.

Pommade de deutoiodure de mercure, Fr.; *Jodquecksilbersalbe*, G.

Preparation.—Take of Red Iodide of Mercury in very fine powder sixteen grains; Ointment a troyounce. Rub the iodide of mercury with the ointment, gradually added, until they are thoroughly mixed. *U. S.*

Take of Red Iodide of Mercury in fine powder sixteen grains; Simple Ointment one ounce. Mix thoroughly. *Br.*

Medical Uses.—This ointment is chiefly used as a stimulant of indolent *scrofulous* and *syphilitic ulcers*, and of scrofulous *glandular swellings*. In India, *goitre* has been cured in many thousands of cases by rubbing into the tumor an ointment made with sixty grains of red iodide of mercury to a pound of lard, and then exposing it for several hours to the direct action of the sun. The operation is repeated twice a day for several days, the applied ointment being allowed to remain. A very similar method has been employed with remarkable success in the treatment of enlargement of the *liver* and *spleen*, the heat of a fire being substituted for that of the sun.

UNGUENTUM HYDRARGYRI NITRATIS, *U. S.*, *Br.*—OINTMENT OF NITRATE OF MERCURY.

Unguentum hydrargyri citrinum, *Unguentum citrinum.*—*Citrine Ointment*, E.; *Pommade de nitrate de mercure*, Fr.; *Gelbe Quecksilbersalbe*, G.

Preparation.—Take of Mercury a troyounce and a half; Nitric Acid three troyounces and a half; Lard sixteen troyounces and a half. Dissolve the mercury in the acid; then heat the lard in an earthen vessel, and, when the temperature reaches 200° F., remove it from the fire. To this add the mercurial solution, and, with a wooden spatula, stir constantly so long as effervescence continues, and afterwards occasionally until the ointment stiffens. *U. S.*

Take of Mercury by weight four ounces; Nitric Acid twelve fluidounces; Prepared Lard fifteen ounces; Olive Oil thirty-two fluidounces. Dissolve the mercury in the nitric acid with the aid of a gentle heat; melt the lard in the oil, by a steam or water bath, in a porcelain vessel capable of holding six times the quantity; and, while the mixture is hot, add the solution of mercury, also hot, mixing them thoroughly. If the mixture do not froth up, increase the heat till it occurs. Keep it stirred until it is cold. *Br.*

On mixing melted fats with a solution of mercuric nitrate containing free nitric acid, a very complicated reaction takes place, resulting on the one hand in the oxidation of the fat and the evolution of nitric oxide (nitrogen dioxide) and hyponitric acid (nitrogen tetroxide), and on the other hand in the conversion by the latter of the olein contained in the fat into solid elaidin. The products of oxidation of the fat contain various volatile fatty acids, but must necessarily vary with the nature of the fat, the amount of free nitric acid, and the degree of the heat. Should the nitric acid be insufficient in quantity or the temperature rise to too high a degree, the oxidation is effected in part at the expense of the mercuric nitrate, which is thereby reduced to mercurous salt. The second formula given above orders a much larger quantity of nitric acid than is necessary, and fails in indicating the precise temperature at which the fat should be mixed with the mercuric solution. The main fault of the first formula is the want of plain directions for dissolving the mercury and the subsequent employment of a higher heat than is desirable. According to the temperature at which the nitric acid acts upon the mercury, the solution will contain mercurous or mercuric nitrate or both salts, with or without hyponitric acid. If free from mercurous nitrate, the solution will yield with lard at 200° F. a citrine ointment having, at least at first, a bright yellow color. In our experience an equally good and permanent ointment is obtained by heating both the mercuric solution and the fat to about 70° C. (158° F.) before mixing them; and even a lower degree of heat, about 50° C. (122° F.), will produce good results if the reaction is completed before the ointment is permitted to cool. All difficulties are, however, overcome by following the process suggested by R. Rother (1870). The lard is melted at a moderate heat, one and a half troyounce of nitric acid is added without stirring, the heat is continued as long as a moderate effervescence continues, and the mixture is then allowed to cool. In the mean time the mercury is dissolved in two troyounces of the nitric acid with the aid of sufficient heat to prevent crystallization; this solution is added to the lard, and treated as stated before, as soon as it has commenced to thicken.

Lard treated with nitric acid in the manner stated yields, on cooling, a light yellow ointment, which is recognized by some European Pharmacopœias as *Unguentum nitricum, s. Ung. oxygenatum*, and is produced, according to the German Pharmacopœia, by melting fifty parts of lard, adding three parts of nitric acid spec. grav. 1.185, and heating slowly and with constant stirring until the mixture ceases to redden blue litmus paper. When it commences to congeal, the ointment is poured out into paper moulds in a manner similar to that of cerates (see page 373).

Neat's-foot oil was directed in former editions of the United States Pharmacopœia for preparing citrine ointment. Butter has likewise been used for the same purpose, and perhaps all non-drying fats may afford good preparations. Drying oils, however, yield unsightly ointments with solutions of mercury in nitric acid.

Citrine ointment should be prepared in glass or porcelain vessels, and should not be brought into contact with iron or other metals.

Medical Uses.—Citrine ointment is employed in nearly all of the cases mentioned under the head of white precipitate ointment, but especially in chronic diseases of the *skin*. It is more stimulating than that preparation, and generally needs dilution with lard. It is very apt to occasion salivation.

UNGUENTUM HYDRARGYRI OXIDI FLAVI, *U. S.*—OINTMENT OF YELLOW OXIDE OF MERCURY.

Pommade d'oxyde jaune de mercure, Fr.; *Gelbe Quecksilberoxydsalbe*, G.

Preparation.—Take of Yellow Oxide of Mercury in very fine powder sixty grains; Ointment four hundred and twenty grains. Rub the oxide of mercury with the ointment, gradually added, until they are thoroughly mixed. *U. S.*

The yellow wax contained in the simple ointment will protect this preparation from rancidity; but it is best to keep the ointment on hand for a short time only, or to prepare it when needed.

Medical Uses.—This preparation was introduced as a substitute for ointment of the red oxide of mercury, with which it is identical in its medicinal qualities; but owing to the amorphous condition and the greater fineness of subdivision of the particles of the oxide from which it is made, it appears to be more suitable for application to the eye and other delicate tissues.

UNGUENTUM HYDRARGYRI OXIDI RUBRI, *U. S.*, *Br.* —OINTMENT OF RED OXIDE OF MERCURY.

Unguentum hydrargyri rubrum, P. G.; *Ung. præcipitatum rubrum.—Pommade de précipité rouge, Baume ophthalmique rouge*, Fr.; *Rothe Quecksilbersalbe*, G.

Preparation.—Take of Red Oxide of Mercury in very fine powder sixty grains; Ointment four hundred and twenty grains. Rub the oxide of mercury with the ointment, gradually added, until they are thoroughly mixed. *U. S.*

Take of Red Oxide of Mercury in very fine powder sixty-two grains; Yellow Wax one-fourth of an ounce; Oil of Almonds three-fourths of an ounce. Melt the wax at a gentle heat, mix the oil with it, and when the mixture is nearly cold, add the oxide of mercury, and mix the whole thoroughly together. *Br.*

The proportions of other Pharmacopœias for one part of red oxide of mercury are: 15 parts of rose ointment (*F. P.*); 9 parts of lard (*P. G.*). The German Pharmacopœia recognizes also an *Unguentum ophthalmicum*, which is made by melting together 30 parts of expressed oil of almonds and 19 parts of yellow wax, and mixing these intimately with 1 part of the red oxide. The red oxide of mercury should be very finely levigated with a small quantity of the ointment before the remainder is added. None of the above ointments, except that of the French Codex, is liable to rancidity on being kept for some months.

Medical Uses.—Red precipitate ointment, when used as a dressing for *ulcers*, is very apt to produce the specific effects of mercury upon the system. It should not, therefore, be too freely applied, nor upon too large a surface at once. Its use is very much restricted to the treatment of indolent *syphilitic sores*, and chronic inflammation of the edges of the eyelids (*blepharitis*). For the latter purpose the ointment should usually be diluted. One part of red precipitate ointment to eight or ten of simple ointment is usually strong enough.

UNGUENTUM HYDRARGYRI SUBCHLORIDI, *Br.*— OINTMENT OF SUBCHLORIDE OF MERCURY.

Unguentum calomelanos.—Pommade de calomélas, Fr.; *Quecksilberchlorürsalbe*, G.

Preparation.—Take of Subchloride of Mercury eighty grains; Prepared Lard one ounce. Mix thoroughly. *Br.*

The French Codex directs one part of calomel to be mixed with nine parts of benzoated lard.

Medical Uses.—Calomel ointment has the advantage over all the ointments made with salts of mercury of being wholly unirritating, and over simple mercurial ointment of not discoloring the skin or staining the clothing. It is, therefore, adapted to the local treatment of *cutaneous eruptions* of limited extent, and especially to those of a *syphilitic* nature. It is conveniently associated with white precipitate ointment in the affections to which that ointment is applied.

UNGUENTUM IODINII, *U. S.*—IODINE OINTMENT.

Pommade d'iode, Fr.; *Jodsalbe*, G.

Preparation.—Take of Iodine twenty grains; Iodide of Potassium four grains; Water six minims; Lard a troyounce. Rub the iodine and iodide of potassium first with the water and then with the lard, until they are thoroughly mixed. *U. S.*

The water and potassium iodide are serviceable for effecting the fine division of the iodine. The lard should be added at first in very small quantities, and the trituration continued until the solid ingredients are perfectly levigated, and the mixture is entirely free from grittiness, and uniform in color.

Medical Uses.—Iodine ointment has been employed extensively to promote the absorption of the exudation occurring in local inflammation; and it is generally of use, although perhaps less efficient than the application of tincture of iodine. Such cases are those of indolent enlargement of the *tonsils*, the *thyroid*, and the *lymphatic glands; hydrarthrosis, cold abscess*, and chronic *peritonitis*. It may also be applied to the *mamma* when abscess threatens to form in this gland, and to promote the absorption of *pleural* and *pericardial effusions.*

UNGUENTUM IODINII COMPOSITUM, *U. S.*—COMPOUND IODINE OINTMENT.

Unguentum iodi, Br.—*Ointment of iodine*, E.; *Pommade d'iodure de potassium ioduré*, Fr.; *Jodkaliumsalbe mit Jod*, G.

Preparation.—Take of Iodine fifteen grains; Iodide of Potassium thirty grains; Water thirty minims; Lard a troyounce. Rub the iodine and iodide of potassium first with the water, and then with the lard, until they are thoroughly mixed. *U. S.*

Take of Iodine and Iodide of Potassium, each thirty-two grains; Proof Spirit one fluidrachm; Prepared Lard two ounces (avoird.). Rub the iodine and the iodide of potassium well together, with the spirit, in a glass or porcelain mortar; add the lard gradually, and mix thoroughly. *Br.*

The ointment should be free from grittiness, and have the iodine uniformly diffused. The French Codex orders one part of iodine to five of potassium iodide and forty parts of benzoated lard.

Medical Uses.—This ointment, it will be observed, contains less iodine, by five grains to the ounce, than the simple ointment. The advantage of the iodide of potassium in it must depend upon the absorption of the salt, which cannot be very great from so limited a surface as that to which the ointment is usually applied. The compound and the simple ointments are used for the same purposes.

UNGUENTUM MEZEREI, *U. S.*—MEZEREON OINTMENT.

Pommade épispastique au garou, Pommade de mézeréon, Fr.; *Seidelbastsalbe*, G.

Preparation.—Take of Fluid Extract of Mezereon four fluidounces; Lard fourteen troyounces; Yellow Wax two troyounces. Melt the lard and wax together with a moderate heat, add the fluid extract of mezereon, and stir the mixture constantly until the alcohol has evaporated; then continue to stir while cooling. *U. S.*

The corresponding ointment of the German Pharmacopœia is made by mixing one part of extract of mezereon with nine parts of simple ointment; that of the French Codex contains four per cent. of ethereal extract of mezereon.

Medical Uses.—Mezereon ointment is employed for the purpose of maintaining a discharge from suppurating surfaces created by *cantharides, caustics, setons, issues*, and other irritants.

UNGUENTUM PICIS LIQUIDÆ, *U. S.*, *Br.*—TAR OINTMENT.

Pommade de goudron, Fr.; *Theersalbe*, G.

Preparation.—Take of Tar, Suet, each twelve troyounces. Mix the tar with the suet previously melted with a moderate heat, and, having strained the mixture through muslin, stir it constantly while cooling. *U. S.*

Take of Tar five ounces; Yellow Wax two ounces. Melt the wax with a gentle heat, add the tar, and stir the mixture briskly while it cools. *Br.*

The French Codex employs three parts of lard to one part of purified tar.

Medical Uses.—Tar ointment will sometimes cure *scabies*, but its action is uncertain and dilatory. In scaly eruptions, as *psoriasis* and *lepra*, its efficacy is much more decided, as well as in *chronic eczema* after the liquid secretion has ceased. In *ringworm*, and in *prurigo*, it is one of the best applications; and it may be used with advantage in the greater number of indolent and gangrenous *ulcers*.

UNGUENTUM PLUMBI ACETATIS, *Br.*—OINTMENT OF ACETATE OF LEAD.

Preparation.—Take of Acetate of Lead in fine powder twelve grains; Benzoated Lard one ounce. Mix thoroughly. *Br.*

Medical Uses.—The action and uses of this ointment are probably identical with those of the cerate of subacetate of lead. It is applied as a dressing to *wounds*, *excoriations*, and *inflamed surfaces* generally.

UNGUENTUM PLUMBI CARBONATIS, *U. S.*, *Br.*—OINTMENT OF CARBONATE OF LEAD.

Unguentum cerussæ s. Ung. album simplex, P. G.—*Pommade de carbonate de plomb*, *Onguent blanc de Rhazis*, Fr.; *Bleiweissalbe*, G.

Preparation.—Take of Carbonate of Lead in very fine powder sixty grains; Ointment four hundred and twenty grains. Rub the carbonate of lead with the ointment, gradually added, until they are thoroughly mixed. *U. S.*

Other Pharmacopœias direct: Carbonate of lead sixty-two grains; simple ointment one ounce (avoird.). *Br.* Carbonate of lead one part; benzoated lard five parts. *F. P.* Carbonate of lead one part; lard two parts. *P. G.*

Medical Uses.—It is used for the same purposes as the last-mentioned ointment, from which it perhaps differs in being less astringent. It forms a suitable dressing for recent *burns* of the first degree. The danger of poisoning by the absorption of the lead it contains is regarded as an objection to its prolonged use.

UNGUENTUM PLUMBI IODIDI, *U. S.*, *Br.*—OINTMENT OF IODIDE OF LEAD.

Pommade d'iodure de plomb, Br.; *Jodbleisalbe*, G.

Preparation.—Take of Iodide of Lead in very fine powder sixty grains; Ointment four hundred and twenty grains. Rub the iodide of lead with the ointment, gradually added, until they are thoroughly mixed. *U. S.*

Take of Iodide of Lead in fine powder sixty-two grains; Simple Ointment one ounce. Mix thoroughly. *Br.*

The French Codex orders one part of iodide of lead to nine parts of benzoated lard.

Medical Uses.—The discutient influence of this ointment upon the *enlarged glands* of the lymphatic system, and even upon certain *mammary tumors* of uncertain nature, is sometimes very distinctly marked. In chronic enlargement of the *testicle* following gonorrhœa it is often of palpable use. It has also been applied to some local cutaneous eruptions, but without demonstrable advantage.

UNGUENTUM PLUMBI SUBACETATIS COMPOSITUM, *Br.* See CERATUM PLUMBI SUBACETATIS.

UNGUENTUM POTASSÆ SULPHURATÆ, *Br.*—OINTMENT OF SULPHURATED POTASH.

Pommade de foie de soufre, Fr.; *Schwefellebersalbe*, G.

Preparation.—Take of Sulphurated Potash thirty grains; Prepared Lard one ounce. Triturate the sulphurated potash in a porcelain mortar and gradually add the lard, rubbing them together until the ointment is perfectly smooth and free from grittiness. *Br.*

Medical Uses.—Sulphuret of potassium ointment is only used in the treatment of *scabies*, for which it is an efficient remedy.

UNGUENTUM POTASSII IODIDI, *U. S.*, *Br.*—OINTMENT OF IODIDE OF POTASSIUM.

Unguentum kalii iodati, P. G.—*Pommade ioduré*, Fr.; *Jodkaliumsalbe*, G.

Preparation.—Take of Iodide of Potassium in fine powder sixty grains; Water boiling hot half a fluidrachm; Lard four hundred and twenty grains. Dissolve the iodide of potassium in the water, in a warm mortar, then add the lard gradually, and thoroughly mix them. *U. S.*

Take of Iodide of Potassium sixty-four grains; Carbonate of Potash four grains; Distilled Water one fluidrachm; Prepared Lard one ounce. Dissolve the iodide of potassium and carbonate of potash in the water, and mix thoroughly with the lard. *Br.*

Without the addition of carbonate of potassium or of a few drops of potassa solution, this ointment will turn yellow or brownish in a short time from liberated iodine. The German Pharmacopœia prevents this change by mixing the potassium iodide with one-twentieth its weight of hyposulphite of sodium.

Medical Uses.—The discutient powers of this ointment are certainly inferior to those of the ointments of iodine; its only advantages consist in its being colorless and in not staining the linen. It is used as a discutient for *enlarged glands.*

UNGUENTUM RESINÆ, *Br.* See CERATUM RESINÆ.

UNGUENTUM SABINÆ, *Br.* See CERATUM SABINÆ.

UNGUENTUM SIMPLEX, *Br.* See UNGUENTUM.

UNGUENTUM STRAMONII, *U. S.*—STRAMONIUM OINTMENT.

Pommade de stramoine, Fr.; *Stechapfelsalbe*, G.

Preparation.—Take of Extract of Stramonium sixty grains; Water half a fluidrachm; Lard four hundred and twenty grains. Rub the extract with the water until uniformly soft, then gradually add the lard, and thoroughly mix them. *U. S.*

Medical Uses.—Stramonium ointment, although less efficient than belladonna ointment, may be used for the same purposes, viz., to allay *pain* and relieve *spasm.* It has been found to palliate the suffering caused by open *cancer* of the breast, and it affords much comfort in cancer of the *rectum*, *piles*, fissures of the *anus*, etc. An ointment composed of equal parts of stramonium ointment, ointment of galls, and cerate of subacetate of lead is very useful in these affections and also to arrest the itching caused by vermicular *ascarides.*

UNGUENTUM SULPHURIS, *U. S.*, *Br.*—SULPHUR OINTMENT.

Unguentum sulfuratum simplex, P. G.—*Pommade soufrée*, Fr.; *Schwefelsalbe*, G.

Preparation.—Take of Sublimed Sulphur a troyounce; Lard two troyounces. Rub the sulphur with the lard, gradually added, until they are thoroughly mixed. *U. S.*

Take of Sublimed Sulphur one ounce; Benzoated Lard four ounces. Mix thoroughly. *Br.*

Medical Uses.—The chief use of sulphur ointment is in the treatment of *scabies.* The modes of using it and the conditions of its success have been described under Sulphur.

UNGUENTUM SULPHURIS IODIDI, *U. S.*, *Br.*—OINTMENT OF IODIDE OF SULPHUR.

Pommade d'iodure de soufre, Fr.; *Jodschwefelsalbe*, G.

Preparation.—Take of Iodide of Sulphur in very fine powder thirty grains; Lard a troyounce. Rub the iodide of sulphur with the lard, gradually added, until they are thoroughly mixed. *U. S.*

Take of Iodide of Sulphur thirty grains; Prepared Lard one ounce. Triturate the iodide of sulphur in a porcelain mortar and gradually add the lard, rubbing them together until the ointment is perfectly smooth and free from grittiness. *Br.*

The French Codex orders the two ingredients in the proportion of one to twenty.

Medical Uses.—The tendency to speedy decomposition of this ointment renders it practically of little value, even in the treatment of limited chronic eruptions of *eczema*, *lepra*, and *acne*, and in *lupus.*

UNGUENTUM TABACI, *U. S.*—TOBACCO OINTMENT.

Unguentum nicotianæ.—Pommade de tabac, Fr.; *Tabaksalbe*, G.

Preparation.—Take of Tobacco in fine powder half a troyounce; Lard eight troyounces; Water a sufficient quantity. Moisten the tobacco with a little water, introduce it into a conical glass percolator, and, having pressed it firmly, pour water upon it until four fluidounces of liquid have passed. Evaporate this liquid to the consistence of a soft extract, and mix it thoroughly with the lard. *U. S.*

The ointment is of a brownish color, and has the odor of tobacco.

Medical Uses.—This ointment, which was formerly used occasionally in the treatment of *scabies*, *prurigo*, and *psoriasis*, and also for resolving induration of the mammary and lymphatic *glands*, is now seldom employed. It is one of the most efficient agents in destroying head and body *lice*. In all cases it is apt to occasion nausea unless sparingly applied.

UNGUENTUM TEREBINTHINÆ, *Br.*—OINTMENT OF TURPENTINE.

Pommade térébenthinée, Fr.; *Terpenthinsalbe*, G.

Preparation.—Take of Oil of Turpentine one fluidounce; Resin in coarse powder sixty grains; Yellow Wax, Prepared Lard, of each half an ounce. Melt the ingredients together by the heat of a steam or water-bath. Remove the vessel, and stir the mixture constantly while it cools. *Br.*

Melt turpentine and yellow wax of each one part, and add oil of turpentine one part. *P. G.*

UNGUENTUM TEREBINTHINÆ COMPOSITUM, s. Unguentum digestivum, *P. G.*—Triturate Venice turpentine thirty-two parts with yolk of egg one part; add powdered myrrh and powdered aloes of each one part; olive oil eight parts; and mix thoroughly.

The *onguent digestif simple* of the French Codex is composed of turpentine four parts; yolk of egg two parts; and olive oil one part.

Medical Uses.—This ointment has the same virtues as the compound resin cerate; but, owing to its softer consistence, it is a more convenient application to *burns*, *erysipelas*, *erythema*, and other recent local inflammations of the skin.

UNGUENTUM VERATRIÆ, *U. S.*, *Br.*—VERATRIA OINTMENT.

Pommade de vératrine, Fr.; *Veratrinsalbe*, G.

Preparation.—Take of Veratria twenty grains; Lard a troyounce. Rub the veratria with a little of the lard; then gradually add the remainder, and thoroughly mix them. *U. S.*

Take of Veratria eight grains; Prepared Lard one ounce; Olive Oil half a fluidrachm. Rub the veratria and the oil together; then mix them thoroughly with the lard. *Br.*

To prevent annoyance from the dust arising during the trituration of dry veratria, the alkaloid should be previously covered with a small quantity of olive oil, or thoroughly dampened with a little alcohol.

Medical Uses.—The American is more than twice as strong as the British ointment. For an account of its uses, see *Veratria.*

UNGUENTUM ZINCI OXIDI, *U. S.*—OINTMENT OF OXIDE OF ZINC.

Unguentum zinci, Br., P. G.; *Unguentum de nihilo albo.—Pommade d'oxyde de zinc*, Fr.; *Zinksalbe*, G.

Preparation.—Take of Oxide of Zinc eighty grains; Ointment of Benzoin four hundred grains. Rub the oxide of zinc with the ointment of benzoin, gradually added, until they are thoroughly mixed. *U. S.*

Take of Oxide of Zinc eighty grains; Benzoated Lard one ounce. Add the oxide of zinc to the benzoated lard, previously melted with a gentle heat, and stir the mixture constantly while it cools. *Br.*

The oxide of zinc is obtained in an impalpable powder and uniformly diffused through the ointment, by triturating it well in a warm mortar with about its own weight of benzoated lard, until the mixture is perfectly smooth, when the remainder of the lard may be added. The trituration may also be accomplished with glycerin or expressed almond oil in sufficient quantity for forming a soft paste. On keeping, the ointment gradually acquires a tough consistence.

Medical Uses.—Oxide of zinc ointment is a protective, artringent, and mildly stimulant, application adapted to *ulcers* which are irritable, have loose granulations, and discharge pus copiously. It is especially useful as a dressing for *fissures* of the nipple and anus, for local eruptions of *eczema*, *herpes*, and *impetigo;* for all cases of simple *abrasion* or *ulceration*, including blistered surfaces, after their active inflammation has subsided; for *ophthalmia tarsi*, etc.

UREA.—UREA.

Carbamid.—Urée, Fr.; *Harnstoff*, G.

Formula CH_4N_2O. Molecular weight 60.

Origin.—Urea was discovered in urine by Rouelle (1773), and, in the impure condition in which he obtained it, designated as *extrait savonneux de l'urine.* Fourcroy and Vauquelin (1799) prepared it in the pure state. It has been found in the urine of mammals, more particularly in that of the carnivoræ, in the urine of birds and other animals, and in many animal fluids. Human urine contains from 2 to 4 per cent. of urea. The transformation into urea of ammonium cyanate by evaporating its aqueous solution, as observed by Wöhler (1820), was the first instance in which an organic compound produced in the living organism was artificially formed. Urea has also been artificially prepared from other cyanogen compounds.

Preparation.—Urine is evaporated to a syrupy consistence, allowed to cool, and the residue mixed with an equal volume of strong nitric acid. The nitrate of urea, which crystallizes in scales and prisms, is purified by washing with cold water and by recrystallization, and is then decomposed by boiling with water and barium carbonate; the filtrate is evaporated, and the residue exhausted with alcohol. Oxalic acid and calcium carbonate may be substituted in this process for nitric acid and barium carbonate.

Properties.—Urea crystallizes in colorless and inodorous four-sided prisms, which have a cooling saline taste and are permanent in dry air. It melts near 130° C. (266° F.), and at a higher heat is decomposed, giving off ammonia and leaving cyanuric acid, which, at a still higher temperature, yields cyanic acid. Urea dissolves in its own weight of cold water, is readily soluble in alcohol, but is slightly soluble in pure ether. In contact with nitrous acid, urea is decomposed into carbonic acid, nitrogen, and water. A similar decomposition is effected by an acidulated solution of permanganate of potassium. Dissolved in pure water, urea keeps unchanged for a long time; but, in the presence of putrefiable matter, it is rapidly decomposed, yielding ammonia and carbonic acid; hence, foul urine contains no urea.

Urea forms crystallizable compounds with acids, with metallic oxides, and with many neutral salts. *Hydrochlorate of urea* is very deliquescent. *Nitrate of urea*, $CH_4N_2O.HNO_3$, is slightly soluble in cold water and alcohol, and nearly insoluble in nitric acid; it contains 48.78 per cent. of urea. *Oxalate of urea*, $(CH_4N_2O)_2.H_2C_2O_4$, crystallizes in scales, which dissolve at 15° C. (59° F.) in 23 parts of water, but require a much larger quantity of solution of oxalic acid; it contains 57.14 per cent. of urea. The amount of urea in urine is frequently determined by forming the compound either with nitric or oxalic acid.

Medical Action and Uses.—Half a century ago it had been demonstrated by Ségalas that urea injected into the veins of animals increased notably the discharge of urine with a greatly augmented proportion of urea; and, much more recently, Wöhler and Frerichs alleged that when introduced into an animal's stomach it reappeared almost entirely in the urine. Gallois, however, proved that only two-thirds at most of the urea thus administered was recoverable from the urine, and also that in very large doses, such as three hundred grains given to a rabbit, it occasioned prostration, trembling, convulsions, and death.

Several physicians of distinction testified to its virtues as a diuretic in dropsy, and one of high reputation particularly recommended the nitrate of urea as a remedy for scarlatinous dropsy. It was prescribed in doses of two or three grains several times a day. It is probably now quite obsolete, and should be consigned to the "Dreckapotheke," as Strumpf long ago suggested.

URTICA.—NETTLE.

Ortie brûlante, Fr.; *Brennessel*, G.

Urtica dioica, *Lin.*, and U. urens, *Lin.* *Nat. Ord.*—Urticaceæ, Urticeæ.

Origin and Description.—Both plants are common in waste places, along hedges and roadsides, throughout the greater part of Europe and Northern Asia, and have been thoroughly naturalized in North America, where the small annual *U. urens* is less frequent than the taller perennial *U. dioica.* Both species are covered with stiff stinging hairs, and have opposite stipulate and petiolate leaves.

URTICA DIOICA.—The leaves are two or three inches long, dark green above, whitish downy beneath, ovate or ovate-lanceolate, heart-shaped, pointed, and coarsely serrate. The small greenish flowers are usually diœcious, in small clusters, and these are arranged in branching and hanging spikes.

URTICA URENS.—The leaves are one or two inches long, pale green, elliptic, deeply serrate, and almost five-nerved. The small and loose flower clusters appear in axillary pairs.

URTICA CANADENSIS, *Lin.* (Laportea canadensis, *Gaudichaud*).—The leaves are alternate, four to six inches long, long-petioled, ovate or elliptic, obtusely serrate, and strongly feather-veined. The flower clusters form axillary loosely-paniculate cymes. The plant is common in miry, shaded grounds, attains a height of three to five feet, and is armed with stinging hairs.

Constituents.—The analyses of the fresh nettle by Saladin (1830) and by Bohlig (1840) proved the presence of mucilage, salts, and other common constituents of plants, and on distilling the herb with water, notable quantities of ammonia and carbonic acid were found in the distillate. Gorup-Besanez (1849) recognized the irritating compound contained in the stinging hairs as free *formic* *acid*, which is also contained in the aqueous distillate of the fresh herb. A. Buchner, however, observed that the inflammation produced by free formic acid is of a different character than that produced by nettles, and regarded the presence of another irritating compound besides formic acid as probable.

Medical Action and Uses.—The seeds and leaves of the nettle were much used in ancient times in poultices, or bruised, for unhealthy ulcers, as well as for recent wounds and sprains. The bruised leaves were introduced into the nostrils to arrest epistaxis, and given in honey for the cure of pulmonary catarrhs. The well-known irritation of the skin caused by nettles is due to an acrid secretion contained in a minute vesicle situated at the base of each of the stiff hairs that beset the leaves. When the points of these sharp and hollow spines penetrate the skin, the poisonous juice is expressed into its tissue, and gives rise to a burning and stinging pain, with inflammatory redness and swelling. The case is recorded of a woman who, by mistake, drank two cupfuls of a decoction of nettle leaves. On the following day she experienced severe burning over the whole of the upper part of the body, with formication and stiffness. The features were greatly swollen. Over the affected surface minute vesicles appeared, which burst and discharged a limpid and in some parts a bloody fluid. In the course of five or six days the eruption dried up. No fever accompanied the attack.

Nettle juice has always been reputed to be an efficient remedy for spontaneous hemorrhage of nearly every variety, including *hæmoptysis*, *menorrhagia*, *post-partum hemorrhage*, and *epistaxis*. Allowing for the difficulty of determining the efficacy of any medicine in arresting hemorrhage, there appears to remain so great a preponderance of evidence in favor of the one under consideration as to render scepticism in regard to it unreasonable; especially as in most of the cases numerous hæmostatics of recognized activity had failed before this medicine was employed. The juice was administered in doses of half an ounce or an ounce at intervals of several hours; and in no case does it appear to have given rise to any disagreeable or untoward effects. This preparation is also reported to have been very efficacious in certain cases of *gravel*, *jaundice*, and *dropsy;* and the seeds have been used in *diarrhœa*, *dysentery*, *leucorrhœa*, and nocturnal *incontinence of urine*. The decoction of the leaves and stalks is also said to display curative powers in chronic *diseases of the skin*, and this preparation, as well as the expressed juice, to cure ulcerative affections of the mouth and throat. Poultices made by boiling the fresh leaves have been reputed to cure gangrenous, scorbutic, and other unhealthy *ulcers*. Urtication is the name applied to producing an irritation of the skin by means of nettles. It is performed by taking in the gloved hand a bunch of nettles, and flagellating the skin with it, until the redness and the stinging pain denote that the intended effect is produced. This peculiar stimulant, revulsion and counter-irritation, has been long employed for arousing to consciousness persons affected with *lethargy*, *congestion of the brain*, *intoxication* by *alcohol* or *opium*, or *hysterical insensibility*. It has also been used upon the loins and thighs to cure *amenorrhœa* and *sexual impotence*, and, above all, as a means of restoring power to *paralyzed* limbs. The advantages it presents over blistering, pustulation by croton oil, etc., consist in the vivid and intense impression it produces, and which likens it to electricity and massage. It may seem to be a comparatively rude expedient, but cases may occur, particularly in the country, for which it would be peculiarly adapted.

UVA PASSA, *U. S.*—RAISINS.

Uvæ, Br.; *Passulæ.—Raisins*, Fr.; *Rosinen*, G.

The dried fruit of Vitis vinifera, *Lin.* Woodville, Med. Bot., plate 195.
Nat. Ord.—Vitaceæ.

Origin.—The Vitis vinifera is indigenous to Western Asia and probably to Northern Africa, and has been cultivated in Europe from a very early period; it has been introduced into North America chiefly on the Pacific Coast, and into other temperate countries. A large number of varieties have been produced, differing in the shape, size, and color of their berries, and in other characters. Some botanists refer the different varieties of grapevine to three or four species. The *Catawba*, *Isabella*, *Concord*, and other grapes usually cultivated in the United States, are varieties of the indigenous Vitis labrusca, *Lin.*

The genus *vitis* consists of shrubs climbing by tendrils, and bearing these and the greenish, compound-racemose flowers opposite the leaves. The calyx is small, the five petals are united at the apex, fall off together by separating at the base, and alternate with five stamens, which inclose a two-celled ovary, ripening into a juicy berry containing about four hard pyriform seeds.

The tender branchlets (*pampini vitis*) with the leaves are sometimes employed for their agreeable acidulous flavor. The unripe berries (*agresta*) contain a considerable amount of tartaric acid, and yield, when expressed, a very acerb juice (*omphacium*). The mature fruits, dried, constitute the raisins.

Collection.—When the grapes are ripe, their stalks are cut half through, or a portion of the bark is removed, and the grapes are allowed to remain upon the vine for a few weeks, and then cut off, sometimes steeped for a short time in a weak lye to remove the waxy bloom, and then completely dried. Or the ripe grapes are cut off, spread out upon a hard clay floor, and dried by exposure to the sun, which requires a week or two. In rainy weather artificial heat is used for drying them.

Description.—The ripe berry of the grapevine is one-celled from the obliteration of the cell wall, and is globular or oblong in shape. After drying, it is shrivelled and flattened, more or less orbicular, of a brownish color, and somewhat translucent. When long kept raisins become more opaque, owing to the crystallization of the sugar and cream of tartar.

Raisins are produced in Southern Europe, and in commerce are distinguished generally by the ports of exportation. Those produced in Spain are usually preferred, and have either been removed from the stalks, like the *Valencia raisins*, or are sold in bunches like the *Malaga* or *Muscatel raisins.* The *seedless* or *Sultana raisins* are rather smaller than the Spanish and Italian raisins, and are exported from Asia Minor. A variety of raisins, produced in Greece and the adjacent islands, is known in commerce as *Corinthian raisins*, and was distinguished in the older Pharmacopœias as *passulæ minores.* These raisins, often incorrectly called *currants*, are much smaller than those previously described, usually deprived of their stalks, and mostly adhere together in masses; they have a vinous odor and a sweet and acidulous taste. Corinthian raisins are not used medicinally in the United States.

Constituents.—The *skin* of ripe grapes contains tannin and coloring matter. The chief constituents of the *pulp* are grape sugar and acid tartrate of potassium, besides gummy matter, calcium tartrate, and a small quantity of malic acid. The *seeds* contain about five per cent. of tannin, green resin, and between twelve and thirteen per cent. of a bland oil, which, according to A. Fitz (1871), is a mixture of glycerin compounds of erucic, palmitic, and stearic acids, and of another undetermined acid or mixture of acids. Erucic acid (see p. 1262) constitutes about one-half of the acids; palmitic and stearic acids are present in very small proportion.

Off. Prep.—Tinct. cardamomi comp., *Br.;* Tinct. rhei et sennæ, *U. S.;* Tinct. sennæ, *Br.*

Medical Uses.—The pulp of raisins is nutritive and demulcent, and is used to flavor mucilaginous and amylaceous infusions, such as those of flaxseed, oatmeal, rice, barley, etc.

UVA URSI, *U. S.*—UVA URSI.

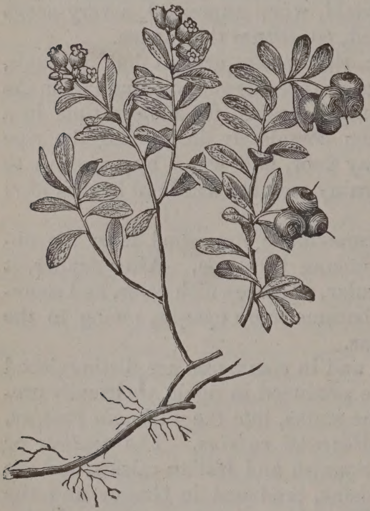
Uvæ ursi folia, Br.—*Bearberry leaves*, E.; *Feuilles de busserole*, Fr.; *Bärentraubenblätter*, G.

The dried leaves of Arctostaphylos (Arbutus, *Lin.*) uva ursi, *Sprengel* (Arct. officinalis, *Wimmer*). Woodville, Med. Bot., plate 70; Bentley and Trimen, Med. Plants, 163.

Nat. Ord.—Ericaceæ, Ericineæ.

Origin.—The bearberry is a trailing, much-branched, evergreen shrub, which is distributed throughout the northern portion of the northern hemisphere, and grows in most parts of Europe, in Northern Asia, and throughout the North American continent as far south as New Jersey. It is found in dry, rocky, or sandy places, and in pine woods; southward it grows chiefly in hilly or mountainous regions. It bears short and drooping racemes of from three to twelve whitish, urn-shaped flowers, and small, bright-red drupes, containing five flattened nutlets, each with one seed. The flowers appear in May, and the fruit ripens in autumn, at which time the leaves should be collected.

Fig. 196.



Arctostaphylos uva ursi, *Spreng.*

Description.—Bearberry leaves are nearly sessile, one inch or less in length, about one-quarter of an inch wide, obovate or oblong-spatulate, entire, and slightly revolute on the margin, obtuse or somewhat retuse at the apex, and almost wedge-shaped at the base. They have a leathery texture, a dark-green, rather glossy upper surface, with depressed veins, and are paler, smooth, and reticulately-veined beneath. The powdered leaves have a faint, hay-like odor, and a strongly astringent and slightly bitter taste.

Constituents.—Meissner (1824) found in uva ursi gallic acid and tannin, producing, with ferric salts, a blue-black precipitate. Kawalier (1852) corroborated the existence of gallic acid in bearberry leaves; and Bowman (1869) determined the amount of tannin, by means of gelatin, to be 6.33 per cent. Besides resin, sugar, and some other unimportant constituents, Kawalier isolated from the leaves arbutin and ericolin, and Trommsdorff another crystalline body, ursone. *Arbutin*, $C_{24}H_{32}O_{14}.H_2O$, is obtained from the decoction of the leaves by precipitating it with subacetate of lead, treating the filtrate with sulphuretted hydrogen, and evaporating to crystallize. It forms neutral, colorless, silky needles, of a bitter taste, freely soluble in hot water and in alcohol, and sparingly soluble in ether. Julius Jungmann (1872) observed that an aqueous solution of arbutin, rendered alkaline by ammonia or potassa, acquires a deep azure-blue color on the addition of phosphomolybdic acid. On being dissolved in strong nitric acid, arbutin yields, after the addition of alcohol, pale-yellow needles of *binitro-arbutin.* By emulsin or by hot diluted sulphuric acid, arbutin is decomposed into glucose and *hydrokinone* or *arctuvin* $C_6H_6O_2$, which crystallizes in colorless, fusible, and sublimable prisms, easily soluble in water, alcohol, and ether. The same compound is also produced from kinic acid by destructive distillation. On oxidizing hydrokinone or arbutin with binoxide of manganese and sulphuric acid, *kinone* is formed (see page 420). Hughes' *ursin* (1847) was proven by Jungmann to be impure arbutin.

The mother liquor from the preparation of arbutin contains *ericolin* (see page 802). After washing the alcoholic extract of bearberry leaves with water and ether, boiling alcohol extracts from the residue *ursone*, $C_{20}H_{34}O_2$; this crystallizes in tasteless, silky, fusible and sublimable needles, is insoluble in water, dilute acids, and alkalies, and is sparingly soluble in ether and cold alcohol.

Arbutin, ericolin, and ursone have been obtained also from other ericaceous plants.

Adulterations and Substitutions.—The leaves of the following plants are said to have been sometimes mistaken for those of uva ursi.

VACCINIUM VITIS-IDÆA, *Lin.*—It is known as *cowberry*, and grows from New England northward, and in Europe. The leaves resemble those of uva ursi, but are not reticulate, and on the lower surface are dotted with fine, blackish, bristly points.

VACCINIUM ULIGINOSUM, *Lin.*—This is known as *bog-bilberry*, and grows in Europe and the northern part of North America. The leaves are scarcely leathery, and are pale blue-green and pubescent on the lower surface; otherwise they resemble the leaves of uva ursi.

LEIOPHYLLUM BUXIFOLIUM, *Ell.*—The *sand myrtle*, indigenous to the United States from New Jersey southward, is a small shrub about six inches high. Its leaves are about one-third of an inch long, oval or oblong, shining, reticulate, and revolute on the margin.

BUXUS SEMPERVIRENS, *Lin.*—The *box*, commonly cultivated in gardens, has ovate leaves, which are narrower towards the apex than near the base.

Off. Prep.—Decoct. uvæ ursi, Extr. uvæ ursi fluid., *U. S.;* Infus. uvæ ursi, *Br.*

Medical Action and Uses.—Uva ursi, or bearberry, in small doses, appears to promote the appetite and confine the bowels; but in large quantities it occasions vomiting and purging, rendering it probable that its medicinal effects do not depend solely upon its astringent principles. On the healthy system it does not produce any diuretic action, but in calculous affections the urine sometimes seems to augment under its influence. It gives to this secretion a dark color and a peculiar odor.

Uva ursi appears to have been first used by physicians about the middle of the eighteenth century. It was then employed in calculous affections, and in all chronic disorders of the urinary passages, from the kidneys to the urethra. It has proved useful in chronic *pyelitis* and *cystitis*, and even in calculous forms of those affections, probably by constringing the mucous membrane of the kidneys and bladder, diminishing its vascularity, and thereby obtunding its sensibility. In many cases, as a consequence of this mode of action, it has caused the parts affected to become more or less insensible to the mechanical irritation of the concretions inclosed by them, and thereby lessened the impediment to the passage of the urine. In this manner, no doubt, it often relieves *incontinence* of urine, *dysury*, and *strangury*. So complete is the relief sometimes afforded by it that a notion once gained credit of its being a solvent of *urinary calculi.* But in truth its mode of action is in great part like that of lime-water, whose efficacy, under analogous circumstances, is well known; it renders the mucous membrane of the urinary passages less susceptible to mechanical irritation. The benefits of the medicine in most of the cases referred to are only to be obtained by its persistent use. But in strangury from blisters its action is sometimes very prompt. Uva ursi has been also used with advantage for chronic *bronchitis*, and atonic *diarrhœa*, *leucorrhœa*, and *hemorrhage*, especially uterine hemorrhage. It is alleged to act as an oxytocic.

The *dose* of the drug in powder is generally stated to be from twenty to sixty grains; but its most striking effects have been obtained by doses not greater than a fourth of these. The decoction and the fluid extract of uva ursi are both efficient.

VALERIANA, *U. S.*—VALERIAN.

Valerianæ radix, Br.; *Radix valerianæ minoris.*—*Valerian root*, E.; *Racine de valériane*, Fr.; *Baldrianwurzel*, G.

The root of Valeriana officinalis, *Lin.* Woodville, Med. Bot., plate 96; Bentley and Trimen, Med. Plants, 146.

Nat. Ord.—Valerianaceæ.

Origin.—Valerian is a native of Europe from the Mediterranean northward, and of Northern Asia, and is cultivated to some extent in Holland and England, and in this country in New England and New York. It is an herbaceous perennial, and grows on the banks of streams and other wet places, and likewise in uplands and dry situations. It varies considerably in size and in foliage, and several of the varieties have been regarded by some botanists as distinct species. The plant is easily propagated from short horizontal runners. It is two to four feet high, branching at the top, has opposite, clasping, long-petiolate and oddly pinnate leaves, with from four to ten pairs of oval or lancelinear, entire or toothed, sessile, and smooth leaflets, and bears compound cymes composed of numerous small pinkish, triandrous flowers. The fruit is an ovoid, compressed akene, crowned by a plumose pappus. The rhizome with the rootlets attached constitutes the officinal portion, and is collected in autumn.

Fig. 197.

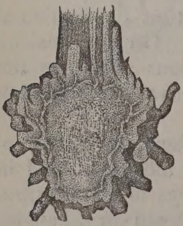
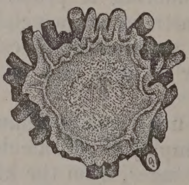


Fig. 198.



Longitudinal and transverse section of rhizome of valerian.

Description.—The rhizome of valerian is upright, subglobular or obconical, truncate below and at the apex, often crowned with short portions of the overground stem, or with a tuft of short leaf bases. It varies in length between about a half and one and a half inch, has a diameter nearly of the same dimensions, and is on all sides furnished with numerous slender, nearly cylindrical rootlets. These are from two to six inches long, about one-eighth of an inch thick at the base, simple, except near the tip, where they are divided into numerous fine fibres, which are rarely present in the commercial drug. A few short stolons, with long nodes, are occasionally attached to the rhizome. The rhizomes collected from dry situations are the smallest, have a light yellowish-brown color, are subglobular in shape, have a comparatively large number of rather short, thin, and light-colored rootlets attached, and are preferred for medicinal purposes on account of the larger proportion of volatile oil contained in them. The rhizomes collected in wet localities are more elongated, of larger dimensions, more fleshy, and therefore frequently cut longitudinally to facilitate their drying, darker in color, near the lower end marked by scars from decayed rootlets, and near the middle and upper portion have longer, thicker, and darker-colored rootlets than the preceding variety; they also absorb atmospheric moisture more readily. The rootlets of valerian are rather brittle, and break with a short fracture; the rhizome is tougher, and in the interior rather horny and of a light grayish-brown color. It has a thin bark, which, by a dark cambium line, is separated from a narrow circle of whitish woody tissue, and this incloses a large central pith. The rootlets have a thick bark, surrounding a slender ligneous cord. Under the microscope the parenchyma is seen to contain cells filled with oil or resin. The recent rhizome has a very slight odor, but on drying a peculiar somewhat camphoraceous and terebinthinate odor appears, which on long keeping gradually changes to a strong, somewhat cheese-like odor. The taste of valerian is unpleasant, camphoraceous, and bitter. The rootlets of the commercial drug sometimes cover a large amount of dirt.

Constituents.—The most important constituent of valerian is its volatile oil (see page 1007), which varies in proportion between about a half and two per cent., the fresh rhizome from dry soil yielding the larger amount. Cultivated valerian seems to be less rich in volatile oil. Recent valerian, on being distilled with water, yields a distillate which, according to Schoonbroodt (1868), is neutral, or nearly so. Free valerianic acid does not exist in fresh valerian, but is generated from the volatile oil on exposure. The relative proportions of the volatile oil and valerianic acid must, therefore, vary with the age of the drug. Aschoff (1846) found in the root also malic, acetic, and formic acids. The constituents which are of less medicinal importance are tannin, extractive, starch, mucilage, resin, etc.

Off. Prep.—Extract. valerianæ, Extr. valerianæ fluid., *U. S.;* Infusum valerianæ, Tinct. valerianæ, Tinct. valerianæ ammoniata, *U. S.*, *Br.*

Allied Drugs. RADIX VALERIANÆ MAJORIS.—This is obtained from Valeriana phu, *Lin.*, a tall South European perennial, which is occasionally cultivated. The rhizome is oblique, four to six inches long, about half an inch thick, is distantly annulated, of a brown color, and on the lower side furnished with numerous yellowish rootlets. Its odor and taste are much weaker than in the officinal valerian.

NARDUS CELTICA is the rhizome of Valeriana celtica, *Lin.*, a native of the Alps. It is thin, about three inches long, densely covered with brown scaly leaf remnants, has long simple rootlets on the lower side, and possesses a strong odor and taste of valerian.

NARDUS INDICA s. *Spica nardi*, or true *spikenard*, formerly much employed, is obtained from Nardostachys (Valeriana, *Roxb.*) jatamansi, *D. C.*, indigenous to India. It is a quarter of an inch or less thick, densely beset with numerous fibrous remnants of leaf stalks, and has a bitter aromatic taste, and a penetrating odor resembling that of serpentaria.

Medical History.—Valerian is described by ancient authors as diuretic and emmenagogue, as a remedy for epilepsy, and, locally, as a detergent. The singular passion for it displayed by cats has long been known. Valerian was anciently called in English *Setwall*, a name properly applied to *Zedoary;* and the root was so much valued for its medicinal virtues that, as Gerarde (1567) remarks, the poorer classes in the north of England esteemed "*no broths, pottege, or physicall meats*" to be worth anything without it. Its odor, now considered intolerable, was not so regarded in the sixteenth century, when it was absolutely the custom to lay the roots among clothes as a perfume in the same way as those of Valeriana Celtica, *Lin.*, and the Himalaya valerians are still used in the East (Flückiger and Hanbury, Pharmacographia).

Physiological Action.—When taken habitually, in moderate doses, valerian improves the appetite and digestion without confining the bowels. Two drachms at a single dose may occasion a sense of heat and weight in the abdomen, eructations, and even vomiting, colic, and diarrhœa; also some excitement of the pulse, general warmth, and either perspiration or diuresis. In somewhat smaller doses its operation is chiefly restricted to the nervous system; it renders the mind tranquil, disposes to good humor and activity, produces, sometimes, a lively formication in the hands and feet, and a sensation about the head and spine which has been compared to the aura epileptica. Sometimes, on the contrary, there is a sense of embarrassment in the head, with heaviness and pain. In states of morbid nervous excitement, without fever, when through exhaustion the pulse has become small and frequent, valerian lessens its frequency and increases its force and volume.

Given to rabbits in doses of from one to three drachms valerianic acid renders the heart's action more rapid, but feebler; the respiration is hurried at first, and then slower; and death usually takes place in three or four hours, preceded by prostration and convulsions. If death occurs speedily, the gastric mucous membrane is pale, but if delayed, it may be congested; the kidneys are apt to be congested, and the urine bloody. Oil of valerian appears to lessen the excitability of the spinal cord, and even to paralyze it, since two centigrammes ($\frac{1}{3}$ gr.), injected under the skin of a frog, have been found capable of preventing tetanic spasms after a like injection of five milligrammes ($\frac{1}{13}$ gr.) of strychnia. Given alone to these animals, hypodermically, it impairs motility and sensibility. Valerianic acid, applied to the human skin, produces a white spot, followed by irritation and redness; and upon the tongue it may cause the epithelium to exfoliate.

Medical Uses.—Valerian is not a cure for *hysteria*, but it is a most valuable palliative when employed to avert or mitigate hysterical paroxysms provoked by some accidental cause. Especially is this the case in females of weak constitutions and excitable temperament, and who are exhausted by care and anxiety. It is still more efficient in preventing the development of those hysteroidal attacks which weak and morbidly sensitive girls and women are liable to, and which consist in an excessive susceptibility to impressions, and in the power of converting into real sensations the suggestions of a disordered fancy, whereby countless subjective perceptions and various disordered actions of the lungs, heart, stomach, etc., arise. In mild cases of *mental derangement*, especially when caused by nervous shock or strain; in nervous *atony* simulating paralysis; in cases, also, of irregular distribution of the blood, accompanied, it may be, with indications of cerebral congestion, or, on the other hand, of cerebral anæmia, of which the chief symptoms are *vertigo*, rush of blood to the head or fainting, confusion of sight and hearing, etc., which, more than at any other time are apt to occur about the menopause, valerian is the most promptly efficient of all the palliatives that have been used. In all such cases valerian exhibits the same potency as assafœtida, musk, and castor, and more decidedly. Oil of valerian dissolved in ether may be administered by inhalation in such attacks. Valerian is one of the best remedies for *nervous headache*, especially when it is associated with ammonia, as in the ammoniated tincture of valerian, or the popular valerianate of ammonia. These preparations may be used advantageously along with carminative tinctures in cases of *flatulence* accompanied with palpitation of the heart. The same remedies are equally efficient in relieving *infantile colic*, an affection for which domestic medicine generally provides an analogous remedy in catnep.

Valerian is one of the innumerable medicines that from time to time have been vaunted as remedies for *epilepsy*, and, allowing for the common error of confounding epilepsy with epileptiform reflex convulsions, and even with hysteria, there can be no doubt that, in large doses and long continued, it has sometimes cured the disease in females and young children, and especially when it originated in fright or some analogous impression. Even in these cases it must be administered in large doses and long continued, while other and especially hygienic measures are employed, to give permanent strength to the nervous system.

Valerian is useful in the treatment of the milder forms of *delirium tremens*, especially when they follow surgical operations or injuries; and in the ataxic phenomena which belong to the *typhoid state* of fevers and inflammations. It has had some reputation as a *vermifuge* for children, especially when associated with purgatives, such as jalap, and by enema, as a remedy for ascarides of the rectum. It has also been used successfully in *polyuria*, or diabetes insipidus, and for the relief of *dysmenorrhœa*.

Valerian may be prescribed in powder in *doses* of from thirty to ninety grains repeated three or four times a day. Its disagreeable taste may be masked by the addition of any aromatic powder. Of its several officinal preparations, the infusion and the fluid extract are to be preferred; next to these ranks the oil.

VANILLA, *U. S.*—VANILLA.

Fructus (*s. Siliqua*) *vanillæ*, P. G.—*Vanille*, Fr., G.

The prepared, unripe fruit of Vanilla planifolia, *Andrews*. Bentley and Trimen, Med. Plants, 272.

Nat. Ord.—Orchidaceæ.

Origin.—The name vanilla is derived from the Spanish *baynilla*, the diminutive of *bayna*, a pod. The plant is indigenous to eastern Mexico, where it grows in hot, moist woods, and is cultivated by fastening shoots to trees just above the ground, where they soon strike roots, begin to produce fruits in about three years, and continue to bear for about thirty years. The plant has a long, fleshy stem, supporting itself by simple aërial rootlets; alternate sessile, fleshy, oval, lanceolate leaves, and axillary spikes of large greenish-white flowers, with a depressed recurved and crenate lip, and with an elongated, fleshy, cylindrical ovary. The cultivated plant is Schiede's *Vanilla sativa*. The wild growing plant (Schiede's *V. sylvestris*) is usually regarded as a mere variety of the former, and yields a smaller and less aromatic fruit, known in Mexico as *baynilla cimarrona*. The vanilla plant has been introduced into some of the West Indian islands, into Bourbon, Madagascar, and several East Indian islands. In its native country it is probably fertilized through the agency of insects; in other countries artificial fertilization is required.

Collection.—The fruit is collected before it is ripe, when the green color begins to change. In order to develop its aroma, and to prevent its dehiscence, the unripe fruit is partly sundried, or exposed to artificial heat, and then wrapped in blankets until it begins to sweat, when the exposure and subsequent wrapping up are repeated. Steeping in hot water is said to be in some places resorted to previously to drying. Some of the constituents are supposed to undergo a kind of fermentation, through which the odorous principle is developed. After the fruits have obtained the proper dark color, agreeable aroma, and sufficient dryness, they are tied into bundles of fifty, weighing a little over eight ounces, and these are sometimes wrapped in tinfoil, and packed in tin boxes. For the year ending June 30, 1876, 36,539 pounds of vanilla were imported into the United States; less than half this quantity was imported in 1877.

Properties.—The cultivated vanilla fruit is known in Mexico as *baynilla corriente*, and is further distinguished and assorted according to its size and the thickness of its integuments. The finest quality attains a length of twelve inches, has a thin pericarp, and is rarely seen in our market. The varieties usually met with are from six to ten inches long, about one-third of an inch thick, and somewhat triangular, but flattened. Vanilla is of a dark brown color, glossy, longitudinally wrinkled, somewhat narrowed at both ends, bent or hooked at the base, and rather oblique at the apex. The surface is frequently marked with a few circular or oblong warts, and some varieties are more or less covered with an efflorescence of acicular crystals. The integuments of the fruit are leathery, of a brown color; the interior is filled with a blackish-brown fragrant pulp, in which very numerous small, flattish-ovate seeds are imbedded. The fruit is one-celled, and has three parietal placentæ, each projecting with four curved branches into the interior.

Varieties.—Mexican vanilla is regarded as the best. Bourbon vanilla resembles it, and is usually covered with crystals, but has an odor somewhat suggesting that of tonka. Costa Rica vanilla is less attenuated at the ends, and has hardly the fine flavor of the Mexican variety. Vanilla from the Seychelles is considerably thinner. A vanilla is produced in Venezuela, which is three to six inches long, rather thick, and of a decided tonka flavor. In Brazil, Peru, and other parts of South America, a broad and fleshy vanilla is obtained, which is five to eight inches long, about an inch wide, and of an inferior vanilla odor; it is probably the fruit of Vanilla pompona, *Schiede.* It is not unlikely that several other species, besides those mentioned above, yield vanilla; but the different species are very imperfectly known. Vanilla guianensis, *Splitberger*, indigenous to the northeastern portion of South America, may perhaps yield the Venezuelan vanilla. Vanilla palmarum, *Lindley*, a native of Bahia, has a thick cylindrical, not very fragrant fruit, about two inches long. Vanilla aromatica, *Swartz*, is indigenous to South America, but not to Mexico, and its fruit is said to be not aromatic.

Constituents.—According to the analysis of Bucholz (1828) vanilla contains about 11 per cent. of fixed oil, 2.3 per cent. of soft resin, 6 per cent. of sugar, 11 per cent. of gum, and considerable extractive matter. The odor of vanilla is not due to a volatile oil. The crystalline efflorescence was for a long time regarded as identical with either benzoic or cinnamic acid; but Bley (1831) proved it to be distinct from both, and Gobley (1858) established its peculiar nature and its difference from coumarin, and named it *vanillin.* The compound is obtained from the alcoholic extract of vanilla by diffusing it in a little water, agitating with ether, and evaporating the ethereal liquid; the brown odorous residue yields to boiling water vanillin, which is purified by recrystallization and treatment with animal charcoal. Vanillin crystallizes in hard colorless, four-sided prisms; has the odor of vanilla, and a pungent, warm taste; is fusible and sublimable; has a feeble acid reaction, and is freely soluble in boiling water, in alcohol, ether, fats, and volatile oils. It does not decompose alkaline carbonates, but dissolves in caustic alkalies, and is precipitated unaltered from the solutions on the addition of an acid. On account of its feeble acid properties, Stokkebye (1864) proposed to name it *vanillic acid.* Carles (1870) found its formula to be $C_8H_8O_3$, and this was corroborated by Tiemann and Haarmann (1874), who prepared vanillin artificially from *coniferin*, $C_{16}H_{22}O_8$, a compound contained in the sap of coniferous trees; this, on being treated with emulsin, is split into sugar and another compound, $C_{10}H_{12}O_3$, which, on being oxidized with a mixture of sulphuric acid and potassium bichromate, like coniferin itself, yields vanillin. Vanillin was recognized as the methylic aldehyd of protocatechuic acid, and is converted into this compound by fusing it with caustic potassa, carbonic acid being produced at the same time. The same authors proposed (1875) to estimate the amount of vanillin by completely exhausting not less than thirty grams of cut vanilla with ether, concentrating the ethereal tincture, agitating the ethereal liquid repeatedly with solution of bisulphite of sodium, decomposing the mixed aqueous liquids with dilute sulphuric acid, and dissolving the liberated vanillin by agitation with ether. Mexican vanilla yielded 1.7, Java vanilla 2.75, and Bourbon vanilla 1.9 to 2.5 per cent. of pure vanillin; the last two varieties were found to contain, in addition, an oily matter having a disagreeable odor. Tiemann (1875) also showed that vanillin may be obtained from carbolic acid, and that coniferin, on being oxidized with potassium permanganate, yields *vanillic acid*, $C_8H_8O_4$, having a slight vanilla-like odor.

Leutner's analysis (1871) agrees well with that of Bucholz; but he obtained 6.6 per cent. of sugar and 10 per cent. of gum; also 6 to 7 per cent. of ash.

The poisonous effects repeatedly observed to be due to the use of vanilla as a flavor for ices have been referred by Schroff, in the absence of metallic poisons, to the presence of cardol, resulting from the alleged employment of the fixed oil of the cashew nut (see p. 171) for improving the appearance of vanilla.

Pharmaceutical Uses.—Vanilla is employed in perfumery and as a flavoring ingredient in Troch. ferri subcarb. and Troch. potassii chloratis, *U. S.*

VANILLA SACCHARATA, *P. G.*, consists of one part of finely cut vanilla and nine parts of sugar, triturated together until a grayish-white uniform powder is obtained.

ESSENCE OF VANILLA.—*Fluid extract of vanilla* is generally made either by percolation or by digestion in a closed vessel, so that a pint of the preparation represents one ounce of vanilla. This is cut fine and beaten with twice its weight of sugar until a uniform powder is obtained, which is exhausted with alcohol of about 60 per cent. strength. *Syrup of vanilla* is made by mixing simple syrup with sufficient essence of vanilla until the desired flavor is obtained.

Medical Action and Uses.—In Mexico, its native country, the Spanish conquerors found vanilla in common use for flavoring chocolate, and for this purpose it still continues to be extensively used. Very probably it promotes the digestion of this aliment, as it does that of many other fatty and farinaceous articles of food, and therefore may be classed with the aromatics. In its action it has some analogy with balsam of Peru. Like the aromatics generally, aphrodisiac qualities are attributed to it. In medicine it is rarely employed alone, but it may be prescribed in powder, in doses of from five to thirty grains mixed with sugar. A syrup made with it is an agreeable flavoring ingredient of mixtures. It may be added also to troches for a similar purpose, as it is in the officinal troches of subcarbonate of iron.

VAPORES.—INHALATIONS.

These are mixtures, consisting of water with a volatile substance, which are perhaps never made by the apothecary, and appear to be better adapted for extemporaneous prescription. The *vapores*, as originally employed in medicine, are external applications.

VAPOR ACIDI HYDROCYANICI, *Br.*—INHALATION OF HYDROCYANIC ACID.

Take of Diluted Hydrocyanic Acid ten to fifteen minims; Water (cold) one fluidrachm. Mix in a suitable apparatus and let the vapor that arises be inhaled. *Br.*

Medical Action and Uses.—The "inhalation of hydrocyanic acid" is too dangerous a remedy to be recommended under any circumstances. The difficulty, if not impossibility, of determining the exact strength of the solution, the various degrees of susceptibility to its action, and the promptly fatal effects of an overdose inhaled, should condemn it as a medicine.

VAPOR CHLORI, *Br.*—INHALATION OF CHLORINE.

Take of Chlorinated Lime two ounces; Water (cold) a sufficiency. Put the powder into a suitable apparatus, moisten it with the water, and let the vapor that arises be inhaled. *Br.*

Medical Uses.—This preparation is a convenient means of obtaining chlorine for inhalation; but the necessity of making it officinal by prescribing the exact amount of chlorinated lime to be used, is the reverse of apparent.

VAPOR CONIÆ, *Br.*—INHALATION OF CONIA.

Take of Extract of Hemlock sixty grains; Solution of Potash one fluidrachm; Distilled Water ten fluidrachms. Mix. Put twenty minims of the mixture on a sponge, in a suitable apparatus, so that the vapor of hot water passing over it may be inhaled. *Br.*

The potassa is added for the purpose of liberating the conia contained in the extract.

Medical Uses.—The proportion of extract of conium directed for this inhalation must vary according to the strength of the preparation used, which, being very uncertain, the "inhalation" cannot be of uniform power.

VAPOR CREASOTI, *Br.*—INHALATION OF CREASOTE.

Take of Creasote twelve minims; Boiling Water eight fluidounces. Mix the creasote and water in an apparatus so arranged that air may be made to pass through the solution, and may afterwards be inhaled. *Br.*

Medical Uses.—This "inhalation" also appears to be a very superfluous officinal preparation. The proportion of creasote used should vary with the condition it is intended to remedy.

VAPOR IODI, *Br.*—INHALATION OF IODINE.

Take of Tincture of Iodine one fluidrachm; Water one fluidounce. Mix in a suitable apparatus, and, having applied a gentle heat, let the vapor that arises be inhaled. *Br.*

Medical Uses. According to our experience the proportion of tincture of iodine in this "inhalation" is entirely too large for ordinary use if the iodine is vaporized rapidly. The proportion of tincture of iodine used should be left to the judgment of those who are skilful enough to use the preparation at all. Conia, creasote, and iodine are much more efficaciously used by inhalation in atomized solutions.

VERATRIA, *U. S.*, *Br.*—VERATRIA.

Veratrinum, P. G.—*Vératrine*, Fr.; *Veratrin*, G.

Formula $C_{32}H_{52}N_2O_8$. Molecular weight 592.

Preparation.—Take of Cevadilla in moderately fine powder twenty-four troyounces; Alcohol, Sulphuric Acid, Magnesia, Water of Ammonia, Purified Animal Charcoal, Water, each a sufficient quantity. Digest the cevadilla with eight pints of alcohol for four hours in a distillatory apparatus with a heat approaching to boiling, and pour off the liquid. To the residue add eight pints more of alcohol mixed with the portion distilled, and, having digested for an hour, pour off the liquid as before. Digest for a third time with the same quantity of alcohol, together with the portion last distilled, and again pour off. Press the remains of the cevadilla, mix and strain the liquids, and, by means of a water-bath, distil off the alcohol. Boil the residue three or four times in water acidulated with sulphuric acid, mix and strain the liquids, and evaporate to the consistence of syrup. Add magnesia in slight excess, shake the mixture frequently, then express, and wash what remains. Repeat the expression and washing two or three times, and, having dried the residue, digest it with a gentle heat several times in alcohol, and strain after each digestion. Distil off the alcohol from the mixed liquids, boil the residue for fifteen minutes in water mixed with a little sulphuric acid and purified animal charcoal, and strain. Having thoroughly washed what remains, mix the washings with the strained liquid, evaporate with a moderate heat to the consistence of thin syrup, and drop in sufficient water of ammonia to precipitate the veratria. Lastly, wash the alkaloid with water, and dry it with a gentle heat. *U. S.*

Take of Cevadilla two pounds; Distilled Water, Rectified Spirit, Solution of Ammonia, Hydrochloric Acid, each a sufficiency; Purified Animal Charcoal sixty grains. Macerate the cevadilla with half its weight of boiling distilled water in a covered vessel for twenty-four hours. Remove the cevadilla, squeeze it, and dry it thoroughly with a gentle heat. Beat it now in a mortar, and separate the seeds from the capsules by brisk agitation in a deep, narrow vessel, or by winnowing it gently on a table with a sheet of paper. Grind the seeds in a coffee-mill, and form them into a thick paste with rectified spirit. Pack this firmly in a percolator, and pass rectified spirit through it till the spirit ceases to be colored. Concentrate the spirituous solution by distillation, so long as no deposit forms, and pour the residue, while hot, into twelve times its volume of cold distilled water. Filter through calico, and wash the residue on the filter with distilled water, till the fluid ceases to precipitate with ammonia. To the united filtered liquids add the ammonia in slight excess, let the precipitate completely subside, pour off the supernatant fluid, collect the precipitate on a filter, and wash it with distilled water till the fluid passes colorless. Diffuse the moist precipitate through twelve fluidounces of distilled water, and add gradually with diligent stirring sufficient hydrochloric acid to make the fluid feebly but persistently acid. Then add the animal charcoal, digest at a gentle heat for twenty minutes, filter, and allow the liquid to cool. Add ammonia in slight excess, and, when the precipitate has completely subsided, pour off the supernatant liquid, collect the precipitate on a filter, and wash it with cold distilled water till the washings cease to be affected by nitrate of silver acidulated with nitric acid. Lastly, dry the precipitate first by imbibition, with filtering paper, and then by the application of a gentle heat. *Br.*

Both Pharmacopœias use only the seeds for preparing veratria. Schroff (1863), however, has shown that the capsules are very poisonous, and probably contain veratria. Alcohol extracts from sabadilla seeds the alkaloid veratria in its natural combination with veratric acid. On evaporating the alcohol, diluting the syrupy liquid with water, and filtering from the resin, the liquid contains veratrate of veratria, and should the water have been acidulated with sulphuric acid, sulphate of veratria is in solution, while the nearly insoluble veratric acid remains on the filter. The dissolved veratria salt may be decomposed by ammonia, potassa, lime, magnesia, or similar bases, and the alkaloid thus isolated requires to be purified by washing with water, and to be treated with alcohol to separate it from excess of magnesia or lime, after which it may be dissolved in a dilute acid, and freed from coloring matter by animal charcoal; ammonia will then precipitate veratria as a white powder.

Several other processes have been recommended for the preparation of veratria, in which advantage is taken of the ready solubility of the alkaloid in acidulated water. Delondre (1855) exhausts the powdered seeds by percolation with water acidulated with hydrochloric acid, precipitates with potassa, and exhausts the washed and dried precipitate with ether, on the evaporation of which the alkaloid is left behind. Merck's process is somewhat similar; powdered sabadilla is boiled with very dilute hydrochloric acid, the solution concentrated to a syrupy consistence, and further acidulated with hydrochloric acid as long as a precipitate of veratric acid appears. The filtrate is precipitated with lime; the precipitate is collected and exhausted with alcohol; the alcohol is distilled off, and the residue dissolved in dilute acetic acid. On the addition of ammonia, veratria is precipitated; it is obtained as a crystalline powder by dissolving it in ether and evaporating.

Properties.—As obtained by the officinal processes, veratria is a whitish amorphous powder, without odor, powerfully sternutatory, and very irritating to the nostrils, and has a persistently acrid taste. It imparts to water an acrid taste, but requires about 1000 parts of this liquid for solution; it has an alkaline reaction to test-paper, forms with acids crystallizable or amorphous salts, and when heated, melts and afterwards is decomposed, forming a spongy charcoal, and is finally dissipated without leaving any residue. Veratria is soluble in 3 parts of alcohol, and dissolves in about 6 parts of ether (*Delondre*), 8.6 parts of chloroform (*Schlimpert*), 96 parts of glycerin (*Cap and Garot*), and 56 parts of olive oil (*Pettenkofer*). Concentrated sulphuric acid dissolves veratria with a deep-red color, which gradually fades; nitric acid imparts to it a yellow color. Its solution in concentrated hydrochloric acid acquires by heat a deep red color (Trapp's test, 1862).

Impurities.—The behavior just described establishes the purity of veratria. On being ignited upon platinum foil, no residue should be left.

Composition.—The formula given above is that ascertained by Merck for the crystalline alkaloid. According to E. Schmidt (1877) commercial veratria contains three distinct modifications, namely, a crystalline base soluble in water, and two amorphous bases, one of which is soluble, the other insoluble in water. The crystalline base predominates, and is regarded by Schmidt as veratria proper; he gives it the formula $C_{32}H_{50}NO_9$; its platino-chloride was found to be easily soluble in alcohol, less soluble in water, and insoluble in ether. The amorphous modifications appear to have the same formula, which differs from that given by Merck chiefly in the amount of nitrogen. For other views concerning the constitution and characters of veratria, see page 1204.

Off. Prep.—Unguentum veratriæ, *U. S.*, *Br.*

Physiological Action. *On Animals.*—The action of this alkaloid has been illustrated by numerous experimenters who agree substantially in their description of it. Administered in moderate doses to hogs, horses, and other quadrupeds, it occasions anxiety and restlessness, a profuse secretion of saliva, colic, vomiting, and purging (the last effects whether the agent is administered by the mouth or hypodermically), general muscular debility, and some spasmodic movements. Under the influence of larger doses the nervous phenomena, spasmodic as well as paralytic, are more marked; the limbs are unable to support the body; the action of the heart becomes slow, irregular, and intermittent, and the respiration deep and labored, the vomiting is violent, and the stools may be bloody. In directly fatal doses veratria depresses the whole nervous system; the respiration and circulation are gradually suspended, the convulsive movements pass into tetanus, the rigidity of the muscles of the chest impede respiration, and death takes place by asphyxia. Accordingly, after death, the lungs and heart are found gorged with blood, and the latter organ has lost its irritability; but there is no trace of inflammation of the stomach. The tetanizing and paralyzing actions of veratria appear to occur as direct effects of the poison upon the muscles, and not through the intervention of the spinal cord, for they may take place in the muscles of a limb whose nervous connection with the spinal marrow is destroyed; and, conversely, they do not occur when all other connections are severed, while the spinal nerves communicating with the limb are left intact. That the tetanizing effect results, not from an action of the poison upon the spinal marrow, but from a direct action upon the muscles or upon the ends of the nerves, is also to be inferred from the fact that in the animal operated upon tetanic spasm is not excited by a direct mechanical irritation of the nerves, but by the voluntary muscular acts of the animal. It also follows irritation of the muscles themselves, which may then take on prolonged, and even permanent, tetanic contraction until their vitality is completely exhausted.

On Man.—Veratria has a bitter and acrid taste, and even the least portion of it placed upon the tongue produces a peculiar and persistent numbness and tingling, with irritation of the throat and salivation. The minutest quantity of it introduced into the nostrils, and even the casual approach of a vial containing it to the nose, occasions protracted irritation and sneezing, and sometimes coughing. Applied in alcoholic solution or in an ointment to the sound skin, it produces a slight prickling sensation, and upon very delicate portions of the integument a pain compared to that which might be occasioned by its puncture with hot needles. The pain, however, is transient, and is followed by a sense of coolness and numbness. If the preparation is strong and is applied with friction, an eruption of vesicles may follow. If well rubbed in, particularly upon the face, slight twitching of the muscles is sometimes observed, and, more rarely, formication, which extends to remote parts of the body. Applied to the denuded skin, or injected hypodermically, it causes severe pain, muscular twitching, and the ordinary effects of its internal administration. These effects vary with its dose. The fortieth and from that to the twentieth of a grain occasions tingling which begins in the fingers and toes, and thence extends to the whole body, followed by a sense of numbness in the same parts, and more or less lowering of the pulse. If the usual limit of medicinal doses is exceeded, and from one-twentieth to one-tenth of the alkaloid or of its acetate is taken, there may occur great faintness and pallor; increased frequency, irregularity, and weakness of the pulse; nausea and vomiting, usually of bilious liquids; diarrhœa, sometimes with bloody stools; cold sweating and muscular twitching; and aching along the spine. If the dose is repeated at intervals, the gastro-intestinal symptoms subside, but the pulse falls considerably below the normal rate. There is also a good deal of irritation and constriction of the fauces, with secretion of mucus.

A woman who swallowed about three grains of veratria in a liniment containing chloric ether and opium, was affected with giddiness, faintness, nausea, thirst, diarrhœa, tenesmus, and constriction of the abdomen; the tongue was swollen, the mouth and throat sore, the pupils contracted, the breathing hurried, the pulse small and quick, the action of the heart feeble. There was extreme itching of the skin which lasted for several days, a tingling which did not cease for two months, and a peculiar spasmodic snapping of the lower jaw.

Medical Uses.—Veratria was used first internally as a remedy for *neuralgia*, and in the most obstinate form of that affection, *sciatica*, which so often depends upon material alterations of structure. It is now very seldom given internally in this or in any other variety of neuralgia, but is of common use as a topical application in all the functional forms of the affection. Although inferior for this purpose to aconitia, it is, nevertheless, efficient in many cases of neuralgia of the fifth pair, of the intercostal nerves, and others. Very probably it acts both by obtunding the sensibility of the painful part, and also by its counter-irritant operation upon the skin, when it is applied in due strength directly to the sensitive points of the nerve. It is sometimes injected hypodermically, one-sixth of a grain at a time; but the officinal ointment of veratria is preferable. It is rendered much more efficient by the addition to each drachm of it of two or three grains of muriate or sulphate of morphia.

In the treatment of *acute articular rheumatism* this medicine has been systematically employed, by beginning on the first day of the treatment with a single dose of one-thirteenth of a grain, and each successive day by giving an additional dose until the sixth or seventh day, unless the disease sooner yielded or the toxical effects of the medicine were developed. In the latter case it was suspended, or its dose diminished. It was claimed for this treatment that it speedily reduced the fever and subdued the pain of the disease, and that in a patient of unimpaired constitution it frequently triumphed over an acute attack of the disease in a week. It was further asserted that it did not, like copious bloodletting, exhaust the patient's strength and develop anæmia. This advantage over the older sanguinary method may be admitted, but there is not a shadow of evidence to demonstrate its power of shortening an attack of rheumatism, or, above all, of preventing the most serious of the ordinary complications of the disease, inflammation of the heart and its membranes. Indeed it is seldom employed at present; and those who imagine that the cure of rheumatism consists in repressing certain of its symptoms, find in the preparations of green hellebore equally efficient and less dangerous agents. The same remark is literally applicable to the use of veratria in *pneumonia.* The strongest reason that could be found by an eminent therapeutist for employing veratria in this disease was that the "results from its use appear to be comparable to those of the antimonial treatment" (Trousseau). But since the latter is one of the most mischievous that was ever employed, the merit of the former may be duly estimated. If some will use this medicine, as they would green hellebore, digitalis, aconite, etc., in febrile affections, they should be prepared with diffusible stimulants to combat its sedative effects when they grow alarming.

Veratria has occasionally been used to allay disordered action of the *heart* in acute and also in chronic diseases of that organ, and it may sometimes become a useful palliative of this distressing symptom, and thereby even avail to diminish cardiac dropsies. But for such purposes other preparations of veratrum are preferable. It is unnecessary to discuss its virtues in eruptive fevers, or in typhoid fever for which it has usually been prescribed, or in nervous affections such as whooping-cough, chorea, hysteria, and functional paralysis; or to do more than state the fact of its having been applied topically to reduce enlarged glands, scrofulous swelling of joints, etc.

Administration.—Owing to its very acrid taste, veratria is generally given internally in pilular form in doses varying from one-fortieth to one-fourth of a grain. The dose should be rapidly, but cautiously, increased from the minimum until nausea or slowing of the pulse occurs. Externally, the officinal ointment is a convenient preparation for application by friction, which should be made with a mop, or with the finger guarded by a glove, and until a feeling of burning or prickling is perceived by the patient. Solutions in oil and in glycerine may be applied in the same manner. For endermic use from one-eighth to one-half of a grain mixed with starch may be prescribed. Hypodermically, one-sixth of a grain may be employed at a single operation; but the method is objectionable on account of the pain it occasions and the probability of abscess being caused by it.

VERATRUM ALBUM, *U. S.*—WHITE HELLEBORE.

Rhizoma veratri, P. G.; *Radix hellebori albi.*—*Vératre blanc*, Fr.; *Weisse Nieswurzel*, *Weisser Germer*, G.

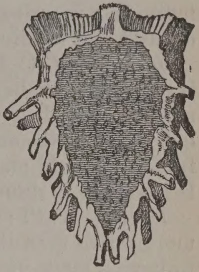
The rhizome of Veratrum album, *Lin.* *Nat. Ord.*—Melanthaceæ.

Origin.—Veratrum album is an herbaceous perennial, growing in moist meadows of the Pyrenees and Alps, and eastward throughout Russia, Siberia, Northern China, and Japan. It has likewise been found in Colorado, and probably exists in other parts of Western North America. The stem is two to four feet high, and has numerous alternate elliptic, or broadly oval, entire leaves, which are about six inches long, strongly ribbed, and plicate, and sheathing at the base; the upper ones are smaller, narrower, and lanceolate in form. The inflorescence is a large racemose panicle, twelve to eighteen inches long, with polygamous flowers, having six spreading lance-oblong, yellowish-white, and externally green sepals. The three-horned fruit consists of three partly united follicles, containing numerous flattened and winged seeds. The rhizome is collected in autumn.

VERATRUM LOBELIANUM, *Bernh.*, is found in Europe, and is considered to be a variety of the preceding, which it closely resembles, differing chiefly in the more simple inflorescence, the longer bracts, and the pale green flowers.

Description.—The rhizome of white veratrum is upright, obconical in shape, simple or occasionally divided above into two branches; it is two to three inches long, and one and a half or two inches thick, tufted above with the remnants of the leaf-bases, truncate below, the lower half beset with dead, and the upper portion with fleshy nearly simple rootlets, which shrink considerably in drying. In the commercial drug the rootlets have been cut off close to the rhizome, and this has been occasionally divided to facilitate the drying. The rhizome is somewhat annulate, externally of a dull blackish-gray color, tuberculated above with yellowish-white root-remnants, and marked below with grayish scars. Internally it is of a whitish or grayish-white color, and shows upon transverse section, at a distance of about one-eighth inch from the outer surface, a brownish, wavy nucleus-sheath, and in the inner portion numerous small wood-bundles, which are irregularly scattered, more crowded near the nucleus-sheath, and irregularly curved in various directions. The tissue outside of the nucleus-sheath contains only a few small wood-bundles, passing into the rootlets. The nucleus-sheath and the short curved and scattered wood-bundles are also observed on the longitudinal section. The drug is inodorous, but its dust is strongly sternutatory; its taste is bitterish and burningly acrid.

Fig. 199.



Veratrum album, *Lin.* Longitudinal section of rhizome.

Constituents.—Pelletier and Caventou (1820) obtained from white veratrum liquid and solid fat, a volatile acid, gum, starch, and an alkaloid, which they declared to be identical with *veratria*, and to be combined with gallic acid. The existence in veratrum of gallic acid was, however, denied by Pfaff and by Weigand (1841). The latter found in it about 10 per cent. of pectin. E. Simon (1838) announced the isolation of a second alkaloid, *jervia*, $C_{30}H_{46}N_2O_3$. After Charles Bullock (1865) had proved the non-existence of veratria in veratrum viride, Dragendorff (1872) announced its absence also from white veratrum, and this observation was corroborated by C. L. Mitchell (1874), who found in it, besides jervia, a second alkaloid, which he named *veratralbia*.

Jervia, when pure, is a white powder, crystallizes from alcohol, is tasteless, not sternutatory, insoluble in water and ether, and soluble in alcohol and chloroform. Its salts with acetic and phosphoric acids are soluble in water, and these solutions are precipitated by sulphuric, hydrochloric, and nitric acids and their soluble salts. According to Bullock (1875) its acetic acid solution, treated with potassium nitrate, affords a ready method for obtaining the alkaloid in a pure state. Sulphuric acid colors jervia yellow, changing to green, and finally to turbid yellow; on the addition of bromine the green color changes to a faint brownish tint. The other color reactions (yellow by nitric and boiling hydrochloric acid) are not very characteristic.

Veratralbia is white, uncrystallizable, bitter, burningly acrid, and violently sternutatory. It dissolves in alcohol, amylic alcohol, ether, chloroform, carbon bisulphide, and in dilute acids forming soluble and uncrystallizable salts. It melts near 170° C. (338° F.), and sublimes in small feathery crystals. In its behavior to reagents it closely resembles *veratroidia*, and is regarded by Tobien (1877) as being identical with it.

Weppen (1872) could not find Weigand's pectin, and leaves it undecided whether the presence of that compound is due to an adulteration or to the period at which the rhizome had been collected. Pelletier and Caventou's gallic acid was recognized as a new acid, called jervic acid, and the coloring matter as *veratramarin*, a light yellow, very bitter, and deliquescent neutral principle, which is present in very minute quantity, so that sixty pounds of the rhizome yielded a quantity insufficient for a thorough chemical investigation. Veratramarin is easily soluble in water and alcohol, insoluble in ether, benzol, chloroform, and petroleum-benzin, and is precipitated from its solutions by subacetate of lead and tannin.

Jervic acid, $C_{14}H_{10}O_{12}.2H_2O$, is a white crystalline powder, has an acid taste, is insoluble in benzol, carbon bisulphide, chloroform, petroleum-benzin, and amylic alcohol, is very sparingly soluble in absolute alcohol and ether, and requires more than one hundred parts of cold water for solution. The acid is neither fusible nor sublimable; its silver salt crystallizes from the solution in hot water, is insoluble in dilute nitric acid, and is not altered on exposure to light.

Dr. Jos. Waltl (1828) considered the rhizome with the rootlets attached to be more active than the rhizome alone, and Schroff (1860) announced the rootlets to have a more powerful action than the rhizome, and somewhat different from it.

Medical History.—White hellebore, or hellebore, as it was distinctively called by the Greeks, was used by them in the treatment of chronic diseases rebellious to ordinary remedies, such as insanity, especially melancholy, dropsy, diseases of the skin, tetanus, gout, hydrophobia, tic douleureux, etc. It was always associated with lenitives to moderate its violent action. It gradually fell into disuse.

Physiological Action. *On Animals.*—White hellebore is poisonous to all animals. Its effects are nearly the same when, experimentally, it is introduced into the system by the stomach or the bloodvessels. They consist of retching or vomiting, salivation, general debility, a small, feeble, irregular, or rapid pulse, slow and labored breathing, spasm of the abdominal muscles, general tonic or clonic convulsions, tremulousness and tottering, urination, sweating, contracted pupils, and insensibility. After death the lungs are congested, and when the poison has been taken by the stomach, its mucous membrane is very red.

On Man.—When taken internally in poisonous doses, it occasions soreness of the mouth and swelling of the tongue, a burning heat in the stomach, and vomiting, anxiety, tremor, vertigo, weakness of the limbs, syncope, aphonia, interrupted respiration, a feeble pulse, convulsions, sinking, distortion of the eyes, dilated pupils, blindness, mental aberration, prolonged insensibility, and cold sweating. Among these symptoms purging is not mentioned, but it occurs under the prolonged use of the drug. When death has directly resulted from poisoning by this drug, signs of active gastro-intestinal inflammation and congestion of the lungs have been found. In poisoning with recovery there has been observed for several days debility, tremulousness, muscular twitching, and a sense of constriction and distress in the præcordial region.

Medical Uses.—White hellebore is hardly now used as an internal medicine. Externally it has been applied in decoction to destroy *vermin* in man and beast, and for the relief of *pruritus vulvæ*. It was formerly employed in the treatment of *itch*. Its irritant properties caused it to be used as an *errhine*, when diluted with starch or some other inert powder, or with snuff. In this way it is sometimes made use of to relieve the frontal headache which occurs in some cases of *coryza*. If the drug is administered internally, the commencing dose should not exceed one or two grains.

VERATRUM VIRIDE, *U. S.*—AMERICAN HELLEBORE.

Veratri viridis radix, Br.—*Green hellebore root, Indian poke*, E.; *Vératre vert*, Fr.; *Grüner Germer*, G.

The rhizome of Veratrum viride, *Aiton.* *Nat. Ord.*—Melanthaceæ.

Origin.—The green veratrum grows in swampy places and on the border of damp thickets in Canada and the United States as far south as Georgia. It resembles the white veratrum so closely that no important botanical difference between them can be ascertained, and Asa Gray remarks that it is "much too near Veratrum album of Europe." It more especially resembles the green flowering variety *lobelianum*, and Regel (1861) regarded it as identical with a variety growing in Eastern Siberia. Its flowers are yellowish-green, and appear in June. The rhizome is collected in autumn.

Description.—The rhizome agrees in size, shape, color, taste, and structure so closely with that of white veratrum that it is difficult if not impossible to distinguish the two drugs, if they have been trimmed alike. The American veratrum is nearly always dried with the rootlets attached, and these are four or six inches long, about one-tenth of an inch thick, much shrivelled, and of a light yellowish-brown color; those on the lower part of the rhizome, if present, are thinner and black. We have occasionally found considerable portions of the leaf-stalks and stem present in the commercial drug; these parts appear to be inert, or nearly so, and should be rejected.

Constituents.—H. W. Worthington (1838) isolated an alkaloid from green veratrum which he regarded as identical with veratria. The same conclusion was arrived at by J. G. Richardson (1857) and by G. J. Scattergood (1861). But Charles Bullock (1865) proved that American veratrum contains two alkaloids, neither of which is identical with veratria. These alkaloids were subsequently named by Prof. G. B. Wood *viridia* (insoluble in ether) and *veratroidia* (soluble in ether). E. Peugnet (1872) recognized the so-called viridia as impure *jervia*, and C. L. Mitchell (1874) made the same observation. In the same year Mitchell characterized *veratroidia* as follows: It is a white uncrystallizable powder, of a bitter taste, leaving a tingling sensation in the fauces, violently sternutatory, and extremely irritating. It fuses near 130° C. (265° F.), is soluble in alcohol, amylic alcohol, ether, chloroform, carbon bisulphide, and when freshly precipitated slightly in petroleum-benzin. It forms soluble salts with the acids, most of which are uncrystallizable. Sulphuric acid colors it yellow, changing to dark red. Boiling hydrochloric and nitric acids color it yellow. Tobien's (1877) elementary analysis leads to the formula $C_{51}H_{78}N_2O_{16}$, or to $C_{24}H_{37}NO_7$. He obtained both jervia and veratroidia also from the rhizome and the young leaves of *Veratrum lobelianum*, and found in the dried rhizome of *Veratrum album* but little jervia and a larger quantity of veratroidia. C. A. Robbins (1877) announced that he had isolated from American veratrum, besides jervia, another crystallizable alkaloid, which is soluble in ether, and which produces with sulphuric acid and sugar a yellow color changing to blue, and with sulphuric acid a yellow color quickly changing to pink-red, and after several hours to indigo-blue; presence of jervia or of coloring matter prevents the appearance of the blue color. Whether it is veratroidia in a purer state remains to be investigated.

In the investigations recorded above, no notice has been taken of the probable difference in the composition of the rootlets and rhizome, as suggested by Prof. Schroff.

The rhizome of American, like that of the white veratrum, contains considerable resin, from which the alkaloids are not easily purified.

Off. Prep.—Extr. veratri vir. fluid., *U. S.*; Tinct. veratri viridis, *U. S.*, *Br.*

Medical History.—Green hellebore was well known to the aborigines of this country for its poisonous properties, and was subsequently used by farmers to poison the birds that ravaged their crops. It was also employed at a later period (1835) in the treatment of various fevers and inflammations; but its vogue remained local until 1850, when extravagant accounts of its virtues were widely disseminated. Since that time it has been more generally used both at home and abroad, but chiefly by those physicians who disregard the interdependence of morbid phenomena, forget that the suppression of a symptom is not the cure of a disease, and overlook the consideration that while the exhibition of fever may be prevented, the causes of fever may be destroying life.

Physiological Action. *On Animals.*—Birds poisoned by corn soaked in an infusion of green hellebore, have their muscular power temporarily so much impaired as to prevent their flying or walking. The alkaloids and resin, given internally, occasion prolonged vomiting, salivation, prostration, and slowing of the pulse. The tincture injected hypodermically in frogs, dogs, and rabbits, causes the pulse to fall as much as 40, 50, or even 100 beats in a minute, while the temperature declines to between one and five degrees, Cent., and the breathing grows slow and irregular. In animals that vomit, vomiting and purging precede the other symptoms. The most conspicuous symptom is complete prostration, which no stimulants overcome, but which, in course of time, ceases spontaneously. According to Dr. H. C. Wood, veratroidea slows the respiration, and ultimately produces asphyxia, while the pulse beats rapidly. But until asphyxia threatens, the heart and pulse act more slowly, and the blood-pressure is reduced; and if asphyxia is prevented by artificial respiration, the pulse continues to fall. In all doses it affects the respiration, but only in large doses appears to act directly upon the cardiac muscles. Its power of lowering the pulse-rate appears to be exercised through the par vagum. Like many other medicines, it produces opposite effects, inhibitory or stimulating, according as the dose is large or small. Poisonous doses are sufficient to neutralize the influence of the most intense faradaic currents. Viridia (or jervia), according to the same authority, in its action upon the circulation as compared with its influence upon the respiration, is much more powerful than veratroidea. Like veratroidea, it slows the pulse, and lessens the arterial pressure by a direct action upon the cardiac muscles and upon the vaso-motor centres. It seems not to affect the inhibitory and accelerator nerves of the heart, as veratroidea does.

On Man.—Green hellebore is a powerful irritant. Its powder, snuffed into the nostrils, causes violent and prolonged sneezing. Applied to the skin in a moist state it occasions redness and burning. Taken internally in full doses it excites nausea, with prolonged and violent vomiting, sometimes accompanied by purging, and a reduction of the force and frequency of the pulse, and the animal temperature. The pulse may be reduced to thirty-five or forty in a minute, and in some exceptional cases to twenty-two. Excessive doses give rise to the following symptoms: faintness, somnolency, coma (?), dimness of sight, dilatation of the pupils, vertigo, headache, rarely delirium, impaired muscular power, general numbness, slow and infrequent respiration, hiccup, a pale cold skin covered with a clammy sweat, persistent vomiting, excruciating pain in the præcordium, flatulence, profuse watery diarrhœa in some cases, and a small, infrequent, and feeble pulse. It is remarkable that diarrhœa so rarely is present as an effect of excessive doses of this medicine; and that, notwithstanding the sedation of the heart, and the general appearance of collapse produced by them, no case of fatal poisoning of an adult by green hellebore should have been recorded. It is said to have caused death in two cases of children, the one eighteen months, and the other eleven months old. Green hellebore has been supposed to be an abortifacient; but there is no evidence that it is so, except in so far as all violent emetics may produce abortion.

Medical Uses.—The greater number of reports which have been published concerning the medicinal uses of green hellebore are, unfortunately, not only deficient in the details on which a judgment could securely rest, but exhibit great ignorance of the natural history of disease, and of the relations of medicines to its cure. There are many reporters who attribute to this medicine equal curative virtues in asthenic and sthenic diseases, in inflammations and in fevers, and not a few who extol its virtues when it formed only one of several active agents simultaneously administered to the patient. The only conclusion to be drawn from a critical study of the mass of conflicting evidence respecting its use in the diseases referred to, is that the patients would have been better off not only without its use, but also without that of the medicines associated with it. The suggestion has been made that the effects of veratrum viride and of depletion are so similar that the drug may serve as a substitute for that operation. Upon which it may be remarked, that the condemnation of venesection *upon scientific grounds* has been so general and complete, that to advocate a medicine on account of its supposed analogy to depletion is not to recommend it. Nor should it be forgotten that this identical reason was at one time urged in favor of substituting digitalis for depletion. Now veratrum viride and digitalis are physiological antagonists. But venesection does much more than reduce the pulse-rate in inflammatory affections (and, indeed, in comparison with green hellebore, its action is, in this respect, very insignificant), it takes away from the blood a portion of the solids which sustain the inflammatory process, and supplies their place with water; it also removes from the system a portion of the effete matters produced by inflammation, and which tend to convert the circulating fluid into a poison. Cardiac sedatives, of which the medicine under consideration is the type, tend to retain in the blood all that is injurious in it; and hellebore at the same time reduces the patient to a state of such wretchedness that he is unable to take food, or to digest it if he ate it, or even to find energy enough to cling to that last refuge of sufferers, hope.

There is but one class of cases in which the utility of this medicine is presumable, cases of imminent or commencing congestion or inflammation, in which the maintenance of its sedative action on the heart for a short period allows the conservative powers of the system to operate within normal limits. This statement applies to certain *wounds* which tend to dangerous results, like those of the head, pericardium and heart, and peritoneum. The comparative immobility in which the inflamed parts are maintained by the infrequent arterial movement, may favor their cure. In some cases of organic *heart disease*, as well as of *nervous palpitation*, this medicine is reported to have afforded great relief, probably by allowing the heart sufficient rest for recovering its power. Apparently it would be unsuited for the treatment of cardiac affections depending upon absolute debility of the organ. It has been used with alleged benefit in *puerperal mania*, *puerperal convulsions*, *epileptiform convulsions*, and *mania-à-potu*. In a case of persistent *priapism* affecting only the corpora cavernosa, and after failure to reduce it by means of many medicines, including tartar emetic, belladonna, and bromide of potassium, the penis began to be relaxed as soon as veratrum viride had reduced the pulse to 50. (Walker.)

Externally, tincture of green hellebore is used as a discutient and anodyne.

The proper remedies in poisoning by this drug are diffusible stimulants, and especially alcohol, which should be given by the rectum if the patient vomits. Its efficacy is shown by the case of a physician who took an ounce of the tincture at one draught; so completely did the alcohol counteract the green hellebore of the preparation, that, except nausea, vomiting, and some dyspnœa, no evil results followed. Besides alcohol, ammonia may be administered, and sinapisms should be applied over the heart. During the treatment the patient's head should be kept as low as his body, or even lower.

Administration.—Green hellebore may be administered in powder in the dose of two grains; but the liquid preparations are more eligible. Of these the fluid extract and the tincture are officinal; the dose of the former is from one to three drops, and of the latter from four to eight drops. They should be given at intervals of about three hours. Their tendency to cause vomiting may be prevented by the administration of from five to ten drops of deodorized laudanum ten or fifteen minutes before each dose. As soon as the pulse begins to fall the dose should be diminished. Females and growing persons ought not to take doses exceeding two-thirds of those mentioned; and for children from one to five years old a sufficient quantity is one drop of the tincture. From ten to fifteen minims of the tincture, largely diluted with water, have been administered hypodermically.

VERBASCUM.—Mullein.

Molène, Bouillon-blanc, Fr.; *Wollkraut, Königskerze*, G.

Verbascum thapsus, *Lin.*, and other species of Verbascum.

Nat. Ord.—Scrophulariaceæ.

Origin.—The genus Verbascum consists of tall, more or less woolly, biennial or perennial herbs, with the flowers in dense spikes or paniculate racemes. The flowers have a five-parted calyx, a wheel-shaped somewhat unequally five-lobed corolla, five more or less woolly stamens, and a two-celled, two-valved, and many-seeded capsule. Three species, Verb. blattaria, *Lin.*, V. lychnitis, *Lin.*, and V. thapsus, *Lin.*, have been naturalized in North America; of these, the last one only is medicinally employed; and, in Europe, the leaves and flowers of two allied species, V. thapsiforme, *Schrader*, and V. phlomoides, *Lin.*, are likewise collected.

Description.—Folia verbasci.—The leaves are from four to eight or twelve inches long, the upper ones sessile on the stem and all decurrent. They vary in shape between elliptic, oblong, and oval-lanceolate, are acute, more or less crenate on the margin, and densely covered with soft whitish stellate hairs. The leaves are nearly inodorous, and have an insipid mucilaginous, faintly bitter taste.

Flores verbasci, *P. G.*—The calyx is rejected, and only the corolla with the adhering stamens is preserved. The wheel-shaped corolla is one or one and a half inch broad, bright yellow, has five obovate roundish lobes, and bears in the short tube the stamens of which the three upper ones have the filaments covered with a white wool; the two lower stamens are longer and smooth, and have elongated decurrent anthers. To preserve their bright color, the flowers should be thoroughly dried and kept in a dry and well-stoppered bottle; if permitted to become damp, they acquire a blackish color. The flowers have a slight agreeable odor, and a mucilaginous and sweet taste.

Constituents.—The leaves and flowers contain mucilage. Morin (1826) obtained from the flowers a trace of yellowish volatile oil, a fatty substance, sugar, and coloring matter which is insoluble in ether and cold water, and yields in alcoholic solution a yellow precipitate with acetate of lead.

Pharmaceutical Uses.—Mullein flowers enter into the following:—

Species pectorales, *P. G.*, s. *Species ad infusum pectorale.* Pectoral tea, *E.*; Brustthee, *G.*—Marshmallow root eight parts, peeled liquorice root three parts, orris root one part, colt's foot leaves four parts, mullein flowers and star-anise, each two parts. The drugs are cut into thin slices and mixed.

Species pectorales cum fructibus, *P. G.*—This is a mixture of pectoral tea sixteen parts, cut St. John's bread six parts, cut figs three parts, and pearl barley four parts.

Medical Action and Uses.—The chief medicinal constituent of this plant is the mucilage furnished by its leaves; but its flowers contain an essential oil, in small proportion, to which the agreeable odor of the fresh plant and its slightly stimulant qualities are due. Fish are said to become stupefied by eating the seeds. The infusion of mullein is useful in catarrhal affections of the *respiratory organs* and the *bowels*, and in irritations of the *urinary bladder.* It may be used by enema in *dysentery.* A poultice made with the leaves boiled in milk is a convenient application to inflamed *hemorrhoids.* Olive oil saturated with mullein flowers during prolonged exposure to the sun, or kept near a fire for several days in a corked bottle, is a popular preparation in Germany for *bruises*, *frostbite*, and irritable *piles.* The infusion should be made of the fresh leaves and flowers, if possible, in the proportion of an ounce to a pint of boiling water. When cool it should be strained to free it from the irritating hairs which cover the leaves.

VERONICA.—Speedwell.

Véronique mâle, Fr.; *Ehrenpreis*, G.

Veronica officinalis, *Lin.* *Nat. Ord.*—Scrophulariacæ.

Origin and Description.—The common speedwell is distributed over a considerable portion of the Northern Hemisphere, and grows in dry grassy places and open woods. It is a procumbent pubescent perennial with ascending branches, and with opposite, short-petiolate, obovate, or elliptic and coarsely serrate, grayish-green leaves, which are about an inch long. The flowers are in one or two axillary racemes on the upper part of the branches, are on short pedicles, and have a wheel-shaped four-parted pale-blue corolla with dark-blue stripes and with two exserted stamens. The fruit is an inversely heart-shaped two-celled capsule. The fresh herb is faintly aromatic; after drying it is inodorous, and has a bitterish and slightly astringent taste.

Constituents.—Speedwell appears to contain a little tannin and a bitter principle.

Allied Species.—Veronica beccabunga, *Lin.;* Brooklime, *E.;* Cressonée, *Fr.;* Bachbungen, *G.*—It grows in Europe and Asia near springs and in brooks, and has an ascending smooth stem, with opposite, short-petiolate, oval or oblong, crenate-serrate, obtuse, and smooth leaves, about one and a half inch long, and with axillary loose racemes of pale-blue and veined flowers.

Ver. americana, *Schweinitz*, resembles the preceding, but has petiolate, ovate, acutish, and often slightly heart-shaped leaves.

Brooklime is inodorous, and has a bitterish, somewhat saline, and slightly pungent taste.

Medical Action and Uses.—Veronica is bitter, astringent, and slightly aromatic, in which qualities it resembles horehound and several other plants which, like it, have been used in the treatment of chronic *bronchitis.* Its decoction has been applied externally in the treatment of *scabies*, papular *cutaneous eruptions*, and *ulcers*, and given internally in *calculous disorders.*

VIBURNUM.—Black Haw.

The bark of Viburnum prunifolium, *Lin.* *Nat. Ord.*—Caprifoliaceæ.

Origin.—The black haw is a tall shrub or small tree from 10 to 20 feet high, and grows in thickets throughout the greater portion of the United States east of the Mississippi. Its leaves are opposite, about two inches long, shining, oval or obovate, sharply serrulate, and have short slightly margined petioles. The small white pentamerous flowers have a wheel-shaped corolla, and produce small blue-black edible drupes containing a flattish smooth putamen. The bark is employed in medicine.

Description.—Black haw bark is in thin quills, and has externally a somewhat glossy purplish-brown, and, when older, a grayish-brown color. The surface is marked with scattered small roundish or transversely elongated warts, and often with minute black dots. The thin papery corky layer is easily removed from the green outer bark. The inner bark is white, and the inner surface smooth. The bark breaks with a short smooth fracture, is without odor, and has a slightly astringent and distinctly bitter taste.

Allied Species.—VIBURNUM OBOVATUM, *Walt.*, grows in the Southern United States, and is a shrub about eight feet high; it is also known as *black haw*. The leaves are one-half to one inch long, rather leathery, broadly obovate or spatulate, narrowed into a short petiole, slightly revolute on the margin, either entire or crenate near the apex, and on the lower surface marked with minute brownish dots. The cymes are small and three-rayed, the flowers white, and the fruit black and ovoid-oblong. The leaves are inodorous, and have a bitter taste, which is more persistent than that of the brown or reddish-gray bark.

VIBURNUM OPULUS, *Lin.* Cranberry tree, *E.*; Obier, *Fr.*; Wasserholder, *G.*—It is a native of Canada, the Northern United States, and of Europe and Northern Asia. It grows to a height of from ten to fifteen feet, and has gray or brown-gray bark, three-lobed serrate leaves, and white or yellowish-white flowers. The fruit is a bright red, elliptic, one-seeded drupe resembling the cranberry. The bark has a pungent taste, and is known as *cramp bark.*

VIBURNUM LANTANA, *Lin.*, is a European shrub with ovate or oval, slightly heart-shaped, acutely serrate leaves, and with red, finally black, mealy drupes of a mucilaginous and sweet taste. The inner bark is acrid.

Constituents.—The *viburnic acid* of Krämer (1844), obtained from the bark of the cranberry tree, was proved by Monro (1845) to be identical with valerianic acid. The *viburnin* of Krämer is a light yellowish mass or whitish powder of a neutral reaction and of a purely bitter taste; it is slightly soluble in water and more freely soluble in alcohol. Enz (1863) found in the fruit of *V. lantana* a hygroscopic, neutral, bitter principle, readily soluble in water; also valerianic, acetic, tartaric, and tannic acids. The two species of black haw have not been chemically examined.

Medical Action and Uses.—Nothing definite appears to be known respecting the mode of action of this plant. Incongruous qualities are assigned to it, such as that it is at once nervine, astringent, diuretic, and tonic. The only medicinal operation attributed to it does not involve any of these operations, viz., a power of preventing *abortion*, particularly when attempted by the use of cotton root. It has been given in the form of an infusion or a decoction made with an ounce of the bark to a pint of water, and in *doses* of one or two ounces repeated every two or three hours.

VINA MEDICATA.—MEDICATED WINES.

Vins médicinaux, Fr.; *Medicinische Weine*, G.

Medicated wines are preparations analogous to tinctures, but differ from them in the menstruum, which contains a much smaller and a somewhat variable quantity of alcohol and a certain proportion of extractive matter and bitartrate of potassium. The United States and British Pharmacopœias employ sherry wine as the menstruum, which is likewise directed in most cases by the German Pharmacopœia. The French Codex prefers Malaga wine. Since even the strongly alcoholic officinal wines cannot be kept unaltered for an indefinite period, if exposed to the air, the medicated wines, which necessarily contain various principles subject to gradual decomposition, should be kept in well-stoppered bottles.

VINUM ALOES, *U. S.*, *Br.*—WINE OF ALOES.

Vinum aloeticum.—*Vin aloétique*, Fr.; *Aloewein*, G.

Preparation.—Take of Socotrine Aloes in fine powder a troyounce; Cardamom in moderately fine powder, Ginger in moderately fine powder, each sixty grains; Sherry Wine a pint. Macerate for seven days, with occasional agitation, and filter through paper. *U. S.*

Take of Socotrine Aloes one and a half ounce (avoird.); Cardamom Seeds freed from the pericarps and bruised, Ginger in coarse powder, each eighty grains; Sherry two pints (imp.). Macerate for seven days in a closed vessel, with occasional agitation; filter the liquor and add sufficient sherry to make two pints. *Br.*

Medical Uses.—This preparation is rarely used, because, like all liquid preparations of aloes, its taste is repulsive, and the pilular forms of the medicine are therefore more acceptable. Yet it probably has the advantage over them of being already a solution, and therefore of acting in a relatively smaller dose. It is useful in cases of habitual *constipation* from torpor of the colon and rectum, especially when associated with flatulent dyspepsia, gout, or amenorrhœa. *Dose*, as a laxative, about half a fluidounce.

VINUM ANTIMONII, *U. S.*—WINE OF ANTIMONY.

Vinum antimoniale, Br.; *Vinum stibiatum s. emeticum*, P. G.—*Antimonial wine*, E.; *Vin antimonié*, *Vin stibié*, Fr.; *Brechwein*, G.

Preparation.—Take of Tartrate of Antimony and Potassium thirty-two grains; Boiling Distilled Water a fluidounce; Sherry Wine a sufficient quantity. Dissolve the salt in the distilled water, and, while the solution is hot, add sufficient sherry wine to make it measure a pint. *U. S.*

Nearly the same proportions are the following: Tartarated antimony forty grains; sherry one pint (imper.). *Br.* Tartar emetic one part; sherry two hundred and fifty parts. *P. G.* Tartar emetic one part; Malaga wine three hundred parts. *F. P.*

If made with good sherry wine and judiciously preserved, antimonial wine will keep unaltered for a long time.

Off. Prep.—Mistura glycyrrhizæ comp., *U. S.*

Medical Uses.—The chief value of antimonial wine consists in its being a convenient addition to febrifuge solutions, and especially in association with a liquid preparation of opium and spirit of nitrous ether. In such combinations it greatly promotes diaphoresis, which is the natural crisis of fever. The direct sedatives of the heart have no such salutary operation. In like manner it may be added to mixtures for promoting expectoration in febrile affections of the air-passages, as in the officinal compound liquorice mixture. It should seldom be used as an emetic, for its action in children is too depressing, and for adults the necessary dose of it is such that the stimulant action of its wine counteracts the sedative or nauseant operation of the antimonial. As a febrifuge and expectorant, the *dose* of antimonial wine is about ten drops, repeated at longer or shorter intervals, according to its effects. This dose is preferable to the larger ones generally recommended.

VINUM AURANTII, *Br.*—ORANGE WINE.

Wine made in Britain by the fermentation of a saccharine solution to which the fresh peel of the bitter orange has been added. *Br.*

It is a vinous liquid, having a golden sherry color and a taste and aroma derived from the bitter orange peel. It contains about 12 per cent. of alcohol, and is but slightly acid to test-paper.

Off. Prep.—Vinum ferri citratis, Vinum quiniæ, *Br.*

Medical Uses.—Orange wine is used exclusively as a flavoring ingredient of mixtures and as an excipient in certain British officinal preparations.

VINUM COLCHICI RADICIS, *U. S.*—WINE OF COLCHICUM ROOT.

Vinum colchici, Br.—*Vin de bulbes de colchique*, Fr.; *Zeitlosenknollenwein*, G.

Preparation.—Take of Colchicum Root in moderately fine powder twelve troyounces; Sherry Wine a sufficient quantity. Moisten the powder with four fluidounces of sherry wine, pack it firmly in a conical percolatar, and gradually pour sherry wine upon it until two pints of filtered liquor are obtained. *U. S.*

Take of Colchicum, sliced, dried, and bruised, four ounces (avoird.); Sherry one pint. Macerate the colchicum in the wine for seven days in a closed vessel, with occasional agitation; press, and strain through calico; then add sufficient sherry to make one pint (imperial). *Br.*

This preparation is recognized in Great Britain as *wine of colchicum*, under which name in the United States the wine of colchicum *seeds* is usually understood. Owing to the deterioration of colchicum tuber when long kept, the preparation is apt to be deficient in strength, since the drug cannot be at all times obtained fresh or recently dried.

Medical Uses.—This preparation, which is believed to possess all the virtues of colchicum, may be prescribed in *doses* of ten minims, and gradually increased.

VINUM COLCHICI SEMINIS, *U. S.*—WINE OF COLCHICUM SEED.

Vinum colchici, P. G.—*Vin de semences de colchique*, Fr.; *Zeitlosensamenwein*, G.

Preparation.—Take of Colchicum Seed in moderately coarse powder four troyounces; Sherry Wine two pints. Macerate for seven days, with occasional agitation; then express, and filter through paper. *U. S.*

Macerate for eight days coarsely powdered colchicum seed one part, in sherry wine ten parts. *P. G.*

In order to extract the colchicia the seeds require to be well bruised. By passing them several times through a good drugmill, regulating at the same time the grinding surface, they may be obtained of a sufficiently fine powder. If a suitable mill is not at hand, they should be macerated in a portion of the wine for several days, and be bruised in a mortar while damp.

Medical Uses.—The wine of colchicum seeds is no longer officinal in the British Pharmacopœia. The commencing *dose* is about half a fluidrachm.

VINUM ERGOTÆ, *U. S.*—Wine of Ergot.

Vin de seigle ergoté, Fr.; *Mutterkornwein*, G.

Preparation.—Take of Fluid Extract of Ergot four fluidounces; Sherry Wine twenty-eight fluidounces. Mix them, and filter through paper. *U. S.*

Made with a properly prepared fluid extract, this wine appears to represent ergot much better than the vinous percolate of the powdered drug.

Medical Uses.—Wine of ergot is less frequently employed than other preparations of ergot, but may be prescribed in *doses* of from one to three fluidrachms.

VINUM FERRI, *Br.*—Wine of Iron.

Vinum chalybeatum s. martiatum.—*Vin chalybé*, Fr.; *Eisenwein*, *Stahlwein*, G.

Preparation.—Take of Fine Iron Wire (about No. 35) one ounce; Sherry one pint. Macerate for thirty days in a closed vessel, the iron being almost, but not quite, wholly immersed in the wine, and the vessel frequently shaken, and the stopper removed; then filter. *Br.*

The acid tartrate of potassium dissolves the iron with the evolution of hydrogen, resulting in the formation of ferrous tartrate or of its double salt with potassium tartrate. Owing to the variable acidity of different wines, and to the necessarily variable composition of this preparation, it has very properly been discarded by most Pharmacopœias, or has been replaced by one of more definite strength in iron, like the wine of citrate of iron.

Medical Uses.—This preparation is one of the mildest of ferruginous medicines. It is, however, quite as well prepared extemporaneously by making a solution of tartrate of iron and potassium in sherry or Rhenish wine in the proportion of ten grains to the fluidounce. The *dose* of the officinal wine is from one to four fluidrachms, and of the magistral solution nearly twice as much.

VINUM FERRI CITRATIS, *Br.*—Wine of Citrate of Iron.

Vin ferrugineux, Fr.; *Eisenwein*, G.

Preparation.—Take of Citrate of Iron and Ammonia one hundred and sixty grains; Orange Wine, one pint. Dissolve, and let the solution remain for three days in a closed vessel, shaking it occasionally; afterwards filter. *Br.*

Medical Uses.—The wine of the citrate of iron has nearly the same qualities as the wine of iron, and, like it, may be used when the stomach is irritable. The *dose* is from one to four fluidrachms.

VINUM IPECACUANHÆ, *U. S.*, *Br.*—Wine of Ipecacuanha.

Vin d'ipécacuanha, Fr.; *Brechwurzelwein*, G.

Preparation.—Take of Fluid Extract of Ipecacuanha two fluidounces; Sherry Wine thirty fluidounces. Mix them, and filter through paper. *U. S.*

Take of Ipecacuanha bruised one ounce; Sherry one pint. Macerate for seven days in a closed vessel, with occasional agitation; strain, press, and filter; then add sufficient sherry to make one pint. *Br.*

Medical Uses.—The wine of ipecacuanha contains all the virtues of the drug. It is a very inappropriate form for the production of emesis, since the large proportion of alcohol contained in it counteracts the emetic operation of the ipecacuanha, and may be unsuited to the febrile elements of the affections for which it is prescribed. This objection applies less forcibly to its use as a diaphoretic and expectorant. It is especially useful, when associated with spirit of nitrous ether, in favoring diaphoresis in *catarrhal fever*, *muscular rheumatism*, etc. In infantile and also in senile *bronchitis* it is peculiarly serviceable when the bronchial secretions obstruct the air passages, and an emetic as well as a stimulant operation is called for. In the *vomiting* of pregnancy, this preparation, in hourly doses of one drop, sometimes arrests that distressing symptom. It is probable that in doses nearly as small it would be found as useful as powdered ipecacuanha has proved in relieving atonic *dyspepsia*, and *chronic diarrhœa* from intestinal debility.

The *dose* of wine of ipecacuanha as an emetic is stated to be a fluidounce for an adult, and a fluidrachm for an infant, but, for the reasons assigned, it is not eligible for this purpose. As an expectorant or diaphoretic the proper dose is from five to ten drops, repeated every half hour or hour.

VINUM OPII, *U. S.*, *Br.*—WINE OF OPIUM.

Tinctura opii crocata, P. G.; *Laudanum liquidum Sydenhami.*—*Sydenham's laudanum*, E.; *Vin d'opium composé*, Fr.; *Safranhaltige Opiumtinktur*, G.

Preparation.—Take of Opium dried and in moderately fine powder two troyounces; Cinnamon in moderately fine powder, Cloves in moderately fine powder, each sixty grains; Sherry Wine a sufficient quantity. Mix the powders with fifteen fluidounces of sherry wine, and macerate for seven days, with occasional agitation; then transfer the mixture to a conical percolator, and, when the liquid has passed the surface, gradually pour on sherry wine until a pint of filtered liquor is obtained. *U. S.*

Take of Extract of Opium one ounce (avoird.); Cinnamon Bark bruised, Cloves bruised, each seventy-five grains; Sherry one pint (imperial). Macerate for seven days in a closed vessel, with occasional agitation, and filter. *Br.*

Both Pharmacopœias have discarded the use of saffron, which is still retained by the French and German Pharmacopœias. The preparation of the United States Pharmacopœia is identical with that of the French Codex, except that the latter employs Malaga wine, and orders saffron equal to one-half the weight of opium. The preparation of the German Pharmacopœia is about one-eighth weaker, and the proportion of opium to saffron is 8 to 3. The wine of the British Pharmacopœia is only about two-thirds the opium strength of that of the other Pharmacopœias. As officinal in the United States Pharmacopœia, eight minims of the wine represent one grain of opium. On keeping, wine of opium is apt to deposit a little narcotina, together with extractive matter.

Medical Uses.—This preparation, also known as Sydenham's laudanum, is much superior to the tinctures of opium as an internal medicine, on account of its being less apt to nauseate, and less offensive in taste and smell. Eight minims, or from sixteen to seventeen drops, may be given as a full dose. It is sometimes used as an application to the conjunctiva in granular and other chronic forms of inflammation of that membrane.

VINUM PORTENSE, *U. S.*—Port Wine.

Vin d'Oporto, Fr.; *Portwein*, G.

Origin and Description.—Port wine is the fermented juice of the grape cultivated in the district near the river Douro, in Portugal, and is chiefly exported from Oporto. When recently made it is of a red color, which by age changes to a deep reddish-brown, while at the same time a considerable portion of altered astringent matter is deposited, and the wine acquires its full flavor. Port wine is considered to be best when about eight or ten years old. As exported from Portugal it is always mixed with a certain quantity of spirit, which is added for the purpose of better preservation; its alcoholic strength is thereby increased to from 18 to 22 per cent. Ripeness and strength are said to be imparted to new wine by adding brandy towards the end of fermentation, and the product, particularly the cheaper varieties of port wine, is often artificially colored with preparations containing the juice of elderberries. Port wine has a pleasant vinous odor, and an agreeable, warm, sweetish, and slightly astringent taste.

Other red wines.—The juice of red and black grapes is colorless, or nearly so, and, if fermented alone, yields a white wine; but if fermented with the husks, the coloring matter of the latter is extracted, and the wine has a red color, varying in shade with the variety of the grapes. In the place of true port wine a variety of French wine, known in commerce as *Burgundy port wine*, is much used in the United States; it resembles port wine in appearance and flavor, and contains about 14 or 16 per cent. of alcohol.

California port wine is very similar, and is the product of grapevines originally obtained from the port-wine district of Portugal, and chiefly cultivated in Los Angeles County. The lighter French red wines are known as *claret*, and usually contain from 10 to 12, and some varieties as much as 15 per cent. of alcohol. A considerable amount of red wine is produced in the United States, in the Mississippi Valley, and eastward near to the Atlantic coast; it is of a deep red color, and of a rich aromatic flavor, quite different from that of the European wines.

For composition, see *Vinum Xericum.*

History.—The dietetic history of wine is almost coeval with that of the human race, for all the countries inhabited by those nations whose remote history has come down to us abound in grapes, and the first sin committed after the deluge was drunkenness. Its medicinal virtues were treated of by Hippocrates, Galen, Pliny, and the Arabian physicians. The last described in full detail the consequences of its excessive use, which, indeed, had already been done by Jewish as well as Roman writers. They are essentially those which have been enumerated in the article on Alcohol. Nevertheless, it would be a grave error to conclude that a given quantity of wine is equivalent to an equal quantity of water containing a like percentage of alcohol. The peculiar effects of a true wine depend upon its ethereal and saline elements, its sugar, tannic acid, etc., which modify materially those which would be produced by its alcohol alone. It is to be regretted that the United States Pharmacopœia should have copied the British in selecting as representatives of wine the two varieties which most nearly resemble alcohol in their operation, port and sherry, which are seldom to be had in a pure condition, and which often consist simply of distilled alcohol, with various ingredients added to counterfeit the genuine wines. The true medicinal effects of wine are to be sought in the products of the vineyards of continental Europe and a few other places. Those of our own country have not yet attained the degree of perfection which would enable them to compete with foreign wines; yet even in their comparatively crude state they are probably less mischievous than distilled spirits, provided they can be obtained pure. Improvement in their manufacture, by rendering them generally acceptable, would not only confer a priceless boon upon the sick, but would provide even for the drunkard a potation less injurious to himself than alcohol, and save the commonwealth from a large proportion of those infamous crimes which disgrace our civilization, and from the physical deterioration which threatens to produce national decrepitude. In France, drunkenness, as it is known in this country and in the north of Europe, was comparatively rare as long as wine and cider were the only alcoholic beverages in general use; but the vice has greatly extended of late years, and its increase has been mainly in the cider-drinking departments, where alcohol distilled from grain is largely used. In the wine-growing districts where brandy of a less injurious quality is made, the use of the latter beverage is comparatively small; and in the departments where wine is not produced, the cases of drunkenness requiring legal action are five times greater than in those which consume wine principally. In like manner the proportion of cases of insanity originating in alcoholic drinks is in direct proportion to the use of distilled spirits, and especially of those which are not procured from wine.

Physiological Action.—Wine, including all forms of genuine wine, is essentially a stimulant of the nervous and circulatory systems; but its mode of stimulation is quite unlike that of alcohol. In due proportion it gives to all the faculties increased activity and freedom of action, quickening and brightening the intellect and the imagination, warming the feelings, invigorating the digestive powers, and diffusing a cordial satisfaction throughout the whole being. Distilled spirits, on the other hand, tend to benumb the faculties even while stimulating them, so that they seem to be struggling under a brute force; the exhilaration they produce is usually fierce or maudlin; and they leave behind them a dull and inert dejection. As already stated, the peculiar effects of wine are due to the salts, acids, sugar, and, above all, the ethereal elements in which it abounds, and which, while they tend to mitigate the anæsthesia produced by the alcohol of the liquid, insure a more rapid discharge of this substance from the system. In excessive doses the effects of wine resemble more nearly those produced by distilled spirits, yet even these are less extreme and debasing. Its habitual use is conducive to the health of those who drink it in moderation, and is the best corrective of the brutality and preventive of the crime which everywhere attend the consumption of ardent spirits. The very quantity of it required to produce intoxication tends to limit the mischiefs of its excessive use; and, even when indulged in beyond measure, its mischievous influence upon the health is less than that of alcohol; for while the latter tends directly to occasion fatal disease of the liver, heart, and kidneys, the intemperate use of wine is more apt to engender gout, gravel, and nervous affections. Even these results are rarely attributable to some of the sorts of wine which are most largely used, as the Rhenish, Bordeaux, and most Italian wines.

Medical Uses.—Wine is employed in the treatment of the same forms of disease for which distilled alcohol is appropriate, but, according to general usage, in the less grave forms of disease, and for women, children, and old persons, rather than for adult men. The clearest indication for its use is furnished by *adynamic fevers*, and most of all typhus fever, a disease in which enormous quantities of wine have sometimes been administered with the most salutary results. In a less degree it is useful in *typhoid fever*, and in all febrile affections which assume the *typhoid state*, provided the following symptoms are present, viz., prostration, wandering, delirium, petechiæ, stupor, and brown tongue; feebleness, irregularity, dicrotism or softness of the pulse; and particularly feebleness or absence of the first sound of the heart. When delirium, unconsciousness, and dryness of the tongue have been succeeded by a state of exhaustion, languor, and debility, with imperfect sleep and anorexia, the cordial operation of wine is a precious help towards the cure. But it is as true of wine as of distilled spirits, that the necessity for it is often more apparent than real, and that a premature and excessive use of it renders the patient insensible to its operation when it has become essential to his recovery. We have never had such good reason to be pleased with the results of treatment in typhoid fever as when in a large hospital service the use of alcohol in this disease was almost wholly omitted.

During *convalescence* from many diseases wine taken with food is often a potent aid to recovery, and it is often, also, of essential utility in chronic affections which waste the strength by profuse *discharges* or by *pain*, or by inducing an *anæmic* condition. In all of these cases red wines are more efficacious than white. The latter, however, and, in general, the more stimulating wines, are best adapted to cases in which a speedy but transient influence is intended, as where *syncope* is imminent, or the patient is reviving from it, after powerful nervous shocks, exhausting fatigue of body or mind, severe pain, hemorrhage, etc., and in cases of debility of the heart arising from structural alterations in it. In the milder forms of *delirium tremens*, especially as they occur in females, and notably in those of the better classes, wine is greatly to be preferred to distilled spirits. In some minor *spasmodic affections*, as the *vomiting* of pregnancy, or of sea-sickness, the sparkling wines are often of great service. Infantile reflex *convulsions* may frequently be prevented by a timely dose of wine, or relieved by its administration by the rectum or the mouth. *Tetanus* has been successfully treated by wine; and the depressing action of *tobacco*, and other sedatives of the heart and nervous system, may be counteracted by its means.

Red wines, and especially port wine, are used as injections into the tunica vaginalis testis after the operation for *hydrocele*, to promote permanent obliteration of the sac; into the urethra and vagina in *chronic discharges* from those passages, and into *fistulous sores* with a similar object. For these purposes factitious port wine is probably better than the genuine, since it is more astringent.

VINUM QUINIÆ, *Br.*—WINE OF QUINIA.

Vin de quinine, Fr.; *Chininwein*, G.

Preparation.—Take of Sulphate of Quinia twenty grains; Citric Acid thirty grains; Orange Wine one pint. Dissolve, first the citric acid, and then the sulphate of quinia, in the wine; allow the solution to remain for three days in a closed vessel, shaking it occasionally; and afterwards filter. *Br.*

Medical Uses.—It is difficult to perceive the advantages of this preparation over an extemporaneous solution of the citrate of quinia in wine. The *dose* is from four to eight fluidrachms.

VINUM RHEI, *U. S.*, *Br.*—WINE OF RHUBARB.

Tinctura rhei vinosa, P. G.—*Vin de rhubarbe*, Fr.; *Weinige Rhabarbertinktur*, G.

Preparation.—Take of Rhubarb in moderately coarse powder two troyounces; Canella in moderately fine powder sixty grains; Sherry Wine fourteen fluidounces; Diluted Alcohol a sufficient quantity. Mix two fluidounces of diluted alcohol with the sherry wine, and moisten the powders, previously rubbed together, with half a fluidounce of the mixture; then transfer them to a conical percolator, and gradually pour upon them the remainder of the mixture, and afterwards diluted alcohol, until a pint of filtered liquid is obtained. *U. S.*

The proportions directed by other Pharmacopœias are: Rhubarb root in coarse powder one and a half ounce (avoird.); canella alba bark sixty grains;

sherry sufficient for one pint (imperial). *Br.* Rhubarb three parts; Malaga wine fifty parts. *F. P.* Rhubarb finely cut eight parts; bitter orange peel cut two parts; cardamom seed powdered one part; sherry wine one hundred parts; white sugar twelve parts. *P. G.* The last is a simplified formula for *tinctura rhei Darelii.*

Medical Uses.—Wine of rhubarb has the same general virtues as the tincture of rhubarb, but is preferable as being less stimulant. It may be described as cordial, carminative, and *laxative*, and may be used by persons of a *constipated* habit and gouty constitution, and especially by females who add to these conditions scanty and painful menstruation and leucorrhœa. The *dose* is from one to four fluidrachms.

VINUM TABACI, *U. S.*—WINE OF TOBACCO.

Vin de tabac, Fr.; *Tabakwein*, G.

Preparation.—Take of Tobacco in moderately fine powder a troyounce; Sherry Wine a pint. Macerate for seven days, with occasional agitation; then express, and filter through paper. *U. S.*

Medical Uses.—Wine of tobacco might, doubtless, be employed in nearly all the cases in which the drug itself and its other preparations have been prescribed, and especially in the treatment of *dropsy*, and of nervous *asthma*. It is, however, very little used. The *dose* is from ten to thirty minims.

VINUM XERICUM, *U. S.*, *Br.*—SHERRY WINE.

Vinum Xerense, P. G.—*Vin de Xérès*, Fr.; *Xereswein*, G.

Origin.—All European wines are obtained from the fruit of Vitis vinifera, *Lin.*, of which species numerous varieties have been produced by long-continued cultivation and under the influence of climate and soil. Sherry wine is made in the Southwestern part of Spain, in the neighborhood of Xeres, from which place it takes its name, altered to *sherry.*

Manufacture of Wine.—In addition to the constituents of grapes enumerated on page 1467, vegetable albumen, glutinous matter, pectin, and various extractive matters are found in the juice of grapes, and occasionally racemic acid, either in the free state or partly combined with bases. Besides tartrates, the saline constituents are sulphate of potassium, chloride of sodium, phosphate of calcium, magnesia, alumina, and silica. The relative amount of these principles varies considerably, depending on the nature of the soil and on atmospheric conditions during the growth and ripening of the fruit. The sugar varies in amount between 12 and 30 per cent., the larger quantity being produced in warm climates. It is obvious from this that the treatment of the grape juice for the production of wine must vary under different circumstances and in different countries. The grapes are either crushed and the juice fermented in the presence of the husks, or the juice, called *must*, is fermented by itself, in which case a light-colored wine is obtained. Red wines are made by fermenting with husks of red or purple grapes. In a short time after the must has been pressed, fermentation commences, and continues for two or three weeks, when the liquid becomes somewhat clear, and is removed from the precipitate into another vessel, where a slow fermentation, called the *after-fermentation*, proceeds for several weeks or months, requiring the occasional removal of the liquid from the sediment formed, until it is fit to be transferred into casks, where it is allowed to "ripen." The best wines are usually bottled some time after they have become perfectly clear, the complete clarification being effected by gelatin, which, in combining with the tannin present, forms an insoluble compound, carrying down with it all traces of yeast and other matters held in suspension. The "bouquet" of wine is much improved after bottling, and red wines which do not contain a large amount of tannin become darker, while wines rich in tannin form a deposit in the bottle and become lighter in color.

The conditions under which fermentation takes place, and the results, are explained on pages 119 and 120. In the presence of the numerous constituents of grapes, odorous principles are generated during fermentation to which wines owe their peculiar aroma or bouquet. If the must contains a moderate quantity of sugar, this is entirely, or nearly, decomposed into alcohol and carbonic acid, resulting in a *dry wine.* But in a strongly saccharine must fermentation ceases before the sugar is completely consumed, and the product is a *sweet wine.* In some cases the amount of sugar in the juice is increased by exposing the cut ripe grapes for some time to the sun until a portion of the water has evaporated; but the addition of fermentable sugar to grape juice does not improve the quality of the wine, though it may result in an increase of its alcoholic strength. If wine is bottled before it has undergone the after-fermentation, a *sparkling wine* will be obtained. The fermentation will slowly proceed in the bottle, which is placed upside down, so that the precipitate which forms may settle in the neck, and may be finally withdrawn by carefully removing the stopper and quickly replacing it. The effervescence of sparkling wines is produced by the carbonic acid confined in the bottle.

As the alcohol increases during the prolonged fermentation of the must, the acid tartrate of potassium becomes less soluble and is gradually deposited, the deposition continuing for some time after the storing of the wine in casks. Sometimes grape juice contains notable quantities of uncombined tartaric acid, which it was proposed by Liebig to remove by the addition of an estimated quantity of neutral potassium tartrate added to the wine in a concentrated solution; cream of tartar will then be formed and slowly precipitated.

Properties.—VINUM RUBRUM, Red wine, see Vinum Portense, p. 1493.

VINUM ALBUM, White wine.—As a class white wines are distinguished from red wines by the absence of red coloring matter and of notable quantities of tannin, though minute proportions of this compound are usually present. They are never colorless, but vary in shade between pale yellow and deep amber-color.

Sherry wine has a rather deep amber-color, an agreeable vinous odor, and a warm and very slightly acid taste. We found (1866) its specific gravity to range between .978 and .995, and its average alcoholic strength to be 20.34 volumetric per cent.; the sugar and extractive averaged 3.27 per cent. in 67 samples examined.

Similar wines are produced in Southern Europe, several of which are met with in our commerce. *Lisbon wine* has a density of about .990, and contains 19 or 20 per cent. of alcohol. *Teneriffe wine* closely resembles the preceding in properties. A stronger wine is *Madeira wine*, which usually contains between 19 and 22 per cent. of alcohol; it has a different, somewhat nutty flavor.

The white *Rhenish wines* are known here as *hock* (from *Hochheimer*). They have a more acidulous taste than the preceding wines, from the presence of acid tartrate of potassium, and the nearly total absence of sugar. They are of a pale-yellow color, and usually contain between 8 and 10 per cent. of alcohol. *Moselle wine* is nearly of the same strength.

The *California wines* resemble the wines of Southern Europe in appearance, flavor, and alcoholic strength; the weaker varieties, which are known as *California hock*, have not the fine bouquet of the better qualities of Rhenish wines, and are generally stronger in alcohol.

The white wines of the Mississippi and Ohio valley are obtained from cultivated varieties of Vitis labrusca, *Lin.*, and V. æstivalis, *Mich.*, among which the *Catawba*, *Isabella*, *Diana*, *Delaware*, *Herbemont*, and other grapes have attracted attention. The *Scuppernong* grape of the Southern United States is a variety of the *Muscadine* or *Southern fox grape*, Vitis vulpina, *Lin.*

The sparkling *Champagne wines* contain between 10 and 12 per cent. of alcohol.

Constituents.—The principal constituents of all wines are water and alcohol. The amount of the latter present in the different wines has been given above. The acidulous taste of wine is due to *acid tartrate of potassium*, and traces of *acetic acid* are met with in old wines, resulting from the spontaneous oxidation of alcohol. A somewhat larger quantity of acetic acid is present in the wines of the eastern section of the United States. The amount of *sugar* varies considerably; while the weaker dry wines contain none or but very little, it is found in sherry to the extent of from 1 to 4 per cent., increases in champagne sometimes to 5 or 6 per cent., in port wine to 6 or 7 per cent., and in the sweet wines, like *Malmsey Madeira*, to 11 or 15 per cent. or more. The "body" of wine has been ascribed by Fauré to a principle which he named *œnanthin*, and which is probably of the nature of gum or dextrin. *Tannin* seems to be present in all wines, in minute proportion in the white, and in larger proportion in the red wines. The *coloring matter* of wine varies for causes stated above; the color of red grapes is not soluble in water, but is extracted during fermentation as the alcohol increases. The *aroma* of wine is doubtless due to the presence of various compound ethers formed in the juice while fermenting. These exist in very minute quantities, and have for this reason not been accurately examined; but the following have been stated to contribute to the aromatic odor of wine, acetic, butyric, caprylic, caproic, œnanthic, pelargonic, capric, and propionic ethers, besides aldehyd, acetal, and probably other compounds. The inorganic constituents of wine are the same as those of grape juice, except that tartrate of calcium and the greater portion of acid tartrate of potassium have been deposited.

Changes.—Like other weak alcoholic liquids wine is apt to undergo acetic fermentation, which is prevented by excluding atmospheric oxygen. Mucous fermentation causes wine to become ropy. Some wines, like Burgundy, are liable to acquire a bitter taste, and occasionally wine becomes mouldy. Scrupulous cleanliness of the vessels in which wine is kept and exclusion of air will prevent most of these changes.

Adulterations.—Wines are frequently adulterated, and even made artificially; but on account of the complex nature of the constituents, of their variable proportions, and of the difficulty of determining some of the natural constituents of wine, adulterations are difficult to detect. The presence of poisonous metals is without great difficulty proven by the usual tests; but the nature of artificial coloring matters and of other fruit wines is not easily determined. Most pure red wines yield with acetate of lead a greenish-gray precipitate, but the coloring matters of red beet and of Brazil wood give red precipitates, and logwood, elderberries, and mulberries, yield blue or purplish ones with the same reagent. Winckler stated that cider and other fruit wines contain lactic acid and calcium lactate, which are not found in grape wine. Tuchschmid (1870) found the amount of carbonate of calcium obtainable in the ashes of grape wine never to exceed 0.049 per cent., while other fruit wines yield between 0.11 and 0.40 per cent. of the same salt.

Pharmaceutical Uses.—Sherry wine is used in making medicated wines.

Medical Action and Uses.—It seems superfluous to say a word of the special virtues of sherry wine, since it is almost impossible to procure any of it which is pure, and presents that peculiar "nutty" flavor, and that "dryness," or slight acidity, which at one time were characteristic of this wine, and which rendered it a valuable cordial in exhaustion of the nervous system and the heart, and a wholesome aid to feeble digestion. In England, where, more than elsewhere, it was generally used by the better classes, it was regarded as especially appropriate for dyspeptic, gouty, and rheumatic invalids. At present those who prescribe "sherry wine" should know that there is seldom any wine in the liquid at all, but that it consists usually of alcohol, water, and flavoring ingredients. It is far better to use medicinally whiskey made from wheat or rye, which there is less temptation for the dishonest dealer to adulterate, than the mischievous compounds sold under the name of sherry. The special uses of genuine wine have been enumerated, and it need only be added here that, as compared with port, sherry is less astringent, and according to some analyses, slightly less, and according to others, slightly more, alcoholic. Commercial sherry wine is less suited than pure wine for making *wine whey*, which is prepared by adding the wine to milk at the boiling temperature, in the proportion of from two to eight fluidounces of the former to a pint of the latter, straining off the whey, and sweetening it. It is a mild and slightly nutritious stimulant much used in cases of debility from exhaustion and in the *typhoid state.* Wine diluted with water may be given by enema with scarcely less advantage than by the stomach, when from any cause it cannot be advantageously taken in the natural way.

VIOLA, *U. S.*—VIOLET.

Violette, Fr.; *Veilchen*, G.

The rhizome of Viola pedata, *Lin.* *Nat. Ord.*—Violaceæ.

Origin and Description.—The violets are perennial, or very rarely annual herbs, having mostly a short, partly underground stem. The leaves are alternate, and the flowers axillary and irregular, with a one-spurred corolla of five petals, five strongly connivent stamens, and a three-valved, many-seeded capsule. The officinal species grows in sandy soil from the New England States southward, and westward to the Mississippi. It has a short, erect, and truncate rhizome, about an inch long and nearly as thick, and beset with slender rootlets. The leaves are radical, smooth, pedately five- or seven-parted, and have the divisions linear or narrowly spatulate, and occasionally slightly toothed at the apex. The flowers are large, about an inch broad, beardless, vary in color between light blue and dark purple, and have a very faint violet odor, which is observable only with a large number of flowers. The leaves and flowers have a mucilaginous and sweet taste; the taste of the rhizome is mucilaginous, bitter, and somewhat acrid. The plant flowers in May and frequently a second time in August or September.

Allied Plants. VIOLA CUCULLATA, *Aiton*, is the common blue violet of North America, growing in meadows and in dry grassy places and open woods. The rhizome is spreading, forms compact masses, and is covered with numerous short fleshy branches. The leaves are very variable, heart-shaped at the base, with the basal lobes rolled up. The flowers are somewhat bearded, light or dark blue, violet-colored, or variegated. The variety *V. palmata* has the later leaves palmately lobed.

VIOLA ODORATA, *Lin.* (Bentley and Trimen, Med. Plants, 25).—The *sweet-scented violet* is indigenous to Europe and Northern Asia, is frequently cultivated, and grows to a certain extent spontaneously in various parts of North America. It has an oblique rhizome, and produces long, filiform runners. The leaves are reniform or heart-shaped, obtuse and crenate. The flowers are dark-blue or sometimes whitish, bearded, and have a very agreeable odor. For pharmaceutical purposes the dark-blue flowers alone are collected, deprived of the calyx, and only the corolla is used in the fresh state for preparing a syrup.

VIOLA TRICOLOR, *Lin.* Herba violæ tricoloris, *P. G.; Herba jaceæ;* Pansy, Heart's ease, *E.;* Pensée, *Fr.;* Freisamkraut, Stiefmütterchen, *G.*—This is an annual or biennial, indigenous to Europe and Northern Asia, naturalized in the United States, and frequently cultivated in many varieties as an ornamental plant. It has a thin spindle-shaped root, and an erect or ascending angular and branching, nearly smooth stem. The leaves vary between roundish-cordate and oval, crenate and nearly entire, are about an inch long, petiolate, and have prominent lyrately-pinnatifid stipules. The flowers are on long peduncles, and have the corolla partly yellowish, blue and purple, or occasionally yellowish, and in the cultivated varieties very variable. The herb is inodorous, and has a bitterish and slightly acrid taste.

Constituents.—Pansy contains mucilage, a bitter principle, resin, sugar, and other common constituents of plants; and similar principles appear to be present in the herbaceous parts of all violets. The rhizomes of the perennial, and more particularly the acaulescent violets appear to contain *violin*, which Boullay (1828) obtained from all parts of the sweet-scented violet, but in largest quantity from the rhizome. It is prepared by removing from the alcoholic extract chlorophyll and fat by means of ether, boiling the residue with diluted sulphuric acid, adding to the filtrate oxide of lead, evaporating, and exhausting the residue with strong alcohol. Violin is a yellowish, bitter, and fusible powder, which is more readily soluble in water than emetia, but less so in alcohol; is insoluble in ether, and appears to combine with acids to not-well-defined saline compounds. It merits further investigation.

Medical Uses.—Very little is known of the medicinal virtues of the only officinal violet, *V. pedata*, which, as far as can be judged, does not differ much in its qualities from the European species which have long been used in medicine. Sweet violets (V. odorata) were anciently held to be refrigerant and astringent in "ardor of the stomach," inflammation of the eyes, and prolapse of the anus and of the uterus, and also to restrain suppuration. By the Arabians they were employed in coughs, and affections of the kidneys and of the liver, and, when prepared with sugar, as a laxative. The syrup of violets, which to this day is used in France, was employed by the Arabians in pulmonary affections. It was also formerly recommended as a local remedy for *aphthæ;* internally an infusion of the flowers was given in infantile *convulsions;* and the powder as well as an infusion of the root has been used in the same manner as ipecacuanha in the treatment of infantile *dysentery.*

An alkaloid procured from this species is represented to have exhibited the properties of emetia, causing vomiting, purging, and great prostration, in dogs; and in man analogous effects in some cases, but not uniformly. The powdered root applied to the denuded skin has sometimes acted as an emeto-cathartic. Similar effects have been obtained from V. canina.

V. tricolor, heart's-ease, also produces disturbance of the stomach and bowels, and sometimes diuresis. Its continued use is said to occasion sweating and a pustular eruption of the skin, and to impart to the urine a smell like cat's urine or that of conium. It once had a great popular repute in Europe as a purifier of the blood, and as a remedy in chronic *bronchial* and *intestinal catarrh*, in *cutaneous eruptions*, and particularly in *crusta lactea* (eczema infantile). In these affections it was administered in a decoction of milk. It had also some repute in constitutional syphilis. In Europe the syrup of violets is sometimes employed as a laxative for infants, but its chief use is to give a fine color to mixtures.

VISCUM.—Mistletoe.

Gui de chêne, *Gillon*, Fr.; *Mistel*, G.

Viscum album, *Lin.*, and Viscum flavescens, *Pursh.*
Nat. Ord.—Loranthaceæ.

Origin and Description.—The mistletoes are small parasitic evergreen shrubs, growing mostly upon deciduous-leaved trees, and penetrating with their simple roots through the bark into the wood. *Viscum album* is indigenous to Europe, and is chiefly found upon apple, pear, plum, and similar trees, but grows also upon poplars, birches, beeches, and others. *Viscum flavescens* (Phoradendron, *Nutt.*) is an American species growing upon oaks, elms, apples, etc., in the southern United States, and northward to New Jersey, and westward in the Mississippi Valley. Both plants are of a yellowish-green color, one-half to two feet high, much branched, jointed, and have opposite, often scale-like leaves and monœcious or diœcious flowers in small clusters or short spikes. The leaves of the European species are lanceolate or spatulate, obtuse and entire; those of the American plant are obovate or oval. The fruit of both species is a small, whitish, one-seeded berry. The branches are usually collected. They have an unpleasant heavy, and rather weak odor, and a mucilaginous, sweetish, bitter and somewhat astringent taste.

LORANTHUS EUROPÆUS, *Lin.*, is the *viscum quernum* of ancient writers. It is a somewhat larger and thicker shrub, which grows upon oaks and chestnuts in Eastern and Southern Europe, and has a grayish or dark-brown bark and pale yellow berries.

Constituents.—Mistletoe has been analyzed by Gaspard, Funcke, Winckler, Macaire, and Reinsch. It contains mucilage, sugar, an odorous principle, fixed oil, resin, traces of tannin, and various salts. The most interesting constituent is *viscin*, also called *birdlime*, or more properly *birdglue*, from the German name *Vogelleim.* It is insoluble in water, alcohol, and fixed oils, but dissolves in ether and oil of turpentine, and on evaporating the solvents, remains behind as a yellowish viscous and tenacious mass. It seems to be present in the mistletoe in small proportion, but a larger quantity is formed by a kind of fermentation. The same or a similar compound may be obtained from the inner bark of the European holly, Ilex aquifolium, *Lin.*, from the root of Gentiana lutea, *Lin.*, and from other plants. It is employed for catching small birds; hence the name *Vogelleim.*

Medical Action and Uses.—The operation of mistletoe is as uncertain as its virtues are doubtful. The berries are reported by some writers (Cazin) to be innocuous, but others state that they are emetic and purgative, and instances are given in which very young children have suffered convulsions and even death from eating large quantities of them. It seems not impossible that these effects may have been due to indigestion alone. It is true that a case is recorded in which after several children had eaten the berries of V. flavescens, they were affected with vomiting, great thirst, tenesmus, bloody and mucous stools. In one case death ensued in a state of collapse. In Europe, however, the dried young twigs and leaves of mistletoe have alone been used in medicine, and chiefly as a remedy for *epilepsy*, although sometimes for *hysteria*. It was formerly given in powder in the dose of from ten to sixty grains, or in a decoction made with from half an ounce to two ounces of the plant in eight ounces of water, and in tablespoonful doses several times a day. This medicine is now wholly obsolete.

WINTERA.—WINTER'S BARK.

Cortex winteranus.—Cannelle de Magellan, Fr.; *Winter's Zimmt*, G.

The bark of Drimys Winteri, *Forst.*, s. Wintera aromatica, *Murray.*

Nat. Ord.—Magnoliaceæ, Wintereæ.

Origin.—Drimys Winteri is a small tree growing in the western part of South America, from the Straits of Magellan northward to Mexico. It has coriaceous, oblong and obtuse or lance-oblong, dark-green and on the lower side pale bluish-green, entire leaves, axillary clusters of whitish flowers, and about four or eight black obovate berries containing three or four seeds.

Description.—Winter's bark is curved or in quills, between one-tenth and one-quarter inch thick, externally of a gray or whitish color, and underneath the corky layer brown. The inner surface is brown, and marked with longitudinal ridges from the prominent bast fibres. The bark breaks with a short fracture, shows upon transverse section a radiate arrangement of the tissue, and has a peculiar odor and a warm and very pungent taste.

Substitutions.—The Winter's bark of commerce has usually been an entirely different bark, occasionally that of Canella alba, *Lin.*, but more frequently obtained from Cinnamodendron corticosum, *Miërs* (see page 334).

Constituents.—The principal constituents of Winter's bark as ascertained by Henry (1820) are volatile oil, about ten per cent. of pungent resin, and nine per cent. of tannin.

Medical Action and Uses.—The action and uses of Winter's bark resemble those of cascarilla and canella. It is a warm tonic of the digestive organs, increasing the appetite and improving the digestion, especially when deranged by *flatulence* and *colic*. The *dose* of the powder is about thirty grains; and a vinous infusion may be prepared by displacement with an ounce of the bark to twelve ounces of sherry wine.

XANTHORRHIZA, *U. S.*—YELLOW ROOT.

The rhizome and root of Xanthorrhiza apiifolia, *L'Heritier.* Bentley and Trimen, Med. Plants, 9.

Nat. Ord.—Ranunculaceæ.

Origin.—This plant is also known as *shrub yellow root* to distinguish it from Hydrastis canadensis. Xanthorrhiza is a shrub one or two feet high, growing in shady places near streams in New York, and from the mountains in Pennsylvania southward to the Gulf of Mexico. The clustered stems are thin, of a grayish color externally, smooth, and annulate from the distant leaf-scars. The leaves are alternate, crowded at the ends of the branches, long petiolate, pinnate, and have three or five ovate or lanceolate, cleft and toothed leaflets, with wedge-shaped bases. The flowers are polygamous, and in compound drooping racemes appearing in early spring.

Description.—Yellow root consists of a much branched and bent rhizome, several feet long. The thicker portions are about half an inch in diameter, the branches thinner, some being only one-sixteenth of an inch thick, longitudinally wrinkled, of a light yellowish-brown color externally, and rather sparingly beset with brittle rootlets. The bark is thin, internally of a deep yellow color, and separates readily from the bright yellow tough wood, which is radially striate by medullary rays and incloses a thin central pith. The rhizome breaks with a short fibrous fracture, is inodorous, and has a bitter taste, which is more marked in the cortical portion. Portions of the stems, having a larger brownish pith and yellow wood, are often present.

Constituents.—Perrins (1862) showed that yellow root contains berberina; he obtained only seven and a half grains of the nitrate from one pound of the drug. About the same time, W. M. Merrill made a similar observation. Whether berberina is associated with a white alkaloid, as is frequently the case, has not been determined. The parenchyma contains starch. The other constituents of the drug are not known.

Medical Uses.—Yellow root has long been known as an indigenous tonic medicine, and compared either to quassia or columbo. It may be given in decoction, tincture, or powder. Of the last the *dose* is said to be forty grains.

XANTHOXYLUM, *U. S.*—PRICKLY ASH.

Toothache tree, *Angelica tree*, *Suterberry*, E.; *Clavalier*, *Frêne épineux*, F.; *Zahnwehholz*, G.

The bark of Xanthoxylum fraxineum, *Willd.* (s. X. americanum, *Miller*); and of Xanthoxylum carolinianum, *Lamb.*

Nat. Ord.—Rutaceæ, Xanthoxyleæ.

Origin.—Both species of prickly ash are indigenous to North America, and have pinnate leaves, and diœcious, tetramerous or pentamerous flowers, the pistillate ones containing from three to five free ovaries, which produce thick and fleshy two-valved, and one- or two-seeded capsules.

X. AMERICANUM grows in rocky woodlands and on river-banks from Canada southward to Virginia and North Carolina. It is shrubby, and attains a height of ten or twelve feet. The leaves have nine or eleven ovate-oblong, nearly sessile, somewhat serrulate, and on the lower surface downy leaflets. The small, greenish flowers are in umbellate, axillary clusters, appear in April before the leaves, and are destitute of a calyx. The capsules are roundish, red, and contain black, shining seeds.

X. CAROLINIANUM is found near the coast from Virginia southward to Florida, and westward to Texas. It is a small tree, but sometimes grows to the height of thirty or forty feet. Its leaves have from seven to eleven ovate-lanceolate, crenate-serrulate, unequal-sided and shining leaflets, the terminal one alone being equilateral. The numerous greenish flowers are in terminal cymes, appear in June after the leaves, and contain three pistils.

Description.—NORTHERN PRICKLY ASH BARK is in small, curved, or quilled fragments, about two inches or less long, mostly less than one-sixteenth of an inch thick, and occasionally mixed with pieces nearly one-eighth of an inch thick. The corky layer is very thin, of a brown-gray color, nearly smooth, or faintly furrowed longitudinally, occasionally superficially fissured transversely, and marked with some scattered warts, becoming transversely elongated. Irregular whitish patches are usually observed on the surface of the bark, and numerous minute, black, and shining hemispherical dots, which are the perithecia of a lichen, probably a species of *verrucaria*. The brown, glossy spines are not numerous, but are about one-quarter of an inch long, straight, two-edged, and have a narrow linear base, about three-fourths of an inch long. The outer bark underneath the corky layer is of a green color, and the inner bark whitish or yellowish. The inner surface is smooth, or finely striate if obtained from older branches. The bark is quite brittle, breaks with a short, non-fibrous fracture, and exhibits upon transverse section a somewhat tangential arrangement of the tissue. It is inodorous, and has a slightly aromatic, bitterish, and strongly pungent taste.

SOUTHERN PRICKLY ASH BARK resembles the preceding, except that it is somewhat thicker, and bears on its surface many conical, corky projections which are one-half to three-fourths of an inch high, and have an oblong or roundish base, an inch or more in diameter. Sometimes a number of these cones are crowded together. The stout brown spines are situated upon elevated corky bases.

Substitution.—The bark of Aralia spinosa, *Lin.*, which plant is known by the same common names as the two species of Xanthoxylum, is sometimes collected in place of the bark of the latter. Aralia bark is described on p. 226.

Allied Species.—XANTHOXYLUM CLAVA HERCULIS, *Lin.* This is the Hercules' club of the West Indian Islands, and is closely allied to the Southern prickly ash.

X. ALATUM, *Roxb.*, of Northern India, X. PIPERITUM, *D. C.*, a native of

Japan, and several other species, yield pungently aromatic fruits, which are employed as condiments in the East. The bark, leaves, and fruit of most species are pungent or acrid.

Constituents.—Prickly ash bark was examined by Dr. Staples (1829), who obtained from it a little volatile oil, a green-colored fixed oil, resin, and other common vegetable principles, and a crystalline body, which he named *xanthoxylin*, but the nature of which was not further characterized. The bitter principle of the bark of *X. clava Herculis* was isolated by Chevallier and Pelletan (1827), and designated as *xanthopicrit*, but was found by Perrins (1863) to be identical with *berberina.*

The fruit of *X. piperitum* was examined by Stenhouse (1854, 1857). On being distilled with water, volatile oil is obtained, which, on exposure to cold, yields crystals of *xanthoxylin*, $C_{20}H_{24}O_8$. It melts at 80° C. (176° F.), has a slight odor and aromatic taste, and a neutral reaction. The liquid portion of the volatile oil is *xanthoxylene*, $C_{10}H_{16}$, is colorless, has a strong, agreeable odor, boils at 162° C. (324° F.), and yields, with hydrochloric acid, a liquid compound.

Medical Action and Uses.—Xanthoxylum appears to be an arterial and nervous stimulant, which displays its virtues in producing diaphoresis, expelling *flatus*, and allaying muscular *rheumatic* pains. Locally it is an acrid irritant, and hence has been much used as a sialagogue. Its infusion may be applied on compresses or otherwise for producing revulsion. These qualities have caused it to be compared with mezereon, and, like it, to be used as a remedy for chronic constitutional *syphilis.* It has also been employed as an *emmenagogue*, like other acrid stimulants; and doubtless, like them, it will promote the secretion of milk when applied to the *mammæ* under appropriate circumstances. A decoction may be prepared by boiling an ounce of it in three pints of water until reduced to two pints. About a pint should be taken, in divided doses, within twenty-four hours. A saturated tincture may be used in the dose of ten drops.

XYLOL.—XYLOL.

Xylol, *Xylène*, Fr.; *Xylol*, G.

Formula C_8H_{10}. Molecular weight 106.

Origin and Preparation.—Xylol was discovered by Cahours (1850) in crude wood spirit, and was subsequently found by Völckel (1853) in wood tar (see p. 1085), and by Church (1855) in coal tar. Cahours prepared it by diluting crude wood spirit with water, collecting the pale-yellow oily liquid, treating it with sulphuric acid, separating the thin clear liquid, washing it with dilute potassa solution, dehydrating it with chloride of calcium, and then subjecting it to fractional distillation, when toluol is first obtained, and afterwards between 128° and 130° C. (244° and 248° F.) xylol; the residue in the retort contains cumol and other compounds. Völckel's process consists in treating the light oil of wood tar with sulphuric acid, and distilling the undissolved portion in fractions.

Properties.—Xylol is a thin colorless oily liquid, resembling benzol in odor, and having a burning taste. It is insoluble in water, but dissolves readily in alcohol. When pure it boils at 126.2° C. (259° F.), while the isomeric *paraxylol* boils at 139° C. (282.2° F.). On treating xylol with cold concentrated nitric acid, *nitroxylol* is obtained as an oily liquid, having a less agreeable odor than nitrobenzol. Xylol unites with sulphuric acid to *sulphoxylolic acid*, the barium salt of which crystallizes from hot water in transparent scales (*Church*).

Medical Action and Uses.—The only purpose for which this preparation appears to have been employed in medicine is to moderate the angina and eruption in the throat, and to diminish the fetid exhalation from this part and from the skin, in *smallpox*. It seems to have been efficient when used for the throat in a gargle, spray, or wash, in lessening the swelling and difficulty of swallowing, and destroying the fetor when applied to the skin. It may also be given suspended in mucilage and syrup. The dose for an adult is stated to be ten or fifteen drops, and for children three or four drops; but its topical application is to be preferred.

ZEDOARIA.—ZEDOARY.

Rhizoma zedoariæ, P. G.—*Zédoaire*, Fr.; *Zittwerwurzel*, G.

The rhizome of Curcuma zedoaria, *Roscoe*. *Nat. Ord.*—Zingiberaceæ.

Origin.—The zedoary plant is indigenous to India and some of the East Indian islands, has long dark-green leaves with a large purple spot in the centre, and produces a short scape bearing a raceme of yellow flowers. The tuberous ovate or pear-shaped rhizome is about one and a half or two inches long, and is usually cut into transverse slices before drying.

Description.—Zedoary is met with in the market in the form of nearly circular disks, varying in diameter from one-half to one and a half inch. It is externally of a grayish-brown color, upon the transverse surface grayish, and has near the edge a dark-colored circular nucleus-sheath. The central portion contains a large number of small orange-colored resin-cells and irregularly scattered wood-bundles; both are seen also outside of the nucleus-sheath, though in smaller number. The disks break with a short, mealy or somewhat waxy fracture, have a peculiar aromatic odor, and a warm aromatic somewhat camphoraceous taste.

Constituents.—Bucholz (1817) obtained from zedoary starch, mucilage, bitter extractive, a pungent soft resin, and volatile oil; the latter is pale yellow, of a thick consistence, heavier than water, and has a bitterish, pungent, and somewhat camphoraceous taste.

Medical Action and Uses.—Zedoary is usually regarded as being almost identical in its qualities with ginger, but more agreeable, because less burning and acrid. It is used for similar purposes, viz., to promote *digestion*, expel *flatus*, etc. The powder may be prescribed in *doses* of from ten to thirty grains; or an infusion may be made with three or four drachms of the bruised root to half a pint of wine or water, and given in tablespoonful doses.

ZINCI ACETAS, *U. S.*, *Br.*—ACETATE OF ZINC.

Zinci aceticum, P. G.; *Acetas zincicus.*—*Acétate de zinc*, Fr.; *Essigsaures Zinkoxyd*, G.

Formula $Zn(C_2H_3O_2)_2.3H_2O$. Molecular weight 237.

Preparation.—Take of Commercial Oxide of Zinc two troyounces; Acetic Acid, Distilled Water, each five fluidounces. Mix the acid and water, and digest the oxide of zinc in the mixture for half an hour, then heat to the boiling point, filter while hot, and set aside to crystallize. Drain the crystals in a funnel, and dry them upon bibulous paper. An additional quantity of crystals may be obtained by evaporating the mother-liquor to one-half, slightly acidulating with acetic acid, and crystallizing. *U. S.*

The process of the British Pharmacopœia agrees with the preceding except that carbonate of zinc is directed.

On digesting oxide or carbonate of zinc with acetic acid, the zinc is dissolved, in the latter case with the evolution of carbonic acid gas; $ZnO+2HC_2H_3O_2$ yields $Zn(C_2H_3O_2)_2+H_2O$. An excess of the zinc compound is used, to avoid loss of acetic acid, and is removed by filtration. Should the acetic acid not have been diluted with too large a quantity of water, the hot filtrate, on cooling, will deposit most of the zinc acetate as crystals. The mother-liquor should be evaporated without boiling, so as to avoid loss of acetic acid, and formation of basic salt; the acidulation of the concentrated mother-liquor with a little acetic acid will restore the neutral from the basic acetate, should the latter have been formed.

Properties.—Acetate of zinc crystallizes in soft white pearly six-sided tables or scales, which have a sharp metallic taste, and on exposure to the air lose their transparency from the evaporation of some acid and water of crystallization. When heated, the crystals melt, and at a higher heat the salt is decomposed. At ordinary temperatures it dissolves in three parts of water, and in a much smaller quantity at the boiling point. It requires about thirty parts of alcohol for solution. Treated with sulphuric acid the salt is decomposed with the evolution of acetic acid.

Tests.—On passing an excess of sulphydric acid gas through the aqueous solution a white precipitate of sulphide of zinc is obtained, and the filtrate on being evaporated leaves no fixed residue (*absence of other metals*). The aqueous solution is not precipitated by nitrate of barium (*sulphate*) or nitrate of silver (*chloride*); it yields with solution of potassa or ammonia a white precipitate, which is dissolved by an excess of the alkaline liquid, and this solution yields again a white precipitate on the addition of sulphydric acid (*other metals*). *Magnesia*, if present, may be detected in the aqueous solution after rendering it alkaline with ammonia, by adding a drop of phosphoric acid, when a white precipitate will be produced; or the zinc is first completely precipitated by sulphydrate of ammonium, and the filtrate, after having been boiled, is tested with phosphate of ammonium, when ammonio-phosphate of magnesium will be deposited.

Off. Prep.—Zinci acetas, *Br.;* Zinci oxidum, *U. S.*, *Br.*

Medical Action and Uses.—Acetate of zinc acts locally as an irritant and astringent. Internally, in large doses, it occasions vomiting. There is no reason to believe that in any dose it produces poisoning. Internally, it is rarely used in this country. Some years ago it was recommended after this manner by certain German physicians in the treatment of erysipelas and other febrile affections attended with *delirium;* and occasionally it has been employed to check *diarrhœa* in typhoid fever and similar cases. Its chief use, however, is as a local substitutive and astringent application in *conjunctivitis*, *gonorrhœa*, and *leucorrhœa.* For the first named affection a collyrium may be made with rose-water, or pith of sassafras in the proportion of about one or two grains of the salt to the fluidounce, to which a few drops of wine of opium may be added. In gonorrhœa and leucorrhœa a customary injection is prepared by dissolving sulphate of zinc and acetate of lead, of each twelve grains, in eight fluidounces of water. The salts react upon one another, producing acetate of zinc and sulphate of lead, the latter of which is precipitated. The value ascribed to this preparation appears to depend partly upon the modifying influence of the insoluble lead salt which sheathes the inflamed parts. When injected the liquid should be shaken. A similar injection is prepared with sulphate of zinc, gr. vj; solution of subacetate of lead, ♏xxx; water, f℥iv.

ZINCI CARBONAS PRÆCIPITATA, *U. S.*—PRECIPITATED CARBONATE OF ZINC.

Zinci carbonas, Br.; *Zincum carbonicum, Carbonas zincicus.—Carbonate de zinc*, Fr.; *Kohlensaures Zinkoxyd*, G.

Formula $ZnCO_3.(ZnO)_2.3H_2O$. Molecular weight 341.

Preparation.—Take of Sulphate of Zinc, Carbonate of Sodium, each twelve troyounces; Water eight pints. Dissolve the salts separately, with the aid of heat, each in four pints of the water. Then mix the solutions, and, having stirred the mixture, set it by that the precipitate may subside. Lastly, having poured off the supernatant liquid, wash the precipitate with hot water until the washings are nearly tasteless, and dry it with a gentle heat. *U. S.*

Take of Sulphate of Zinc ten ounces; Carbonate of Soda ten and a half ounces; Boiling Distilled Water a sufficiency. Dissolve the carbonate of soda with a pint of the water in a capacious porcelain vessel, and pour into it the sulphate of zinc, also dissolved in a pint of the water, stirring diligently. Boil for fifteen minutes after effervescence has ceased; and let the precipitate subside. Decant the supernatant liquor, pour on the precipitate three pints of boiling distilled water, agitating briskly; let the precipitate again subside, and repeat the processes of affusion of hot distilled water and subsidence till the washings are no longer precipitated by chloride of barium. Collect the precipitate on calico, let it drain, and dry it with a gentle heat. *Br.*

On adding cold solutions of sodium carbonate and zinc sulphate together, neutral zinc carbonate is precipitated; $Na_2CO_3 + ZnSO_4$ yields $Na_2SO_4 + ZnCO_3$. The gelatinous precipitate rapidly undergoes decomposition, carbonic acid being evolved, and this renders another portion of the precipitate soluble. But if the mixture is boiled, the carbonic acid is expelled from the liquid, and the whole of the zinc is precipitated. Adding the solution of zinc sulphate to that of sodium carbonate while boiling hot, keeps the precipitate free from sodium compound, and the sulphate of sodium which is formed at the same time is readily removed by washing with water. Carbonate of potassium is not so well adapted for this process as the sodium salt, because the resulting potassium sulphate is less freely soluble in water; and ammonium carbonate is unsuitable, since a complete precipitation of the zinc cannot be effected.

Properties.—Carbonate of zinc is a soft, white, inodorous, and tasteless powder, insoluble in water, but dissolving readily in acetic and dilute mineral acids with the evolution of carbonic acid gas. When heated in a crucible to redness it parts with its water and carbonic acid, and leaves about 70 per cent. of oxide of zinc.

Composition.—The amount of water and the proportion of oxide of zinc and carbonic acid vary in the precipitated carbonate of zinc, and, according to H. Rose (1852), are influenced by the temperature during its preparation and drying.

Tests.—The solution of carbonate of zinc in dilute nitric acid should not be precipitated by nitrate of barium (absence of *sulphate*), or by nitrate of silver (absence of *chloride*). Mixed with an excess of carbonate of ammonium, the solution should yield a clear liquid (absence of *calcium* compounds), which is not precipitated by a drop of phosphoric acid (*magnesia*), and which yields a white precipitate with sulphuretted hydrogen.

Off. Prep.—Ceratum zinci carb., *U. S.*

Medical Uses.—Carbonate of zinc is seldom given internally, and its topical application is confined to those excoriated or inflamed surfaces which it is desirable to protect from the air and moderately to constringe. Hence, in powder it is very useful in healing *blisters* and other superficial *sores* which resist milder applications; to prevent the friction that occasions *intertrigo*, and to cure such abrasions when they occur. It is most generally applied in the form of the officinal zinc cerate.

ZINCI CHLORIDUM, *U. S.*, *Br.*—CHLORIDE OF ZINC.

Zincum chloratum, P. G.; *Chloruretum zincicum.*—*Chlorure de zinc*, Fr.; *Chlorzink*, G.

Formula $ZnCl_2$. Molecular weight 136.

Preparation.—Take of Solution of Chloride of Zinc a convenient quantity. Evaporate the solution to dryness in an evaporating dish, fuse the dry mass, pour the liquid on a flat stone, and when it has congealed, break the mass in pieces, and keep the fragments in a well-stopped bottle. *U. S.*

The British Pharmacopœia repeats the directions given for preparing the *Liquor zinci chloridi* (see p. 854), except that the last filtrate is to be evaporated in a porcelain basin until a portion of the liquid, withdrawn on the end of a glass rod and cooled, forms an opaque white solid; the liquid is then poured into proper moulds, and when the salt has solidified, but before it has cooled, it is placed in closely stoppered bottles.

The reactions occurring in the preparation and purification of chloride of zinc are explained on pages 854 and 855.[1] Towards the close of the evaporation of the solution, the heat should be regulated so as not to decompose the salt; and, in case it should become opaque from the separation of basic salt, a little hydrochloric acid should be added. If the salt is desired for solution in water, the liquid is evaporated and continually stirred until a granular powder remains.

Properties.—Chloride of zinc is either in the form of a white powder, or in opaque tablets or rods. It has a strongly caustic and metallic taste, is very deliquescent on exposure, and when heated, melts and is subsequently volatilized, forming white fumes and leaving a yellowish residue; but when heated in a current of chlorine gas, the salt sublimes in acicular crystals. Chloride of zinc usually yields with water a somewhat turbid solution from the presence of variable quantities of oxychloride; the solution dissolves starch, paper, and other organic compounds, and should therefore be filtered through asbestos or gun-cotton, but not through paper if a white salt is desired. Chloride of zinc dissolves also freely in alcohol, and somewhat less freely in ether. In contact with sulphuric acid it is converted into sulphate of zinc. Its solutions yield white precipitates with sulphydrate of ammonium and with nitrate of silver. On mixing a concentrated solution of zinc chloride with oxide of zinc, a plastic mass of oxychloride of zinc is obtained which soon hardens.

Tests.—The solution of chloride of zinc in water acidulated with hydrochloric acid should yield no precipitate with sulphuretted hydrogen (*lead and similar metals*). With an excess of ammonium carbonate a clear solution should be obtained (*aluminum, iron, calcium,* etc.), which is not precipitated by a drop of phosphoric acid (*magnesium*), and yields with sulphuretted hydrogen or sulphydrate of ammonium a white precipitate; the filtrate from which, on being evaporated and ignited, leaves no residue (*potassium, sodium*).

Pharmaceutical Uses.—CHLORIDE OF ZINC PENCILS, *Pâte de Canquoin*, Fr., according to the Codex, are prepared by dissolving chloride of zinc in a small quantity of water, and adding, with continual trituration, an equal weight of flour. P. Carles (1878) found this to be too hygroscopic, and proposes to triturate in a mortar 10 grams of fused chloride of zinc with 2 grams of 60 per cent. alcohol, and incorporating, with constant trituration, 15 grams of wheat flour. This mass may be formed into cylinders of suitable size, and when once dry is but little affected by atmospheric humidity.

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[1] On page 855, lines 4 and 6 from top, the figures 24½ should be 33¼, and 9¼ should be 12½.

Physiological Action.—In small and properly adjusted doses chloride of zinc is said to act as a stimulant and tonic to the nervous system, and increase the urinary secretion; but the grounds of these statements are more than equivocal. In large doses it is a powerful irritant poison, occasioning pain in the stomach, nausea, vomiting, anxiety, quick and short breathing, a small and rapid pulse, cold sweats, syncope, and convulsions. Generally, after death, the mucous membrane of the throat and œsophagus, if not of the mouth, is found abraded, and the coats of the stomach are disorganized and converted into a leathery substance. The body shows no signs of putrefaction.

Applied externally it is a powerful corrosive, and although very painful, is perhaps less so than corrosive sublimate or arsenic. Its first application produces a sense of warmth, and more or less redness. Upon the denuded skin its action is more rapid as well as more painful, but it does not extend beyond the limits of the caustic mass. If it is made to penetrate deeply, it coagulates the blood in the vessels, and converts the soft tissues into a tough, dry, and uniform mass, which is not fetid, and which separates in from one to two weeks, leaving behind it a clean, granulating surface, that tends to rapid cicatrization.

Medical Uses.—The rare occasions in which chloride of zinc may be given internally have been already pointed out (see *Liquor zinci chloridi*). In the same connection its uses as a disinfectant were noticed. When, owing to the timidity of patients or any other cause, the knife cannot be employed for the removal of *malignant* and other *morbid growths*, this preparation is preferred before other caustic applications, because it runs no risk of poisoning the system, and because its action is limited to the points of its contact with the tissues. It was originally alleged to be much more successful than excision in the treatment of cancer, and, indeed, to have cured four-fifths of the cases in which it was employed; it was also thought to possess the advantage of acting on the diseased rather than on the healthy tissues. These conclusions have been proved groundless, as well as the allegation that the pain produced by the application is inconsiderable. On the contrary, the pain caused by chloride of zinc far exceeds that occasioned by the knife, even without the use of anæsthetics, and is of much longer duration. To what degree this caustic is capable of preventing a return of cancerous disease, is still undetermined. It is very positively alleged by competent authorities that the recurrence of cancerous tumors is due mainly to their incomplete extirpation by excision, and that this and some other caustics reach and destroy the cancerous germs more effectually than excision.

Several modes of applying chloride of zinc as a caustic have been employed. The oldest is that of Canquoin, who made use of a paste containing one part by weight of the chloride to two, three, four, or five parts of rye flour; or five parts of the chloride, and ten of rye flour made into a paste with two parts of glycerin may be used. Gluten has been used as an excipient instead of flour. Mayet's paste is made as follows: Chloride of zinc, eight parts; oxide of zinc one part; wheaten flour dried at 212° F. seven parts; water one part. Mix the oxide of zinc and the flour, dissolve the chloride of zinc in the water, and add to the solution the mixture of oxide of zinc and flour. Rub the paste in a mortar for ten minutes. Cooke's method consists in saturating lint with the deliquesced salt, and keeping it, after it is dried, in a close box of wood or pasteboard. The lint when used must be cut with scissors that can be spared, since it ruins steel instruments. A convenience of this preparation is that it can be applied in pieces proportioned to the size of the part to be acted upon. A similar advantage is possessed by a mixture of chloride of zinc and gutta percha in equal parts; its caustic action is attenuated by the inert and insoluble portion of it. Conical or arrow-shaped bodies made with chloride of zinc alone, or of this salt and nitrate of potassium, are sometimes thrust into incisions made in the tumor to be acted upon. Before applying any of these mixtures, the cuticle, if unbroken, must be removed by means of strong ammonia. The stronger preparations have been used to destroy anastomotic *aneurisms* and *lupus*, to arrest hospital *gangrene*, and to open *abscesses* where puncture or incision might be dangerous, as abscesses of the liver. It has also been employed to fill the cavities of *carious teeth*, especially of the incisors.

ZINCI OXIDUM, *U. S.*, *Br.*—OXIDE OF ZINC.

Zincum oxydatum purum, P. G.; *Oxydum zincicum.*—*Oxyde de zinc*, Fr.; *Zinkoxyd*, G.

Formula ZnO. Molecular weight 81.

Preparation.—Take of Precipitated Carbonate of Zinc twelve troyounces. Expose it, in a shallow vessel, to a low-red heat, until the water and carbonic acid are wholly expelled. *U. S.*

The British process is identical with the preceding, except that the operation is performed in a loosely covered Hessian crucible. At a sufficiently high temperature, carbonate of zinc parts with its water and carbonic acid, leaving oxide of zinc behind. The operation is known to be finished if a small portion, taken from the centre of the vessel and mixed with a little water, no longer produces effervescence on being dropped into dilute sulphuric acid. A dull red heat, as directed by both Pharmacopœias, is not necessary for this purpose. Mohr observed that a temperature of 280° C. (536° F.) is sufficient for obtaining the oxide, and, according to Hager, all carbonic acid is expelled at 250° C. (482° F.). With quantities of from 6 to 12 ounces of carbonate of zinc, the operation is conveniently performed in a glass flask, placed in a sand-bath, and heated by means of gas or on a stove. The capacity of the flask should be about double the volume of the powdered carbonate. If the carbonate of zinc is not previously powdered, a higher heat and a longer time are required for expelling all the carbonic acid.

Properties.—Prepared by the officinal process, oxide of zinc is a soft, inodorous and tasteless, pale-yellowish, nearly white powder, which, on being heated, acquires a deep lemon-yellow color, and on cooling becomes again nearly white. After having been heated to bright redness, it continues for some time to emit light in the dark. It dissolves in dilute acetic and other acids, is completely insoluble in simple solvents, and is without action on test-paper. According to Daubrée, it may be obtained crystallized by heating chloride of zinc in a current of steam. On exposure to the atmosphere it slowly absorbs water and combines very gradually with carbonic acid.

Tests.—Oxide of zinc may contain traces of chloride or sulphate, which are detected in the solution in dilute nitric acid by the white precipitates produced with nitrate of silver and nitrate of barium. The liquid obtained on boiling oxide of zinc with water and filtering ought not to have an alkaline reaction from the presence of carbonate of sodium. The solution of the oxide in hydrochloric acid should not assume a red color on the addition of sulphocyanide of potassium (*iron*), should not be colored or precipitated by sulphydric acid (*lead* and similar metals), and should be completely precipitated with a white color by sulphydrate of ammonium; the filtrate from this precipitate, after having been boiled, should not be disturbed on the addition of oxalate of ammonium (*calcium*) or of phosphate of ammonium (*magnesium*).

Off. Prep.—Unguentum zinci oxidi (zinci), *U. S.*, *Br.*

Physiological Action.—It is conjectured that oxide of zinc, when it is received into the stomach, is converted into an albuminate, if sufficient food or mucus is contained in the organ, and that otherwise it acts as a local irritant, and even as a caustic. However this may be, it is certain that when continuously given to rabbits in large doses, it causes erosion and ulceration of the stomach, and ultimately wasting of the flesh. In experiments upon healthy men it has been found that repeated doses of four grains, or more, of this salt occasioned nausea, eructation, vomiting, confusion of the mind and senses, heat in the epigastrium, thirst, fever, a jerking pulse, muscular spasm, etc. Sometimes when prescribed in very large and continued doses, it has produced marasmus, œdema of the feet, diarrhœa, etc. These and similar effects are arrested by suspending the medicine; but even when it has been continuously given in doses of twenty, forty, or even more, grains a day, such symptoms have rarely arisen. That, however, they are really due to the poisonous action of zinc, is proved by the manner in which the smelters of the metal are affected, viz., with cough, dyspnœa, and even hæmoptysis; or dyspeptic symptoms, vomiting, and diarrhœa, loss of flesh, neuralgia, muscular spasm, and debility.

Medical Uses.—Oxide of zinc has been used in medicine chiefly for the cure of nervous diseases, and long before the experiments above referred to denoted its special mode of action; for it was introduced by Paracelsus, and proposed as a remedy for epilepsy by Gaubius, who learned its virtues from a charlatan. Many physicians have claimed for it a curative virtue in *epilepsy*, and among them some whose names have the weight of authority; nevertheless a rigid scrutiny of facts has proved that this medicine hardly ever cures, and seldom even palliates, the disease. A very similar account may be given of its use in *chorea*, a disease which as naturally tends to cure as epilepsy is rebellious to all treatment that is not merely palliative. The utility of the medicine in these affections is claimed by some physicians who have used it along with the bromides! Such a confusion of ideas is a fruitful source of errors in therapeutics. Oxide of zinc has also been used with alleged benefit in *spasmodic asthma*. In the nervous state consequent upon *delirium tremens*, and in *chronic alcoholism* attended with want of sleep, trembling, vertigo, tinnitus aurium, muscæ volitantes, and occasional hallucinations, it sometimes is very beneficial. In such cases it may be given in doses of two grains three times a day, and gradually increased. There is little doubt that this medicine is one of the best for colliquative *sweats*, although it sometimes fails, and is not superior to the sulphate of zinc. It should be given in one-grain doses every hour for three or four hours in the evening. In *diarrhœa*, especially among infants, it is reputed to be serviceable. Its association with belladonna is more efficient than either medicine alone. In fine powder it forms an admirable application for promoting the healing of *intertrigo*, superficial *burns* and *scalds*, *fissures* of the *nipples* or *anus*, *balano-posthitis*, flabby *ulcers*, *leucorrhœa*, and moist *eruptions of the skin*. For some of these purposes it may be mixed with powdered starch, acacia, or lycopodium. The officinal ointment is used for similar purposes. Oxide of zinc may be administered in powder or in pill, and in *doses* of from one to five grains. It is best given after meals.

ZINCI OXIDUM VENALE, *U. S.*—COMMERCIAL OXIDE OF ZINC.

Zincum oxydatum venale, P. G.; *Flores zinci*, *Pompholix*, *Nihil album*, *Lana philosophica*.—*Oxide de zinc vénale*, Fr.; *Käufliches Zinkoxyd*, G.

Formula ZnO. Molecular weight 81.

Preparation.—Metallic zinc is heated in an inclined Hessian crucible in contact with air nearly to a white heat, when it takes fire and burns to oxide, which condenses in the upper part of the crucible or in suitable vessels suspended over it, and after cooling is passed through a fine sieve. *F. P.*

Oxide of zinc prepared in this way was introduced as a pigment a number of years ago, as a substitute for white lead, under the name of *zinc white.* At present it is usually prepared directly from zinc ores by processes identical with or similar to those recommended by W. J. Taylor (1861) and G. Darlington (1862). A mixture of zinc ore and coal is packed in a suitable furnace upon a layer of coke, previously ignited and heated by means of a blast, and the vapors of oxide of zinc, which are at first more or less mixed with particles of charcoal, are conducted into a chamber where they condense as a gray powder. As soon as the condensing product has a white color, the vapors are passed into another chamber, where they condense as zinc white. The gray product is identical with the impure oxide of zinc, which was formerly used in medicine under the names of *tutia*, *cadmia fornacum* or *tutty.*

Properties.—Commercial oxide of zinc is a white powder which agrees in all other properties and in its behavior to tests with the oxide of zinc prepared from the carbonate. It is employed for the preparation of acetate and other salts of zinc.

Medical Uses.—Commercial oxide of zinc is used only in powder, as an external application in the various local affections mentioned under oxide of zinc, to diminish secretion and protect the parts from the action of the air.

ZINCI PHOSPHIDUM.—PHOSPHIDE OF ZINC.

Phosphuret of zinc, E.; *Phosphure de zinc*, Fr.; *Phosphorzink*, G.

Formula Zn_3P_2. Molecular weight 257.

Preparation.—If zinc is fused in a crucible, and phosphorus is added in small pieces at a time, the crucible being kept covered as much as possible, a union of the two elements takes place; but it is difficult to obtain the compound of uniform composition. According to Schrötter (1849), finely-divided zinc is heated to dull redness, while the vapor of phosphorus is being passed over it. Vigier's modification of this process consists in heating the zinc in a current of hydrogen; after all atmospheric air has been expelled, vapors of phosphorus are passed over the zinc. On account of the great danger connected with this process, owing to the liability to violent explosions, Proust (1869) proposed the following process: Nitrogen gas is evolved by heating nitrite of ammonium, and the gas is passed through a bottle in which phosphoretted hydrogen is prepared by introducing phosphide of calcium through a wide tube into diluted hydrochloric acid contained in the bottle. The mixed gases are passed through a wash-bottle into a porcelain tube in which zinc is heated to redness, when the metal will combine with the phosphorus, and the liberated hydrogen will escape together with the nitrogen. If the apparatus is filled with nitrogen gas before phosphoretted hydrogen is generated, there is no danger of an explosion.

Properties.—Phosphide of zinc is a gray crystalline or friable mass, having upon the fractured surface a bright metallic lustre. Vigier (1875) recommends it to be powdered and freed by sifting from metallic zinc which may be present; in this state it resembles iron reduced by hydrogen, and is readily soluble in dilute hydrochloric acid, with the copious evolution of phosphoretted hydrogen. It melts at a higher temperature than zinc, and is volatile.

Composition.—Pure phosphide of zinc consists of 24.12 per cent. of phosphorus, and 75.88 per cent. of zinc.

Physiological Action.—Phosphide of zinc in the dose of one grain is sufficient to kill a rabbit weighing seven pounds; and dogs treated with this compound for the purpose of producing fatty degeneration of the liver, all died when the dose reached one and a quarter grains. "It contains one-fourth of its weight of phosphorus, and yet its toxical action represents a strength of only one-eighth. Or eight milligrammes of the phosphide are equivalent to one milligramme of phosphorus in activity. The reason of this difference is that the phosphide is decomposed by the muriatic acid of the stomach, and one-half of the product becomes hypophosphide of zinc, whose action in small quantity is negative; and the remainder is converted into chloride of zinc and phosphoretted hydrogen." (Vigier.) Pills containing $\frac{1}{8}$ gr. of phosphide of zinc are said to occasion slight alliaceous eructations, which are more marked if this dose is exceeded, and it is alleged that $\frac{2}{3}$ gr. may be used without greater inconvenience. Indeed, Vigier states that, having taken $1\frac{1}{2}$ gr. of the phosphide in a single dose, he only experienced a transient gastric oppression; but that on the following day a like dose caused vomiting. In numerous cases two pills each containing $\frac{1}{13}$ gr. of the phosphide have occasioned excessive diarrhœa, gastric oppression, anorexia, alliaceous eructations, and rectal discharges. In other and more numerous cases, the medicine is well tolerated, especially when taken some time before meals.

Medical Uses.—Phosphide of zinc has been used principally in nervous disorders attributed to defective nutrition of the brain and spinal marrow. Among these *locomotor ataxia* and *general paralysis* are especially to be mentioned. It is alleged that in certain cases of the former affection coördination of the movements has been restored, and the evidences of sexual power revived; but the paucity of reports of its success in a disease which is ordinarily rebellious to all medicinal treatment would argue badly in its favor, even if its total want of curative power in other cases of the same disease were not well established. An almost identical statement may be made respecting the other affection mentioned, for only one or two cases of paralysis, ascribed to disseminated sclerosis of the cord, and an equal number of cases of *mercurial* tremor, are recorded, in which any advantage appears to have been derived from the medicine. A very similar statement may be made of its effects in *anaphrodisia.* Several persons have published statements of its curative virtues in *neuralgia, spinal irritation, hysteria,* and *cerebral disorders,* with an excessive elimination of phosphates in the urine; in *chlorosis, anæmia, amennorrhœa, dysmenorrhœa,* and *metrorrhagia.* But these reports, dating as far back as 1868, have not been sufficiently confirmed. More recently (1874) it has been claimed to be an efficient remedy for the neuralgic pains of *herpes zoster;* but this statement, also, lacks confirmation.

Phosphide of zinc may be given in the dose of $\frac{1}{16}$ to $\frac{1}{8}$ gr., which is estimated to equal $\frac{1}{65}$ to $\frac{1}{32}$ gr. of phosphorus; but some of those who have most recommended it direct doses of $\frac{1}{3}$ gr. every two hours. It may be prescribed in pills with liquorice powder and syrup, or in powder with starch. It is suggested that it be given when the stomach does not contain food, as being then less apt to disengage phosphoretted hydrogen.

ZINCI SULPHAS, *U. S.*, *Br.*—SULPHATE OF ZINC.

Zincum sulfuricum, P. G.; *Sulfas zincicus, Vitriolum album.*—*White vitriol*, E.; *Sulfate de zinc, Vitriol blanc*, Fr.; *Schwefelsaures Zinkoxyd, Weisser Vitriol, Galitzenstein*, G.

Formula $ZnSO_4.7H_2O$. Molecular weight 287.

Preparation.—Take of Granulated Zinc sixteen ounces; Sulphuric Acid twelve fluidounces; Distilled Water four pints; Solution of Chlorine a sufficiency; Carbonate of Zinc one-half ounce or a sufficiency. Pour the sulphuric acid previously mixed with the water on the zinc contained in a porcelain basin, and, when effervescence has nearly ceased, aid the action by a gentle heat. Filter the fluid into a gallon bottle, and add gradually with constant agitation the solution of chlorine until the fluid acquires a permanent odor of chlorine. Add now with continued agitation the carbonate of zinc until a brown precipitate appears; let it settle, filter the solution, evaporate till a pellicle forms on the surface, and set aside to crystallize. Dry the crystals by exposure to the air on filtering paper placed on porous tiles. More crystals may be obtained by again evaporating the mother-liquor. *Br.*

Zinc dissolves in dilute sulphuric acid with the evolution of hydrogen, forming sulphate of zinc; $Zn_2 + 2H_2SO_4$ yields $2ZnSO_4 + 2H_2$. Arsenic, copper, and lead, which are sometimes present in commercial zinc, are removed by the continued digestion with an excess of the metal as ordered in the above process; but iron will dissolve, together with the zinc, to ferrous sulphate. This is converted into ferric salt by chlorine water, and ferric hydrate is now precipitated on agitating the liquid with precipitated oxide or carbonate of zinc. The filtered liquid is free from the metals named, and, on being sufficiently concentrated, will yield crystals of pure sulphate of zinc.

The same salt is economically prepared on the large scale by roasting the native sulphide of zinc, ZnS, called *blende*, whereby this compound is oxidized to sulphate; this is extracted with hot water, and the clear solution evaporated yields *crude white vitriol*, which should be purified by redissolving it in water, boiling with zinc, treating with chlorine and carbonate of zinc, filtering, and evaporating to crystallization.

Properties. — Sulphate of zinc crystallizes readily in large transparent rhombic prisms, which are isomorphous with those of sulphate of zinc. As seen in commerce it is in small prismatic crystals, obtained by disturbed crystallization from concentrated solutions. On exposure, the crystals become slowly opaque from the loss of water of crystallization, of which six molecules or 37.6 per cent. are given off at 100° C. (212° F.); the last portion, amounting to 6.3 per cent., is expelled at a low red heat, or at 110° C. (230° F.), in a current of dry air. Sulphate of zinc has a strong metallic styptic taste. According to Poggiale, 100 parts of water dissolve at 10° C. (50° F.) 138.2 parts, at 20° C. (68° F.) 161.5 parts, at 50° C. (122° F.) 263.8 parts, and at 100° C. (212° F.) 653.6 parts of the crystallized salt. Supersaturated solutions are easily obtained, particularly if in contact with air which has been previously filtered through cotton. 100 parts of 40 per cent. alcohol dissolve, according to Schiff, only 3.48 parts of the salt, and in stronger alcohol it is insoluble. The aqueous solution of sulphate of zinc yields white precipitates with chloride of barium and with sulphydrate of ammonium.

Tests.—The solution of sulphate of zinc in water, after having been precipitated by sulphydrate of ammonium, should yield a filtrate which on evaporation to dryness and ignition must leave no fixed residue (*potassium*, *sodium*, *magnesium*, and other salts). If acidulated with sulphuric acid and treated with sulphuretted hydrogen, no coloration or precipitate should be occasioned (*arsenic*, *copper*, and similar metals). In case iron be present, the solution will afford with a little ferrocyanide of potassium a more or less deep-blue precipitate. An excess of ammonia added to the aqueous solution ought to yield a clear and colorless liquid; in the presence of copper the color of the solution would be blue.

Composition.—Sulphate of zinc has the formula given above, and contains 43.9 per cent. of water, 28.22 per cent. oxide of zinc, and 27.88 per cent. SO_3. The sulphate may also be obtained with 6, 5, $3\frac{1}{2}$, 2, and 1 molecules of water.

Off. Prep.—Zinci carbonas, *U. S.*, *Br.*; Zinci valerianas, *Br.*

Physiological Action.—This salt, in a certain proportion, coagulates liquid albumen, but in excess redissolves it. It acts upon mucous membranes as an irritant, but not as a true caustic, for it hardens but does not destroy the tissues. Internally, in doses of from six to twelve grains, it occasions vomiting and sometimes purging. Very large doses produce a styptic taste in the mouth, constriction of the fauces, pain in the stomach and bowels, retching, violent vomiting, purging, distress, thirst, a slow and contracted pulse, slow respiration, cold extremities, spasms, and sometimes death. This last result is, however, of rare occurrence, and in no case is the mind affected. Even four ounces of the salt in five ounces of water are said to have been taken for Epsom salts without causing death. In a fatal case death did not occur before the fifth day, and the only lesions found were some red patches near the pyloric end of the stomach and in the duodenum. The secondary effects of the medicine, or those which result from its absorption, are more or less astringent, tonic, and antispasmodic.

Medical Uses.—Externally and locally its virtues are those of a stimulant astringent; it is commonly applied to quicken vital action as well as to check secretion. It enters into a paste which is very useful in *cancrum oris*, and contains besides extract of cinchona, catechu, and honey of roses. A similar preparation is to be recommended in *aphthæ*. In *conjunctivitis* and in *gonorrhœa*, in the forming stage, or again on the decline, a solution may be employed, containing about one grain of the salt to an ounce of water. In *ophthalmia neonatorum* the following solution has been used as a collyrium: ℞. Sulphate of zinc, grs. xx; water, f℥x; solution of subacetate of lead, fʒss; tincture of camphor, fʒi–ij. A small portion of this solution may be injected between the eyelids several times a day. A solution applied with a brush or sponge to the *throat* or *larynx* should not exceed the strength of ten grains to the ounce; an atomized solution for inhalation may contain one or two grains to the ounce. In the first-named form it is useful in commencing inflammations of the fauces. To arrest *hemorrhage* it is often used in solution, and injected into the bladder, uterus, rectum, or nostrils, though, for all except the first-mentioned case, it is more efficient when applied upon a sponge. In powder this salt has been employed by insufflation in the treatment of *polypi* of the nostrils, and in solution applied to the seat of these growths after evulsion, and to prevent their reproduction. In an ointment containing one hundred and twenty grains of lard to an ounce of the sulphate, or a glycerate made with forty grains of glycerine to an ounce of the sulphate, it has been employed to treat ulcers and soft *tumors* about the vagina, anus, etc., which it dries and shrivels; and, if the part be very soft and of feeble vitality, it may produce a superficial eschar. It may be used in weak solution to lessen the secretion in *eczema*, and appease the itching in that and other cutaneous affections.

Internally, sulphate of zinc is used chiefly as an *emetic*, to evacuate from the stomach indigestible or poisonous ingesta, especially such as are not themselves local irritants, and notably narcotic poisons, such as opium, strychnia, mushrooms, rhus toxicodendron, etc. As it is a mechanical and not a sedative emetic, it is greatly to be preferred before tartarized antimony in these cases, and also when the *air-passages* are obstructed by foreign bodies, or by *false membrane*, as in *croup* and occasionally in *diphtheria*. This medicine has been used alone, or in combination, in *dysentery* and *typhoid fever;* but it is only in the chronic form of the first-named disease, and in greatly prolonged cases of the latter with predominant intestinal symptoms, that it is indicated. In *atonic dyspepsia*, with flatulent distension of the digestive canal, it is certainly of use, probably by its stimulant and astringent operation. It is reported to be efficacious in nervous *palpitation* of the heart, but probably in dyspeptic cases only. Possibly a similar explanation may be applied to its alleged success in *spasmodic* asthma, but when this affection is associated with bronchorrhœa, the efficiency of the medicine is more probable. In *whooping cough* it has enjoyed a certain reputation which may have been due to a similar mode of action, *i. e.*, to its influence in eliminating the catarrhal element. Certainly, when associated with belladonna, it is much more useful. The efficacy claimed for it in *chorea* is not sufficiently demonstrated.

Administration.—As an emetic, sulphate of zinc may be prescribed in *doses* of from ten to sixty grains dissolved in tepid water. Internally, from one to three grains may be given several times a day, and gradually increased. It is best administered in pill, and after meals, except when it is intended to act upon the stomach itself.

ZINCI VALERIANAS, *U. S.*, *Br.*—VALERIANATE OF ZINC.

Zincum valerianicum, P. G.; *Valerianas zincicus.*—*Valérianate de zinc*, Fr.; *Baldriansaures Zinkoxyd*, G.

Formula $Zn(C_5H_9O_2)_2.H_2O$. Molecular weight 285.

Preparation.—Take of Valerianate of Sodium five ounces (avoird.); Sulphate of Zinc five and three-quarter ounces; Distilled Water a sufficient quantity. Dissolve the salts separately, each in two pints (imperial) of distilled water, raise both solutions to near the boiling point, mix them, cool and skim off the crystals which are produced. Evaporate the mother-water at a heat not exceeding 200° F. to four fluidounces, cool again, remove the crystals which have formed and add them to those which have already been obtained. Drain the crystals on a paper filter, and wash them with a small quantity of cold distilled water till the washings give but a very feeble precipitate with chloride of barium. Let them now be again drained and dried on filtering paper at ordinary temperatures. *Br.*

The above process was originally proposed by Trommsdorff. On mixing hot solutions of valerianate of sodium and sulphate of zinc, the salts are mutually decomposed, resulting in the formation of sulphate of sodium, which remains dissolved, and valerianate of zinc, which crystallizes partly on cooling, the remainder being obtained on concentrating the liquid.

The salt may be likewise obtained by digesting one part of oxide of zinc with two parts of valerianic acid, diluted with water or weak alcohol, and when most of the oxide has been dissolved, filtering and evaporating the liquid.

Properties.—Valerianate of zinc crystallizes in soft white pearly scales, which have a slight odor of valerianic acid, and an astringent and sweet taste. It has an acid reaction on litmus paper, melts at about 140° C. (284° F.), at a higher heat gives off white vapors, and finally burns with a bluish flame, leaving oxide of zinc. According to Lieben and Rossi (1871) 100 parts of water dissolve at 25° C. (77° F.) 2.54 parts of valerianate of zinc. On heating the solution moderately, it becomes turbid, and clear again on cooling; but after the saturated solution has been boiled, it does not become entirely clear after cooling, in consequence of the production of a basic salt, which is less freely soluble in water. The salt is also soluble in cold alcohol, and this solution is likewise rendered turbid by heat. Hot ether, however, dissolves it more freely than cold ether. When kept over sulphuric acid the salt becomes anhydrous.

Tests.—Valerianate of zinc should be completely soluble in ammonia water. Its aqueous solution yields a white precipitate with sulphuretted hydrogen, and when an excess of the reagent has been used, the filtrate on being evaporated should leave no fixed residue. *Acetate of zinc* being freely soluble in water, if present as an adulteration, would impart a red color to solution of ferric chloride. *Butyrate of zinc* resembles the valerianate closely; it is detected, according to the British Pharmacopœia, by distilling the suspected salt with dilute sulphuric acid and adding the distillate to a solution of acetate of copper, when, if the valerianate be pure, it does not immediately affect the transparency of the fluid, but forms after a little time oily drops, which gradually pass into a bluish-white crystalline deposit. According to the German Pharmacopœia, the salt should yield nearly 30 per cent. of oxide of zinc.

Medical Action and Uses.—This compound was originally introduced as uniting in itself the peculiar virtues of both its elements in a multiple ratio. This illogical and unscientific judgment did not prevent the medicine from being largely used in spite of its high price, and excessively offensive smell. It is very doubtful whether valerianic acid possesses any medicinal virtues; those belonging to valerian reside in its oil. For a time it was lauded in *neuralgia*, both external and internal, in *nervous headache*, *nervous vertigo*, *whooping-cough*, infantile *convulsions*, and a variety of nervous and *hysterical* affections, including *chorea*. It was even declared to be a remedy for *cholera!* The only real merit it possesses consists in its sometimes alleviating neuralgic pains and headache occurring in very excitable or hysterical females. A case is recorded of its having cured *diabetes insipidus;* but as valerian alone is recognized as one of the best remedies for that disease, and as the patient was also taking opium, the influence of the zinc salt cannot be regarded as even probable. The *dose* of this preparation is variously stated at from half a grain to several grains. Probably, one grain should be the average dose. It may best be given in pill with mucilage or conserve of roses.

ZINCUM, *U. S.*, *Br.*—ZINC.

Speltrum.—*Zinc*, Fr.; *Zink*, G.
Symbol Zn. Atomicity bivalent. Atomic weight 65.

Origin.—Zinc is a rather abundant metal, and exists in the metallic state in Australia, but it is most generally met with in combination either as silicate or carbonate, known as *calamine*, or as sulphide, known as *blende*. Zinc ores have been found in Pennsylvania and Missouri, in Great Britain and different parts of Germany, particularly in Silesia. They are frequently associated with lead and other metals.

Preparation.—On smelting lead and other ores containing zinc, an impure oxide of zinc is condensed in the cooler portions of the furnace. By the long continued roasting of blende or calamine, oxide is likewise obtained. This is mixed with powdered charcoal, and the mixture heated nearly to whiteness in shallow iron retorts, when the zinc distils, and is collected in suitable condensers. The impure metal is purified by a descending distillation in crucibles furnished with an open tube reaching to the upper half of the crucible and passing through its bottom.

Properties.—Zinc is a bluish-white metal, having a lamellar or a granular structure. Its density varies between 6.9 and 7.2. Ordinarily it is rather brittle, but between 120° and 150° C. (248° and 302° F.) it is ductile, and may be rolled into sheets and converted into wire. Heated to 205° C. (401° F.) it becomes so brittle that it may be reduced to powder. It melts at about 410° C. (770° F.), and at near a white heat it boils and volatilizes, and in the presence of air burns with a bluish-green flame to oxide. Melted zinc on congealing contracts considerably. On bending zinc emits a slight cracking noise, weaker than that of tin. It has a bright metallic lustre; but, on exposure, becomes superficially tarnished. It is not much acted on by cold concentrated sulphuric acid, but on heating, unites with it, evolving sulphurous acid gas. Diluted sulphuric and hydrochloric acids dissolve it readily, with the evolution of hydrogen.

Zinc is extensively used in the arts for roofing and other purposes; melted together with copper it forms *brass*. It is useful in protecting surfaces of iron and copper from oxidation; iron having its surface coated with zinc is known as *galvanized iron*.

The *salts of zinc* are usually colorless, soluble in water, have an acid reaction, and a disagreeable metallic taste, and, by prolonged heating, are mostly converted into oxide. Their aqueous solutions acidulated with hydrochloric acid are not precipitated by sulphuretted hydrogen; but they yield with ammonia and potassa white precipitates, soluble in an excess of the alkali. White precipitates are also obtained with sulphydrate of ammonium, alkaline carbonates, and ferrocyanide of potassium; ferridcyanide of potassium yields an orange-red precipitate.

Pharmaceutical Uses. ZINCUM GRANULATUM, *Br.*—Granulated zinc is obtained by melting commercial zinc in an earthen crucible, and pouring the liquid metal in a thin stream into cold water. The congealed zinc is drained and dried.

The following *chemical compounds* of zinc are officinal: Zinci acetas, Zinci carbonas, Zinci chloridum, Zinci oxidum, *U. S.*, *Br.;* Zinci oxidum venale, *U. S.;* Zinci sulphas, Zinci valerianas, *U. S.*, *Br.*

The following *pharmaceutical preparations* contain compounds of zinc: Ceratum zinci carbonatis, *U. S.;* Liquor zinci chloridi, Unguent. zinci oxidi, *U. S.*, *Br.*

Unofficinal Zinc Salts. ZINCI CYANIDUM, *Cyanide of zinc*, $Zn(CN)_2$.—It is obtained by precipitating a solution of acetate of zinc with hydrocyanic acid, whereby acetic acid is liberated, which retains a portion of the zinc cyanide in solution; the liquid should therefore be kept nearly neutral by the occasional cautious addition of an alkali. Cyanide of zinc is a white inodorous and tasteless powder, which is insoluble in water and alcohol, but dissolves in potassa, ammonia, and in dilute acids. When long kept it undergoes decomposition, and acquires a sweetish and metallic taste.

ZINCI FERROCYANIDUM, *Ferrocyanide of zinc.*—It is prepared by precipitating a soluble zinc salt with ferrocyanide of potassium, and forms a white tasteless powder, which is insoluble in water, alcohol, and dilute acids, and evolves hydrocyanic acid on being heated with dilute sulphuric acid.

ZINCI LACTAS, *Lactate of zinc*, $ZnC_6H_{10}O_6,3H_2O$.—It is prepared as described on page 53, or by dissolving carbonate of zinc in dilute lactic acid with the aid of heat. It crystallizes in short quadrangular crystals, which have an acid reaction, and an acidulous metallic taste. The salt is not fusible, requires about 58 parts of cold and 6 parts of boiling water for solution, and is nearly insoluble in alcohol. It yields 27.1 per cent. of oxide of zinc.

ZINCI SULPHOCARBOLAS, *Zincum sulfophenolicum, P. G.; Sulphocarbolate of zinc*, $(C_6H_5SO_4)_2.8H_2O$.—It is prepared by dissolving ten parts of crystallized carbolic acid in twelve parts of sulphuric acid, heating the mixture for several hours in a water-bath, neutralizing with carbonate of barium, filtering from the precipitated barium sulphate, and precipitating the filtrate accurately with sulphate of zinc. The precipitate of barium sulphate is filtered off, and the clear liquid evaporated to crystallization. Sulphocarbolate of zinc crystallizes in reddish, or, if the solution has been acidulated with sulphuric acid, in colorless inodorous prisms or tables, which are readily soluble in water and alcohol, have an acid reaction, and when heated are decomposed without melting. The aqueous solution should yield no precipitates either with chloride of barium or diluted sulphuric acid.

Other sulphocarbolates may be prepared in an analogous manner by substituting for sulphate of zinc the carbonate or sulphate of the metal, which is desired in the form of sulphocarbolate.

Medical Uses.—Zinc is never used as a medicine in the metallic state.

Cyanide of zinc, according to earlier experimenters, occasioned, in doses of half a grain repeated at intervals, cephalic congestion, anxiety, somnolence, nervous tremors, etc. Given in large doses to animals, its effects are identical with those of hydrocyanic acid and its alkaline compounds. It has been used in *epilepsy*, *chorea*, and other convulsive affections, and also in *gastralgia* and other forms of *neuralgia*. In the last named affection, and especially in neuralgia of the fifth pair produced by cold, its good effects appear to be proven.

It may be administered, in such cases, in doses of about half a grain suspended in mucilage, or, preferably, in pill, to insure its more precise administration. It should be given at intervals of an hour or two, since its physiological operation is transient. This salt has also been used with alleged benefit in acute articular *rheumatism;* but the evidence in its favor appears to be inconclusive.

A cyanide of potassium and zinc, which is permanent, and also perfectly soluble in cold water, has been proposed, and is to be preferred on account of its solubility; it is prescribed in the doses already mentioned in sweetened aromatic water.

Lactate of zinc is reputed to be efficacious in the same affections for which the oxide is used, and to be less apt than the latter to disagree with the stomach. Its *dose* is stated to be from half a grain to one grain several times a day.

Sulphocarbolate of zinc has been used internally as a substitute for carbolic acid in surgical dressings, for the prevention of *septicæmia*, and as an injection in *gonorrhœa, leucorrhœa*, etc. It is less liable than carbolic acid itself to act as an irritant. A solution in water of the strength of from one to five per cent. is used as a topical application; and, for injections, a solution of from one to five parts in a thousand.

ZINGIBER, *U. S., Br.*—GINGER.

Rhizoma zingiberis, P. G.—*Gingembre*, Fr.; *Ingwer*, G.

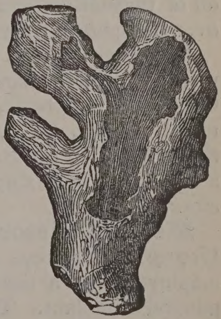
The rhizome of Zingiber officinale, *Roscoe*, s. Amomum zingiber, *Lin.* Woodville, Med. Bot., plate 11; Bentley and Trimen, Med. Plants, 270.

Nat. Ord.—Zingiberaceæ.

Origin.—The ginger plant is a perennial herb, indigenous to tropical Asia, and at the present time cultivated in most tropical countries; but it is not known in the wild state. It has numerous stems, about three or four feet high, and covered with elongated leaf-sheaths, of which the upper ones have a lance-linear spreading blade eight or twelve inches long. The flowering stems are much shorter, have a few loose leaf-sheaths, and are terminated by a short thick spike of bracted yellow and variegated flowers. The rhizome is the part employed.

Description.—Ginger is seen in commerce in two forms, either with the outer integuments present, or else removed by scraping. The former kind is called *coated*, and the latter kind *uncoated* ginger. The British Pharmacopœia directs the *scraped* rhizome; the United States Pharmacopœia does not specify the variety. Commercial ginger consists of flattened branches of the horizontal rhizome, which are somewhat palmately lobed, are known in commerce as *races* or *hands*, and bear at the somewhat thickened end of each lobe a scar from the overground stem. The coated variety has simply been washed and dried, or slightly scraped upon the flattened sides; it is externally of a brown or yellowish-brown color, wrinkled, somewhat annulate from the leaf-bases, and has a more or less shrivelled appearance. The uncoated ginger is of handsomer appearance, of a pale buff color, striated, and nearly smooth externally, or somewhat fibrous from detached prosenchyma cells; it breaks with a mealy and rather fibrous fracture, which is of a whitish or yellowish color. Well-dried coated ginger is slightly darker internally, but some varieties are quite dark-colored, and break with a horny fracture. Coated ginger is often designated as

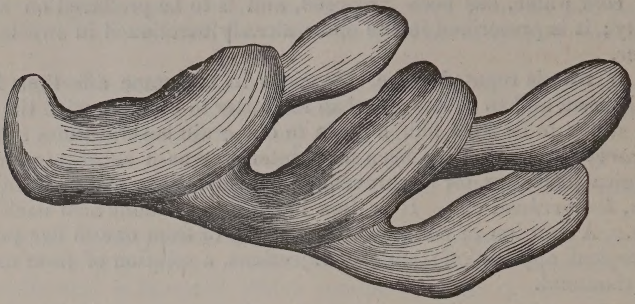
Fig. 200.



Coated ginger.

black ginger, though this name is sometimes restricted to the horny kind, which appears to have been dried by artificial heat or after having been scalded in boiling water. Uncoated ginger is sometimes called *white ginger*, and this name is also used for certain varieties which have been artificially bleached, it is stated, by exposure to the fumes of burning sulphur, whereby they acquire a chalky color, or by immersion in a mixture of chlorinated lime and water, or in lime or gypsum. A transverse section shows near the surface a nucleus-sheath, and outside of this numerous small cells containing oil and resin; the central portion contains in the loose parenchyma many scattered small fibro-vascular bundles, and a smaller number of oil-cells. The variety of ginger preferred in the United States is known as *Jamaica ginger*, comes chiefly from Jamaica, and is distinguished by being longer, and having more slender lobes than the African and East Indian ginger.

Fig. 201.



Uncoated ginger.

Jamaica ginger affords a yellowish powder; that of the other varieties is darker-colored. Ginger has a peculiar aromatic odor, and a warm pungent taste.

Constituents.—The analysis of ginger by Bucholz (1817) proved the presence of volatile oil, a pungent soft resin, starch, gummy and extractive matters. *Oil of ginger* is obtained to the amount of about $\frac{1}{4}$ per cent., has a pale yellow color, the specific gravity 0.88 or 0.89, and boils near 245° C. (473° F.); it has the peculiar odor of ginger, but rather a mild taste. According to Papousek, it is the hydrate of a hydrocarbon, having the composition of oil of turpentine, and is deprived of the elements of water by being distilled over phosphoric anhydrid.

Off. Prep.—Acid. sulphur. aromat., Confectio opii, *U. S.*, *Br.;* Conf. scammonii, Extract. zingiberis fluid., *U. S.;* Infus. sennæ, *Br.;* Infus. zingiberis, Oleoresina zingiberis, *U. S.;* Pilulæ scillæ comp., Pulv. aromaticus (P. cinnamomi comp.), *U. S.*, *Br.;* Pulv. jalapæ comp., Pulv. opii comp., *Br.;* Pulv. rhei comp., *U. S.*, *Br.;* Pulv. scammonii comp., Syrup. rhamni, *Br.;* Syrup. zingiberis, Tinct. zingiberis, *U. S.*, *Br.;* Tinct. zingiberis fortior, *Br.;* Vinum aloes, *U. S.*, *Br.*

Medical History.—Ginger was introduced from Asia through Arabia into Greece and Europe generally, and the Arabian and later Greek physicians employed it as a condiment and carminative, and also as an aphrodisiac and general stimulant. They also recognized the effect of its excessive use in debilitating the stomach.

Medical Action and Uses.—Ginger is a carminative stimulant when taken internally, and, when applied to the skin, it occasions redness, heat, and tingling. Snuffed into the nostrils it is a powerful sternutatory; and when the rhizome is chewed it causes a copious secretion of saliva. Ginger is largely employed in cooking, as the spices proper are, to render more digestible various preparations of flour, sugar, and certain vegetables, and also to expel the flatus produced by the decomposition of food in the digestive canal. In *flatulent colic* ginger is used in powder or in tincture as a carminative and anodyne. It may be given in powder mixed with hot water; but the tincture is preferable. The infusion and tincture have been largely used to correct *diarrhœa* occasioned by cold, and even for a similar purpose in the forming stage of epidemic *cholera.* Ginger has also been recommended in *chronic bronchitis.*

As a rubefacient and anodyne it is much employed in cataplasms and fomentations for the relief of *colic*, *muscular rheumatism*, *neuralgia*, *toothache*, *headache*, etc. The infusion is of use in recent cases of relaxation of the *uvula*, and of *aphonia* from a similar condition of the larynx. The rhizome may be used as a masticatory in *paralysis* of the tongue, cheek, and parts supplied by the portio dura of the fifth pair.

The *dose* of powdered ginger is from ten to thirty grains. The infusion, tincture, fluid extract, syrup, and oleoresin are officinal.

APPENDIX.

TABLE OF MAXIMUM DOSES.

Based upon Table A of the Pharmacopœia Germanica, 1872.

In Germany physicians are not permitted to prescribe heroic medicines in larger doses than those given in the table, without adding the sign ! indicating that the larger dose has been intentionally ordered. With very few exceptions, these doses are larger than the maximum doses given by the Belgian Pharmacopœia. The doses of those preparations not contained in or differing materially from those of the German Pharmacopœia, have either been reduced to the United States standard or are quoted from the Belgian Pharmacopœia; they are indicated by x. All doses are intended for adults.

	For a single dose.		For a day.	
	Gram.	Grain.	Gram.	Grain.
Acidum arseniosum	.005	$\frac{1}{13}$	.01	$\frac{1}{6}$
" carbolicum (crystal)	.05	$\frac{3}{4}$	.15	$2\frac{1}{3}$
x " hydrocyanicum dilutum	.05	$\frac{3}{4}$	.20	3
Aconitia	.004	$\frac{1}{16}$	.03	$\frac{9}{20}$
Aconiti radix	.15	$2\frac{1}{4}$	.6	$9\frac{1}{4}$
Antimonii et potassii tartras	.2	3	1.0	$15\frac{3}{8}$
Aqua amygdalæ amaræ	2.0	$30\frac{3}{4}$	7.0	108.
Argenti nitras	.03	$\frac{9}{20}$	.2	3
xArsenici iodidum	.025	$\frac{3}{8}$	.05	$\frac{3}{4}$
Atropia	.001	$\frac{1}{64}$	.003	$\frac{1}{22}$
Atropiæ sulphas	.001	$\frac{1}{64}$	.003	$\frac{1}{22}$
Auri et sodii chloridum	.06	$\frac{9}{10}$	.2	3
Barii chloridum	.12	$1\frac{4}{5}$	1.5	23
Belladonnæ folia	.2	3	.6	$9\frac{1}{4}$
" radix	.1	$1\frac{1}{2}$	.4	6
Cantharides	.05	$\frac{3}{4}$	.15	$2\frac{1}{3}$
Codeia	.05	$\frac{3}{4}$	.1	$1\frac{1}{2}$
Conia	.001	$\frac{1}{64}$	.003	$\frac{1}{22}$
Conii herba	.3	$4\frac{1}{2}$	2.0	$30\frac{3}{4}$
Creasotum	.05	$\frac{3}{4}$	.2	3
xCupri acetas	.1	$1\frac{1}{2}$	.4	6
" sulphas	.1	$1\frac{1}{2}$	.4	6
" " in divided doses as an emetic	1.0	$15\frac{3}{8}$	—	—
Cupri et ammonii sulphas	.1	$1\frac{1}{2}$	.4	6
Digitalis folia	.3	$4\frac{1}{2}$	1.0	$15\frac{3}{8}$
xExtractum aconiti (foliorum)	.1	$1\frac{1}{2}$	.4	6
" aconiti radicis	.025	$\frac{3}{8}$	.1	$1\frac{1}{2}$
" belladonnæ	.1	$1\frac{1}{2}$	.4	6
" cannabis indicæ	.1	$1\frac{1}{2}$	.3	$4\frac{1}{2}$
x " colchici aceticum	.2	3	.8	$12\frac{1}{3}$
" colocynthidis	.06	$\frac{9}{10}$	.4	6
" conii	.18	$2\frac{3}{4}$	.6	$9\frac{1}{4}$
" digitalis	.2	3	.8	$12\frac{1}{3}$
" hyoscyami	.2	3	1.0	$15\frac{3}{8}$

Table of Maximum Doses—*Continued.*

	For a single dose.		For a day.	
	Gram.	Grain.	Gram.	Grain.
xExtractum ignatiæ	.05	3/4	.15	2 1/3
“ lactucæ	.6	9 1/4	2.5	38 1/4
“ nucis vomicæ (alcoholicum)	.05	3/4	.15	2 1/3
“ nucis vomicæ aquosum	.2	3	.6	9 1/4
“ opii	.1	1 1/2	.4	6
“ physostigmatis	.02	3/10	.06	9/10
“ pulsatillæ	.2	3	1.0	15 3/8
“ sabinæ	.2	3	1.0	15 3/8
x “ scillæ alcoholicum	.1	1 1/2	.5	7 1/2
“ stramonii foliorum	.1	1 1/2	.4	6
x “ “ seminis	.05	3/4	.25	3 3/4
Gambogia	.3	4 1/2	1.0	15 3/8
Hellebori viridis radix	.3	4 1/2	1.2	18 1/2
xHydrargyri cyanidum	.02	3/10	.08	1 2/10
“ chloridum corrosivum	.03	9/20	.1	1 1/2
“ iodidum rubrum	.03	9/20	.1	1 1/2
“ “ viride (flavum)	.06	9/10	.4	6
“ oxidum rubrum	.03	9/20	.1	1 1/2
“ protonitras	.015	2/9	.06	9/10
Hyoscyami folia	.3	4 1/2	1.0	15 3/8
Lactucarium	.3	4 1/2	1.2	18 1/2
Liquor potassii arsenitis	.4	6	2.0	30 3/4
xLiquor arsenici et hydrargyri iodidi	.4	6	2.0	30 3/4
Morphia, or its salts	.03	9/20	.12	1 5/8
Nux vomica	.1	1 1/2	.3	4 1/2
Oleum tiglii	.06	9/10	.3	4 1/2
Opium	.15	2 1/3	.5	7 1/2
Phosphorus	.015	2/9	.06	9/10
Plumbi acetas	.06	9/10	.4	6
xPotassii arsenias	.005	1/13	.025	3/8
x “ cyanidum	.003	1/22	.012	4/22
Sabadillæ fructus	.25	3 4/5	1.0	15 3/8
Santoninum	.1	1 1/2	.5	7 1/2
xSodii arsenias	.005	1/13	.025	3/8
Stramonii folia	.25	3 4/5	1.0	15 3/8
x “ semen	.20	3	.8	12 1/3
Strychnia, or its salts	.01	1/6	.03	9/20
xTinctura aconiti radicis	.22	3 2/5	.9	13 3/4
“ belladonnæ	1.0	15 3/8	4.0	61 1/2
x “ cantharidis	1.2	18 1/2	3.6	55 1/2
“ colchici	2.0	30 3/4	6.0	92 1/2
“ digitalis	2.0	30 3/4	6.0	92 1/2
“ iodinii	.3	4 1/2	1.2	18 1/2
x “ iodinii composita	.6	9	2.5	38
“ nucis vomicæ	.5	7 1/2	1.5	23
x “ opii	1.75	27	6.0	92 1/2
x “ opii acetata	1.35	20 3/4	4.5	69 1/2
x “ opii deodorata	1.75	27	6.0	92 1/2
x “ stramonii	1.2	18 1/2	6.0	92 1/2
x “ veratri viridis	.5	7 1/2	2.0	30 3/4
Toxicodendri folia	.4	6	1.2	18 1/2
Veratria	.005	1/13	.03	9/20
Veratrum album or Veratr. viride	.3	4 1/2	1.2	18 1/2
Vinum colchici	2.0	30 3/4	6.0	92 1/2
Zinci chloridum	.015	2/9	.1	1 1/2
“ lactas	.06	9/10	.3	4 1/2
“ sulphas	.06	9/10	.3	4 1/2
“ “ in divided doses as an emetic	1.2	18 1/2	—	—
“ valerianas	.06	9/10	.3	4 1/2

TABLES OF WEIGHTS AND MEASURES.

Weights and Measures of the United States Pharmacopœia.

One pound, ℔ = 12 Troy ounces = 5,760 grains = 13 ounces avoird. 72.5 grains.
One Troy ounce, ℥ = 8 drachms = 480 " = 1 ounce " 42.5 "
One drachm, ʒ = 3 scruples = 60 "
One scruple, ℈ = 20 "
One grain, gr. = 1 grain.

	Cubic inches.	Troy grains.
1 minim, ♏	0.00376	0.95
60 minims = 1 fluidrachm, fʒ	0.2256	56.96
480 " = 8 fluidrms. = 1 fluidounce, f℥	1.8047	455.69
7680 " = 128 " = 16 fl. ozs. = 1 pint, O, . . .	28.875	7291.11
61440 " = 1024 " = 128 " = 8 pts. = 1 gal. Cong.	231.	58328.88

Weights and Measures of the British Pharmacopœia.

One pound, ℔ = 16 ounces = 7000 Troy grains = ℔ i ℥ij ʒiv gr. xl.
One ounce, oz. = 437.5 " = ʒvij gr. xvijss.
One grain, gr. = 1 grain.

The pound and ounce of the British Pharmacopœia are identical with the same denominations of *avoirdupois weight.* The avoirdupois ounce is subdivided into 16 drachms (1 drachm = 27.34 Troy grains); but the British Pharmacopœia recognizes no subdivisions between the ounce and grain. It is, however, optional with the physician *in prescribing* to use the symbols ℈ and ʒ, the former representing 20 and the latter 60 grains, if such should be found to conduce to accuracy or convenience.

	Troy grains.	Avoirdupois.
1 minim, *min.*	0.91	
60 minims = 1 fluidrachm, *fldr.*	54.7	
480 " = 8 fluidrachms = 1 fluidounce, *floz.* . .	437.5	= 1 ounce.
9600 " = 160 " = 20 fluid ozs. = 1 pint, O.	8750.	= 1.25 pound.
76800 " = 1280 " = 160 " = 8 pints =	70000.	= 10 pounds.

Metric Weights and Measures of the French Codex and German Pharmacopœia.

The ingredients of all preparations, whether liquid or solid, are ordered by the French Codex and German Pharmacopœia in *parts by weight*, definite weights being directed only when necessary on account of the dose. The same plan has to some extent been followed in this work.

1 milligram = 0.001 gram.
10 milligrams = 1 centigram = 0.010 gram.
100 " = 10 centigrams = 1 decigram = 0.100 gram.
1000 " = 100 " = 10 decigrams = 1.000 "
1 gram (weight of 1 cubic centimeter of water at 4° C.)
10 grams = 1 dekagram.
100 " = 10 dekagrams = 1 hektogram.
1000 " = 100 " = 10 hektograms = 1 kilogram.
1 milliliter (or 1 cubic centimeter) = 0.001 liter.
10 milliliters = 1 centiliter = 0.010 liter.
100 " = 10 centiliters = 1 deciliter = 0.100 liter.
1000 " = 100 " = 10 deciliters = 1.000 liter.
1 liter (or 1 cubic decimeter).
10 liters = 1 dekaliter.
100 " = 10 dekaliters = 1 hektoliter.
1000 " = 100 " = 10 hektoliters = 1 kiloliter.

The unit of all metric measures is the *meter* (French, *mètre*), and this is the ten-millionth part of the quadrant, or fourth part of the terrestrial meridian, the quadrant being the distance from the equator to the pole. The cube of the tenth part of a meter, denominated *liter* (Fr. *litre*), was adopted as the unit of measures of capacity. The weight of the one-thousandth part of a liter of distilled water at its greatest density (4° C.) was denominated *gram* (Fr. *gramme*), and adopted as the unit of weight. The subdivisions of all measures are named by prefixing to the name of the unit the Latin numerals *deci* (.1), *centi* (.01), and *milli* (.001); and the larger denominations by prefixing the Greek numerals *deka* (10), *hekto* (100), *kilo* (1000), and *myria* (10000).

Measures of Length.

METRIC.

1 meter = 39.37043 inches.
1 millimeter.
10 millimeters = 1 centimeter.
100 " = 10 centimeters = 1 decimeter.
1000 " = 100 " = 10 decimeters = 1 meter.
10 meters = 1 dekameter.
100 " = 10 dekameters = 1 hektometer.
1000 " = 100 " = 10 hektometers = 1 kilometer.
1 kilometer = 4 furlongs 213 yards 1 foot 10.43 inches.

ENGLISH.

1 inch = 25 millimeters = 0.025 meter.
1 inch.
12 inches = 1 foot.
36 " = 3 feet = 1 yard.
198 " = 16½ " = 5½ yards = 1 rod.
220 yards = 40 rods = 1 furlong.
1760 " = 320 " = 8 furlongs = 1 mile.
1 yard = 0.914 meter.
1 mile = 1609.33 meters.

Relative value of Wine or Apothecaries' and Imperial Measures.

Wine measure.	Imperial measure.			
	Pints.	Floz.	Fldr.	Minims.
1 minim	...	...	...	1.04
1 fluidrachm	...	...	1	2.5
1 fluidounce	...	1	0	20.
1 pint	...	16	5	19.
1 gallon	6	13	2	32.

Imperial measure.	Wine measure.				
	Galls.	Pints.	f℥.	fʒ.	Minims.
1 minim	...	...	...	...	0.96
1 fluidrachm	...	...	...	...	58
1 fluidounce	...	...	...	7	41
1 pint	...	1	3	1	38
1 gallon	1	1	9	5	4

24 fluidounces wine measure = 25 fluidounces imperial measure (difference 1 grain.)

Value of Apothecaries' or Troy Weights in Metric Weights.

Grain. Milligrams.	Grains. Grams.	Apothecaries' w't. Grams.
$\frac{1}{64}$ = 1.012	i = 0.0648	ʒi = 3.887
$\frac{1}{60}$ = 1.079	ij = 0.1295	ʒij = 7.775
$\frac{1}{50}$ = 1.295	iij = 0.1943	ʒiij = 11.663
$\frac{1}{48}$ = 1.349	iv = 0.2591	ʒiv = 15.550
$\frac{1}{40}$ = 1.619	v = 0.3239	ʒv = 19.438
$\frac{1}{36}$ = 1.799	vi = 0.3887	ʒvi = 23.325
$\frac{1}{32}$ = 2.025	vij = 0.4535	ʒvij = 27.213
$\frac{1}{30}$ = 2.159	viij = 0.5183	℥i = 31.103
$\frac{1}{25}$ = 2.591	ix = 0.5831	℥ij = 62.207
$\frac{1}{24}$ = 2.699	x = 0.6479	℥iij = 93.311
$\frac{1}{20}$ = 3.239	xij = 0.7775	℥iv = 124.415
$\frac{1}{16}$ = 4.049	xv = 0.9718	℥v = 155.519
$\frac{1}{15}$ = 4.319	xvi = 1.036	℥vi = 186.623
$\frac{1}{12}$ = 5.399	xviij = 1.166	℥vij = 217.726
$\frac{1}{10}$ = 6.479	xx = 1.295	℥viij = 248.830
$\frac{1}{8}$ = 8.098	xxiv = 1 555	℥ix = 279.934
$\frac{1}{6}$ = 10.798	xxv = 1.619	℥x = 311.038
$\frac{1}{5}$ = 12.958	xxx = 1.943	℥xi = 342.141
$\frac{1}{4}$ = 16.197	xl = 2.591	℔i = 373.245
$\frac{1}{3}$ = 21.597	l = 3.239	℔ij = 746.491
$\frac{1}{2}$ = 32.395	lx = 3.887	℔iij = 1119.736

Table for Converting Apothecaries' Weights and Measures into Gram Weights.

The gram values given below are practical approximations to the correct values. The column for *liquids lighter than water* refers to the officinal spirits and tinctures prepared with stronger alcohol, also to volatile and fixed oils, not exceeding 0.95 in specific gravity. The column for *liquids of specific gravity of water* refers to medicated waters, to tinctures prepared with diluted alcohol, and to fluid extracts prepared with diluted alcohol and alcohol, all having approximately the specific gravity of water. The column for *liquids heavier than water* refers to glycerin, syrups, honeys, and to fluid extracts prepared with glycerin.

Troy weight.	Grams.	Apothecaries' measure.	Grams for liquids		
			Lighter than water.	Spec. grav. of water.	Heavier than water.
Grain $\frac{1}{16}$	.004	Minim 1	.055	.06	.08
$\frac{1}{12}$	.005	2	.10	.12	.15
$\frac{1}{10}$	.006	3	.16	.18	.24
$\frac{1}{8}$	.008	4	.22	.24	.32
$\frac{1}{6}$	.010	5	.28	.3	.40
$\frac{1}{4}$	.016	6	.32	.36	.48
$\frac{1}{3}$	.02	7	.38	.42	.55
$\frac{1}{2}$	.03	8	.45	.5	.65
$\frac{3}{4}$	.05	9	.50	.55	.73
1	.07	10	.55	.6	.80
2	.13	12	.65	.72	.96
3	.20	14	.76	.85	1.12
4	.26	15	.80	.9	1.20
5	.32	16	.90	1.0	1.32
6	.39	20	1.12	1.25	1.60
7	.45	25	1.40	1.55	2.00
8	.52	30	1.70	1.90	2.50
9	.59	35	2.00	2.20	2.90
10 (℈ss)	.65	40	2.25	2.50	3.30
12	.78	48	2.70	3.0	4.00
14	.90	50	2.80	3.12	4.15
15	1.00	60 (fʒi)	3.40	3.75	5.00
16	1.05	65	3.60	4.0	5.30
18	1.18	72	4.05	4.5	6.00
20 (℈i)	1.3	80	4.50	5.0	6.65
24	1.5	90 (fʒiss)	5.10	5.6	7.50
30 (ʒss)	1.95	96	5.40	6.0	8.00
32	2.1	100	5.60	6.25	8.30
36	2.3	120 (fʒii)	6.75	7.5	10.00
40 (℈ii)	2.6	150 (fʒiiss)	8.50	9.5	12.50
45	3.0	160	9.00	10.0	13.30
50 (℈iiss)	3.2	180 (fʒiii)	10.10	11.25	15.00
60 (ʒi)	3.9	210 (fʒiiiss)	11.80	13.0	17.50
70	4.55	240 (fʒiv)	13.50	15.0	20.00
80 (℈iv)	5.2	fʒv	16.90	18.75	25.00
90 (ʒiss)	5.9	fʒvss	18.60	20.75	27.50
100 (℈v)	6.5	fʒvi	20.25	22.5	30.00
110 (℈vss)	7.1	fʒvii	23.60	26.25	35.00
120 (ʒii)	7.80	fʒviii (f℥i)	27.00	30.0	40.00
150 (ʒiiss)	9.75	fʒix	30.40	33.75	45.00
180 (ʒiii)	11.65	fʒx	33.75	37.5	50.00
240 (℥ss)	15.5	fʒxii (f℥iss)	40.50	45.0	60.00
300 (ʒv)	19.4	fʒxiv	47.25	52.5	70.00
360 (ʒvi)	23.3	f℥ii	54.00	60.0	80.00
420 (ʒvii)	27.2	f℥iiss	67.50	75.0	100.00
480 (℥i)	31.1	f℥iii	81.00	90.0	120.00
℥ii	62.2	f℥iiiss	94.50	105.0	140.00
℥iv	124.4	f℥iv	108.00	120.0	160.00

Rules and Tables for Converting Apothecaries' Weights and Measures into their respective Equivalents in Metric Terms for Medical and Pharmacal Purposes, and Suggestions for Writing Metric Prescriptions.

The following rules and tables have been prepared by Professor Oscar Oldberg, Phar. D., Chief Clerk and Acting Medical Purveyor, United States Marine-Hospital Service; have been adopted by John M. Woodworth, M.D., Surgeon-General United States Marine-Hospital Service, and were approved in 1878 by Hon. John Sherman, Secretary of the Treasury.

1. To EXPRESS QUANTITIES BY WEIGHT OF THE APOTHECARIES' SYSTEM IN METRIC TERMS, OR TO WRITE MEDICAL PRESCRIPTIONS IN METRIC WEIGHTS.

RULE A.—*Reduce each quantity to grains; then divide the number by* 10 (or move the decimal point one place to the left), *and from the quotient subtract one-third.* The remainder is in each case the number of grams representing (nearly) the same quantity. Or,

RULE B.—*Reduce each quantity to drachms, and multiply the number by* 4. The product is in each case the number of grams representing (nearly) the same quantity. Or,

RULE C.—*Reduce each quantity to ounces, and multiply the number by* 32. The product is in each case the number of grams representing (nearly) the same quantity.

One gram is equal to 15.43234874 troy grains.—(*Professor Miller.*) In preparing the above rules the fraction has been ignored, as for medical and pharmacal purposes 1 gram and 15 troy grains may be safely considered as equal quantities. In Rule A, therefore, a division by 15 may, if preferred, be substituted for the division by 10 followed by a subtraction of one-third from the quotient, with the same result. The difference between 15 and 15.43234874 is 2.882 + per cent., and hence the deviation from exactness in the answer arrived at by either of the above rules corresponds to an excess of 28.82 + grains for every 1000 grains. To illustrate: By Rule B, 4000 grams would be (nearly) equivalent to 1000 drachms; but 4000 grams is equal to exactly 61,729.40 + troy grains, while 1000 drachms is only 60,000 troy grains. The deviation from exactness, therefore, in the answer arrived at by Rule B (as also in the answers arrived at by Rules A and C), is equivalent to an excess of 1,729.40 + troy grains for every 1000 drachms, or about 14 grains for every ounce, or 28.82 + grains for every 1000 grains, or less than 2.9 per cent.

To insure greater accuracy, if in any case deemed necessary, three per cent. may be deducted from the answer arrived at by either of the Rules, A, B, or C. The deviation from exactness will then be reduced to one-fifth of one per cent., the remainder being less than the exact equivalent sought by only 2.04 grains for every 1000 grains, or about one grain for every ounce.

2. To EXPRESS QUANTITIES BY MEASURE OF THE APOTHECARIES' SYSTEM IN METRIC TERMS, OR TO WRITE MEDICAL PRESCRIPTIONS IN METRIC CUBIC MEASURES.

RULE D.—*Reduce each quantity to minims; then divide the number by* 10 (or move the decimal point one place to the left), *and from the quotient subtract one-third.* The remainder is in each case the number of cubic centimeters representing (nearly) the same quantity. Or,

RULE E.—*Reduce each quantity to fluidrachms, and multiply the number by* 4. The product is in each case the number of cubic centimeters representing (nearly) the same quantity. Or,

RULE F.—*Reduce each quantity to fluidounces, and multiply the number by* 32. The product is in each case the number of cubic centimeters representing (nearly) the same quantity.

One meter is equal to 39.370432 inches.—(*Captain Clarke.*) Hence one cubic centimeter is equal to 0.0610253868—cubic inches, or to 16.2311678 + minims (there being 61,440 minims in each wine-gallon of 231 cubic inches). In preparing the above rules 1 cubic centimeter and 15 minims have been considered as equal quantities, which, for medical and pharmacal purposes, is deemed sufficiently accurate. In Rule D, therefore, a division by 15 may, if preferred, be substituted for the division by 10 followed by a subtraction of one-third from the quotient, with the same result. The difference between 15 and 16.2311678 + is 8.208 — per cent., and hence the deviation from exactness in the answer arrived at by either of the above rules corresponds to an excess of 82.08 — minims for every 1000 minims. To illustrate: By Rule E, 4000 cubic centimeters would be (nearly) equivalent to 1000 fluidrachms; but 4000 cubic centimeters is equal to exactly 64,924.67 + minims, while 1000 fluidrachms is only 60,000 minims. The deviation from exactness, therefore, in the answer arrived at by Rule E (as also in the answers arrived at by Rules D and F), is equivalent to an excess of 4924.67 + minims for every 1000 fluidrachms, or about 41 minims for every fluidounce, or 82.08— minims for every 1000 minims, or 8.2 per cent.

To insure greater accuracy, if in any case deemed necessary, 8 per cent. may be deducted from the answer arrived at by either of the Rules D, E, or F. The deviation from exactness will then be reduced to less than one-half of one per cent., the remainder being less than the exact equivalent sought by only 4.49— minims for every 1000 minims, or less than 2¼ minims for every fluidounce.

The important advantage of a simple relation between the units of weight and the units of measure is acknowledged, and is one of the strong arguments in favor of the metric system, the weight unit or "gram" being the weight of one cubic centimeter of distilled water of maximum density under the pressure of one atmosphere. The minim and the grain, however, have no simple relation to each other; but as the difference between the weight of one minim of distilled water of maximum density under the pressure of one atmosphere, and the weight of a troygrain, is comparatively small, it has been ignored entirely in preparing the rules for the conversion of apothecaries' measure into metric measure (Rules D, E, and F), and hence the arithmetical processes in the rules for converting old measures into new are respectively identical with the processes given in the rules for converting weights, as will be seen upon comparison of Rule D with Rule A, Rule E with Rule B, and Rule F with Rule C. For this purpose one minim is considered as weighing one grain, one fluidrachm as weighing one drachm, and one fluidounce as weighing one ounce. (See below the "table of approximate equivalents of apothecaries' weights and measures in metric terms, as obtained in accordance with the rules herein given.")

It will be seen that if the three Rules A, B, and C, be all applied in converting the several quantities by weight in any one prescription or formula, *the original proportions between these quantities will still be preserved*, the deviation from exactness being invariable. It will also be seen that the three Rules D, E, and F, may be all applied in converting the several quantities by measure in any one prescription or formula *without disturbing the original proportions* between said quantities. Thus, if all the ingredients in the formula be expressed by weight, or if they all be expressed by measure, the rules given may be employed indiscriminately without changing the character of the formula in the least. But if in any one formula both weights and measures are used together, then the proportions between the quantities by weight and the quantities by measure will be changed, so that, in the metric formula, constructed according to the rules given, the measured quantities will be about five per cent. larger in proportion to the weighed quantities, the deviation from exactness in the measures being an excess of eight per cent., while in the weights it is an excess of only three per cent. Thus, if a prescription for one grain of a strychnia salt dissolved in four fluidounces of water, be converted into metric terms by the application of these rules, the metric formula arrived at would give us a solution *five per cent. weaker*, which is an absolutely insignificant difference.

In applying the foregoing rules for writing prescriptions, the metric quantities should be adjusted so as to be expressed in as simple decimal terms as may be practicable, without materially changing the dose or the character of the formula.

The terms "gram" and "cubic centimeter" might be abbreviated "Gm." and "C.C." To preclude the possibility (in *careless* writing), however, of mistaking the sign Gm. (gram) for the sign "gr." (grain), the number should invariably precede the sign, using the common Arabic numerals. Thus, while ten grains is always written "gr. X" (Roman numerals being used), ten grams would be written "10 Gm." When the term "centigram" is used it should be spelled out in full. Ten centigrams might, however, more conveniently be written "0.10 Gm." than "10 centigrams." In writing, the abbreviated metric denominations should always be underscored; but the preceding number should not, as above.

Two examples will suffice to illustrate the foregoing rules and suggestions. The following prescription—

℞. Extr. Coloc. Comp., ʒiss.
Extr. Colch. Acet., gr. xii.
Extr. Digitalis, gr. vj.
Make into 24 pills—

would, in metric terms, be written:—

℞. Extr. Coloc. Comp., 6 Gm. (See Rule B.)
Extr. Colch. Acet., 0.8 Gm. (See Rule A.)
Extr. Digitalis, 0.4 Gm. (See Rule A.)
Make into 24 pills

Or, in a more finished decimal manner:—

℞. Extr. Coloc. Comp., 7.50 Gm.
Extr. Colch. Acet., 1 Gm.
Extr. Digitalis, 0.5 Gm.
Make into 30 pills.

And the following prescription—

℞. Potassii Bromidi, ℥j.
Elix. Aurantii, fl. ℥viij.
Mix—

would, in metric terms, be written:—

℞. Potassii Bromidi, 32 Gm. (See Rule C.)
Elix. Aurantii, 256 C.C. (See Rule F.)
Mix.

Or, in a more finished decimal manner:—

℞. Potassii Bromidi, 30 Gm.
Elix. Aurantii, 250 C.C.
Mix.

The exact equivalents of the grain, drachm, and ounce (troy) in grams; of the gram in grains; of the minim, fluidrachm, and fluidounce in cubic centimeters, and of the cubic centimeter in minims, are as follows:—

1 grain, troy, is equal to 0.065— gram.
1 drachm, troy, is equal to 3.888— grams.
1 ounce, troy, is equal to 31.103+ grams.
1 gram is equal to 15.43234874 grains troy.—*Prof. Miller.*
(1 avoirdupois pound is equal to 453.592+ grams.)
(1 avoirdupois ounce is equal to 28.350+ grams.)
1 minim is equal to 0.062— cubic centimeter.
1 fluidrachm is equal to 3.697— cubic centimeters.
1 fluidounce is equal to 29.573— cubic centimeters.
1 cubic centimeter is equal to 16.231+ minims.
(1 meter is equal to 39.370432 inches.)—*Capt. Clarke.*

Approximate Equivalents obtained in accordance with the rules above given.

	Gm.		C.C.
$\frac{1}{64}$ grain is nearly equal to	0.0010	$\frac{1}{64}$ minim is nearly equal to	0.0010
$\frac{1}{48}$ do do	0.0013	$\frac{1}{48}$ do do	0.0013
$\frac{1}{40}$ do do	0.0016	$\frac{1}{40}$ do do	0.0016
$\frac{1}{32}$ do do	0.0020	$\frac{1}{32}$ do do	0.0020
$\frac{1}{24}$ do do	0.0025	$\frac{1}{24}$ do do	0.0025
$\frac{1}{20}$ do do	0.0033	$\frac{1}{20}$ do do	0.0033
$\frac{1}{16}$ do do	0.0040	$\frac{1}{16}$ do do	0.0040
$\frac{1}{12}$ do do	0.0050	$\frac{1}{12}$ do do	0.0050
$\frac{1}{10}$ do do	0.0066	$\frac{1}{10}$ do do	0.0066
$\frac{1}{8}$ do do	0.0080	$\frac{1}{8}$ do do	0.0080
$\frac{1}{6}$ do do	0.0110	$\frac{1}{6}$ do do	0.0110
$\frac{1}{5}$ do do	0.0133	$\frac{1}{5}$ do do	0.0133
$\frac{1}{4}$ do do	0.016	$\frac{1}{4}$ do do	0.016
$\frac{1}{3}$ do do	0.022	$\frac{1}{3}$ do do	0.022
$\frac{1}{2}$ do do	0.033	$\frac{1}{2}$ do do	0.033
$\frac{3}{4}$ do do	0.050	$\frac{3}{4}$ do do	0.050
1 do do	0.066	1 do do	0.066

Approximate Equivalents—*Continued*.

	Gm.		C. C.
1½ grain is nearly equal to	0.100	1½ minim is nearly equal to	0.100
2 do do	0.133	2 do do	0.133
2½ do do	0.166	2½ do do	0.166
3 do do	0.200	3 do do	0.200
4 do do	0.266	4 do do	0.266
5 do do	0.333	5 do do	0.333
6 do do	0.400	6 do do	0.400
7 do do	0.466	7 do do	0.466
8 do do	0.533	8 do do	0.533
9 do do	0.600	9 do do	0.600
10 do do	0.666	10 do do	0.666
12 do do	0.800	12 do do	0.800
14 do do	0.933	14 do do	0.933
15 do do	1.000	15 do do	1.000
16 do do	1.066	16 do do	1.066
18 do do	1.200	18 do do	1.200
20 do do	1.333	20 do do	1.333
25 do do	1.666	25 do do	1.666
30 do do	2.000	30 do do	2.000
35 do do	2.333	35 do do	2.333
36 do do	2.400	36 do do	2.400
38 do do	2.533	38 do do	2.533
40 do do	2.666	40 do do	2.666
45 do do	3.000	45 do do	3.000
48 do do	3.200	48 do do	3.200
50 do do	3.333	50 do do	3.333
56 do do	3.800	56 do do	3.800
1 drachm is nearly equal to	4.00	1 fluidrachm is nearly equal to	4.00
2 do do	8.00	2 do do	8.00
3 do do	12.00	3 do do	12.00
4 do do	16.00	4 do do	16.00
5 do do	20.00	5 do do	20.00
6 do do	24.00	6 do do	24.00
7 do do	28.00	7 do do	28.00
1 ounce is nearly equal to	32.00	1 fluidounce is nearly equal to	32.00
2 do do	64.00	2 do do	64.00
3 do do	96.00	3 do do	96.00
4 do do	128.00	4 do do	128.00
5 do do	160.00	5 do do	160.00
6 do do	192.00	6 do do	192.00
7 do do	224.00	7 do do	224.00
8 do do	256.00	8 do do	256.00
9 do do	288.00	9 do do	288.00
10 do do	320.00	10 do do	320.00
12 do do	384.00	12 do do	384.00
14 do do	448.00	14 do do	448.00
16 do do	512.00	16 do do	512.00

In preparing requisitions for medical supplies, 500 grams might be estimated for, instead of 1 avoirdupois pound, the latter being about 1½ ounce less than the former quantity; 30 grams might be estimated for, instead of 1 ounce (avoirdupois), the latter being about 20 grains more than the former quantity, and 5 grams might be estimated for, instead of one-eighth ounce (avoirdupois) the latter being 20 grains less; 500 cubic centimeters might be estimated for, instead of 16 fluidounces, the latter being about 1 fluidounce less; and 30 cubic centimeters might be estimated for, instead of 1 fluidounce, the latter being about 30 minims less than the former quantity; 1 meter might be estimated for, instead of 1 yard, the latter being 3⅓ inches less than the former.

Approximate Measures.

In the United States and in Great Britain prescriptions are compounded by weighing the solids and measuring the liquids; but on the continent of Europe weights alone are employed in the making of preparations and in the compounding of prescriptions. Medicines are, however, taken by familiar domestic measures, which are subject to considerable variations, but are usually estimated as having the following capacity:—

	In the United States.	In France.
A teaspoonful	one fluidrachm	5 grams of water.
A desertspoonful	two fluidrachms	———
A tablespoonful	half a fluidounce	20 grams of water.
A wineglassful	two fluidounces	———
A glassful	———	160 grams of water.
A teacupful	four fluidounces	———
A tumblerful	eight fluidounces	———

The approximate measures by the *handful* (Fr. *poignée*) and pinch (Fr. *pincée*) are almost completely discarded or employed only for the least active drugs.

The measuring of small quantities of liquids by drops gives very uncertain and variable results, which are influenced by the viscidity of the liquid, the size and shape of the vessel, the curvature of the lip, the temperature, the rapidity of dropping, and probably by other circumstances. As a rule it may be said that aqueous liquids yield larger drops than those containing little or no water; but very different results are obtained with the same liquid, dropped from different bottles, or even from the same bottle under different conditions; the differences amount frequently to 50, and occasionally to 200 per cent. For these reasons medicated liquids should not be ordered in drops, but preferably by weight or measure; and whenever it is desirable for the patient to take a medicine by drops, the dose may be approximated by estimating each minim to contain of—

Ether and ethereal solutions	2½ to 3 drops.
Tinctures, alcoholic solutions, and volatile oils	1½ to 2 or 2½ drops.
Medicated wines	1 to 1½ drop.
Water and aqueous solutions	¾ to 1 drop.

In order to avoid to some extent the discrepancies resulting from the dropping of liquids under various conditions, dropping measures (*compte-gouttes*) have been constructed in France, yielding at 15° C. drops of distilled water, twenty of which weigh one gram, at least within a limit of 5 per cent.

Table showing the Relation of the Degrees of Baumé's Hydrometers to Specific Gravities.

The hydrometers most frequently used in the United States are those constructed upon the plan of Baumé. For liquids *heavier* than water, the point to which the instrument sinks in pure water is 0, and the point to which it sinks in a solution of 15 parts of dry table-salt in 85 parts of water, is marked 15, the distance between the two points being divided into 15 equal parts, and the scale continued with divisions of the same size. For liquids *lighter* than water, the instrument is floated in a solution of 10 parts of dry table-salt in 90 parts of water, and afterwards in pure water, the distance being divided into ten equal parts and the scale continued in like manner; the point indicating the density of water is marked 10. The hydrometers were originally constructed at a *medium* temperature. In the United States they are made for the temperature of 60° (15.55° C.), and the scales as originally published by Henry Pemberton (1852) are recognized. They agree closely with the determinations made by Schober and Pescher for liquids heavier than water, and differ but little for liquids lighter than water.

Cartier's hydrometer, which is occasionally employed in France, agrees with Baumé's scale for liquids lighter than water, except that 16° of the latter are equal to 15° Cartier.

For Liquids Heavier than Water.

Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.
0	1.0000	16	1.1240	32	1.2831	48	1.4949	64	1.7901
1	1.0069	17	1.1328	33	1.2946	49	1.5104	65	1.8125
2	1.0139	18	1.1417	34	1.3063	50	1.5263	66	1.8354
3	1.0211	19	1.1507	35	1.3181	51	1.5425	67	1.8589
4	1.0283	20	1.1600	36	1.3302	52	1.5591	68	1.8831
5	1.0357	21	1.1693	37	1.3425	53	1.5760	69	1.9079
6	1.0431	22	1.1788	38	1.3551	54	1.5934	70	1.9333
7	1.0507	23	1.1885	39	1.3679	55	1.6111	71	1.9595
8	1.0583	24	1.1983	40	1.3809	56	1.6292	72	1.9863
9	1.0661	25	1.2083	41	1.3942	57	1.6477	73	2.0139
10	1.0740	26	1.2184	42	1.4077	58	1.6666	74	2.0422
11	1.0820	27	1.2288	43	1.4215	59	1.6860	75	2.0714
12	1.0902	28	1.2393	44	1.4356	60	1.7058		
13	1.0984	29	1.2500	45	1.4500	61	1.7261		
14	1.1068	30	1.2608	46	1.4646	62	1.7469		
15	1.1153	31	1.2719	47	1.4795	63	1.7682		

For Liquids Lighter than Water.

Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.
10	1.0000	23	0.9150	36	0.8433	49	0.7821	62	0.7290
11	0.9929	24	0.9090	37	0.8383	50	0.7777	63	0.7253
12	0.9859	25	0.9032	38	0.8333	51	0.7734	64	0.7216
13	0.9790	26	0.8974	39	0.8284	52	0.7692	65	0.7179
14	0.9722	27	0.8917	40	0.8235	53	0.7650	66	0.7142
15	0.9655	28	0.8860	41	0.8187	54	0.7608	67	0.7106
16	0.9589	29	0.8805	42	0.8139	55	0.7567	68	0.7070
17	0.9523	30	0.8750	43	0.8092	56	0.7526	69	0.7035
18	0.9459	31	0.8695	44	0.8045	57	0.7486	70	0.7000
19	0.9395	32	0.8641	45	0.8000	58	0.7446	71	0.6965
20	0.9333	33	0.8588	46	0.7954	59	0.7407	72	0.6930
21	0.9271	34	0.8536	47	0.7909	60	0.7368	73	0.6896
22	0.9210	35	0.8484	48	0.7865	61	0.7329	74	0.6863

Table for Comparing Gay-Lussac's and Tralles's Alcoholometers.

Both scales indicate the percentage of alcohol *by volume*. Gay Lussac's alcoholometer is constructed upon the normal temperature of 15° C. (59° F.) for both the alcoholic liquid and water. The specific gravities of Tralles's alcoholometer refer to the weight of the alcoholic liquid at 15.55° C. (60° F.) compared with the weight of water at 3.9° C. (39°F).

Per ct. by volume.	Specific gravity.		Per ct. by volume.	Specific gravity.		Per ct. by volume.	Specific gravity.		Per ct. by volume.	Specific gravity.	
	Gay Lussac.	Tralles.		Gay Lussac.	Tralles.		Gay Lussac.	Tralles.		Gay Lussac.	Tralles.
1	9985	9976	26	9700	9689	51	9329	9315	76	8753	8739
2	9970	9961	27	9690	9679	52	9309	9295	77	8729	8712
3	9956	9947	28	9679	9668	53	9289	9275	78	8699	8685
4	9942	9933	29	9668	9657	54	9269	9254	79	8672	8658
5	9929	9919	30	9657	9646	55	9248	9234	80	8645	8631
6	9916	9906	31	9645	9634	56	9227	9213	81	8617	8603
7	9903	9893	32	9633	9622	57	9206	9192	82	8589	8575
8	9891	9881	33	9621	9609	58	9185	9170	83	8560	8547
9	9878	9869	34	9608	9596	59	9163	9148	84	8531	8518
10	9867	9857	35	9594	9583	60	9143	9126	85	8502	8488
11	9855	9845	36	9581	9570	61	9119	9104	86	8472	8458
12	9844	9834	37	9567	9559	62	9096	9082	87	8442	8428
13	9833	9823	38	9553	9541	63	9073	9059	88	8411	8397
14	9822	9812	39	9538	9526	64	9050	9036	89	8379	8365
15	9812	9802	40	9523	9510	65	9027	9013	90	8346	8332
16	9802	9791	41	9507	9494	66	9004	8989	91	8312	8299
17	9792	9781	42	9491	9478	67	8980	8965	92	8278	8265
18	9782	9771	43	9474	9461	68	8956	8941	93	8242	8230
19	9773	9761	44	9457	9444	69	8932	8917	94	8206	8194
20	9763	9751	45	9440	9427	70	8907	8892	95	8168	8157
21	9753	9741	46	9422	9409	71	8882	8867	96	8128	8118
22	9742	9731	47	9404	9391	72	8857	8842	97	8086	8077
23	9732	9720	48	9386	9373	73	8831	8817	98	8042	8034
24	9721	9710	49	9367	9354	74	8805	8791	99	7986	7988
25	9711	9700	50	9348	9335	75	8779	8765	100	7947	7948

Table for comparing degrees of the Centigrade and Fahrenheit Thermometers.

Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.
—40°	—40.0°	+21°	+ 69.8°	+ 81°	+177.8°	+141°	+285.8°	+201°	+393.8°
39	38.2	22	71.6	82	179.6	142	287.6	202	395.6
38	36.4	23	73.4	83	181.4	143	289.4	203	397.4
37	34.6	24	75.2	84	183.2	144	291.2	204	399.2
36	32.8	25	77.0	85	185.0	145	293.0	205	401.0
35	31.0	26	78.8	86	186.8	146	294.8	206	402.8
34	29.2	27	80.6	87	188.6	147	296.6	207	404.6
33	27.4	28	82.4	88	190.4	148	298.4	208	406.4
32	25.6	29	84.2	89	192.2	149	300.2	209	408.2
31	23.8	30	86.0	90	194.0	150	302.0	210	410.0
30	22.0	31	87.8	91	195.8	151	303.8	211	411.8
29	20.2	32	89.6	92	197.6	152	305.6	212	413.6
28	18.4	33	91.4	93	199.4	153	307.4	213	415.4
27	16.6	34	93.2	94	201.2	154	309.2	214	417.2
26	14.8	35	95.0	95	203.0	155	311.0	215	419.0
25	13.0	36	96.8	96	204.8	156	312.8	216	420.8
24	11.2	37	98.6	97	206.6	157	314.6	217	422.6
23	9.4	38	100.4	98	208.4	158	316.4	218	424.4
22	7.6	39	102.2	99	210.2	159	318.2	219	426.2
21	5.8	40	104.0	100	212.0	160	320.0	220	428.0
20	4.0	41	105.8	101	213.8	161	321.8	221	429.8
19	2.2	42	107.6	102	215.6	162	323.6	222	431.6
18	0.4	43	109.4	103	217.4	163	325.4	223	433.4
17	+ 1.4	44	111.2	104	219.2	164	327.2	224	435.2
16	3.2	45	113.0	105	221.0	165	329.0	225	437.0
15	5.0	46	114.8	106	222.8	166	330.8	226	438.8
14	6.8	47	116.6	107	224.6	167	332.6	227	440.6
13	8.6	48	118.4	108	226.4	168	334.4	228	442.4
12	10.4	49	120.2	109	228.2	169	336.2	229	444.2
11	12.2	50	122.0	110	230.0	170	338.0	230	446.0
10	14.0	51	123.8	111	231.8	171	339.8	231	447.8
9	15.8	52	125.6	112	233.6	172	341.6	232	449.6
8	17.6	53	127.4	113	235.4	173	343.4	233	451.4
7	19.4	54	129.2	114	237.2	174	345.2	234	453.2
6	21.2	55	131.0	115	239.0	175	347.0	235	455.0
5	23.0	56	132.8	116	240.8	176	348.8	236	456.8
4	24.8	57	134.6	117	242.6	177	350.6	237	458.6
3	26 6	58	136.4	118	244.4	178	352.4	238	460.4
2	28.4	59	138.2	119	246.2	179	354.2	239	462.2
1	30.2	60	140.0	120	248.0	180	356.0	240	464.0
0	32.0	61	141.8	121	249.8	181	357.8	241	465.8
+ 1	33.8	62	143.6	122	251.6	182	359.6	242	467.6
2	35.6	63	145.4	123	253.4	183	361.4	243	469.4
3	37.4	64	147.2	124	255.2	184	363.2	244	471.2
4	39.2	65	149.0	125	257.0	185	365.0	245	473.0
5	41.0	66	150.8	126	258.8	186	366.8	246	474.8
6	42.8	67	152.6	127	260.6	187	368.6	247	476.6
7	44.6	68	154.4	128	262.4	188	370.4	248	478.4
8	46.4	69	156.2	129	264.2	189	372.2	249	480.2
9	48.2	70	158.0	130	266.0	190	374.0	250	482.0
10	50.0	71	159.8	131	267.8	191	375.8	260	500.0
11	51.8	72	161.6	132	269.6	192	377.6	280	536.0
12	53.6	73	163.4	133	271.4	193	379.4	300	572.0
13	55.4	74	165.2	134	273.2	194	381.2	350	662.0
14	57.2	75	167.0	135	275.0	195	383.0	400	752.0
15	59.0	76	168.8	136	276.8	196	384.8	450	842.0
16	60.8	77	170.6	137	278.6	197	386.6	500	932.0
17	62.6	78	172.4	138	280.4	198	388.4	600	1112.0
18	64.4	79	174.2	139	282.2	199	390.2	700	1292.0
19	66.2	80	176.0	140	284.0	200	392.0	800	1472.0
20	68.0								

Réaumur's scale is rarely used at the present time; the freezing point of water is indicated by 0, and the boiling point by 80°. Therefore 4 degrees of Réaumur are equal to 5 degrees of Centigrade and to 9 degrees of Fahrenheit. The freezing point of water in Fahrenheit's scale is at 32°.

TABLE OF ELEMENTS.

	Symbols.	Atomic value.	Atomic weight.
Aluminium	Al	III	27.5
Antimony (Stibium)	Sb	III, V	122
Arsenic	As	III, V	75
Barium	Ba	II	137
Beryllium	Be	II	9.5
Bismuth	Bi	III, V	210
Boron	B	III	11
Bromine	Br	I	80
Cadmium	Cd	II	112
Cæsium	Cs	I	133
Calcium	Ca	II	40
Carbon	C	II, IV	12
Cerium	Ce	II, VI	92
Chlorine	Cl	I	35.5
Chromium	Cr	III, VI	52.5
Cobalt	Co	II, VI	58.8
Copper (Cuprum)	Cu	II	63.5
Decipium	Dp	II	106
Didymium	D	II	96
Erbium	Eb	II	112.6
Fluorine	F	I	19
Gallium	Ga	I	68
Gold (Aurum)	Au	I, III	197
Hydrogen	H	I	1
Ilmenium	Il	V	105
Indium	In	II	75.6
Iodine	I	I	127
Iridium	Ir	IV	198
Iron (Ferrum)	Fe	II, III, VI	56
Lanthanum	La	II	93.6
Lavœsium	Lv	?	?
Lead (Plumbum)	Pb	II, IV	207
Lithium	Li	I	7
Magnesium	Mg	II	24
Manganesium	Mn	II, IV, VI	55
Mercury (Hydrargyrum)	Hg	II	200
Molybdenum	Mo	VI	96

	Symbols.	Atomic value.	Atomic weight.
Mosandrium	Ms	II	?
Neptunium	Np	V	118
Nickel	Ni	II, VI	58.8
Niobium	Nb	V	94
Nitrogen	N	I, III, V	14
Osmium	Os	IV	199
Oxygen	O	II	16
Palladium	Pd	IV	106.6
Philippium	Pp	II	74
Phosphorus	P	III, V	31
Platinum	Pt	IV	198
Potassium (Kalium)	K	I	39
Rhodium	Rh	IV	104.4
Rubidium	Rb	I	85.4
Ruthenium	Ru	IV	104.4
Selenium	Se	VI	79.4
Silicium	Si	IV	28
Silver (Argentum)	Ag	I	108
Sodium (Natrium)	Na	I	23
Strontium	Sr	II	87.5
Sulphur	S	II, IV, VI	32
Tantalum	Ta	V	182
Tellurium	Te	VI	128
Terbium	Tb	II	98
Thallium	Tl	III	204
Thorium	Th	II, IV	235
Tin (Stannum)	Sn	II, IV	118
Titanium	Ti	IV	50
Tungsten or Wolfram	W	VI	184
Uranium	U	IV, VI	240
Vanadium	V	V	51.2
Ytterbium	Yb	II	115?
Yttrium	Y	III	92
Zinc	Zn	II	65
Zirconium	Zr	IV	89.6

LIST OF REAGENTS.

Employed in Chemical Testing, According to the British and German Pharmacopœias.

1. *General Reagents and Test Solutions.*

Acetic acid: Acetic acid, spec. grav. 1.040 to 1.047.

Boracic acid: Boracic acid dissolved in 8 parts of alcohol.

Hydrochloric acid: Pure hydrochloric acid, spec. grav. 1.12 to 1.16.

Nitric acid: Pure nitric acid, spec. grav. 1.185.

Oxalic acid: Oxalic acid, purified by recrystallization and dissolved in 10 parts of distilled water.

Sulphydric acid: Sulphuretted hydrogen gas generated from sulphide of iron and diluted sulphuric acid.

Sulphuric acid: Sulphuric acid, spec. grav. 1.830 to 1.840.

Diluted sulphuric acid: Sulphuric acid, spec. grav. 1.082 to 1.094.

Tannic acid: Tannic acid, dissolved in 9 parts of distilled water, with 1 part of alcohol.

Tartaric acid: Tartaric acid, dissolved in 8 parts of distilled water with 2 parts of alcohol.

Albumen: The white of one egg dissolved in 4 ounces of distilled water.

Alcohol and *Absolute alcohol:* (See page 122.)

Ammonia water: Pure ammonia water, spec. grav. 0.960.

Carbonate of ammonium: Carbonate of ammonium in small pieces, dissolved in 20 parts of distilled water.

Chloride of ammonium: Purified chloride of ammonium dissolved in 10 parts of distilled water.

Oxalate of ammonium: Crystallized oxalate of ammonium dissolved in 20 parts of distilled water.

Sulphydrate of ammonia: Three ounces of ammonia water are saturated with sulphuretted hydrogen; to this liquid 2 ounces of ammonia water are added.

Chloride of barium: Chloride of barium dissolved in 10 parts of distilled water.

Nitrate of barium: Nitrate of barium dissolved in 20 parts of distilled water.

Benzol: (See page 281.)

Bromine water: Bromine dissolved in 40 parts of distilled water.

Lime-water: A saturated solution of hydrate of calcium in distilled water.

Chloride of calcium: Chloride of calcium dissolved in 10 parts of distilled water.

Saturated solution of chloride of calcium: Chloride of calcium 4 parts, dissolved in 5 parts of distilled water.

Sulphate of calcium: A saturated solution of sulphate of calcium in distilled water.

Bisulphide of carbon: (See page 348.)

Chlorine water: A saturated solution of chlorine gas in distilled water.

Chloroform: (See page 398.)

Copper: Pure thin and bright copper foil.

Acetate of copper: Subacetate of copper 1 part, acetic acid 2 parts, distilled water sufficient for obtaining 10 parts of filtrate.

Ammonio-sulphate of copper: Crystallized sulphate of copper 1 part, distilled water 15 parts; dissolve, add ammonia water until the precipitate formed is nearly redissolved, filter and add water to obtain 20 parts.

Anhydrous sulphate of copper: Sulphate of copper deprived of its water of crystallization by a heat of 205° C. (400° F.).

Sulphate of copper: Crystallized sulphate of copper dissolved in 10 parts of distilled water.

Ether: (See page 106.)

Gelatin: Russian isinglass dissolved in 40 parts of warm distilled water.

Gold: Pure metallic gold.

Chloride of gold: The chloride obtained from 1 part of metallic gold (see page 260), dissolved in 36 parts of distilled water.

Sulphate of indigo or *Indigo solution:* Heat in a water-bath for one hour indigo 1 part, in sulphuric acid 20 parts; then add to sulphuric acid 1600 parts, and decant from the undissolved powder.

Tincture of iodine: (See page 1413.)

Perchloride of iron: Solution of ferric chloride (see page 829) diluted with 5 parts of distilled water.

Sulphate of iron: Ferrous sulphate precipitated by alcohol (see page 631).

Sulphate of iron solution: Pure ferrous sulphate dissolved in 40 parts of distilled water.

Sulphide of iron: (See page 633.)

Acetate of lead: Crystallized acetate of lead dissolved in 10 parts of distilled water.

Tincture of litmus: Litmus 1 part, diluted alcohol 10 parts.

Blue litmus paper: Unsized white paper steeped in tincture of litmus.

Red litmus paper: Unsized white paper steeped in tincture of litmus previously reddened by a very minute quantity of dilute sulphuric acid.

Ammonio-sulphate of magnesium: Sulphate of magnesium 2 parts; chloride of ammonium and ammonia water, of each 1 part; distilled water 18 parts; dissolve and filter.

Sulphate of magnesium: Sulphate of magnesium dissolved in 10 parts of distilled water.

Perchloride of mercury: Corrosive sublimate dissolved in 20 parts of distilled water.

Platinum black: Platinum in a state of minute division, obtained by adding excess of carbonate of sodium and some sugar to solution of perchloride of platinum, and boiling until a black precipitate is formed, which is washed and dried.

Perchloride of platinum: Dissolve platinum in nitro-muriatic acid, evaporate the solution in a water-bath until vapors cease to be given off, and dissolve the residue in 20 parts of distilled water.

Acetate of potassium: Acetate of potassium dissolved in 5 parts of distilled water.

Bichromate of potassium: Bichromate of potassium dissolved in 10 parts of distilled water.

Ferridcyanide of potassium: Ferridcyanide of potassium dissolved in 10 parts of distilled water.

Ferrocyanide of potassium: Ferrocyanide of potassium dissolved in 10 parts of distilled water.

Iodate of potassium: Digest 5 parts each of iodine and chlorate of potassium, 1 part of nitric acid, and 20 parts of water, until the color of iodine disappears; boil for a minute, evaporate to perfect dryness at 100° C. (212° F.), and dissolve the residue in 430 parts of distilled water.

Iodide of potassium: Iodide of potassium dissolved in 20 parts of distilled water.

Permanganate of potassium: Permanganate of potassium dissolved in 10,000 parts of distilled water.

Sulphate of potassium: Sulphate of potassium dissolved in 15 parts of distilled water.

Sulphocyanide of potassium: Sulphocyanide of potassium dissolved in 20 parts of distilled water.

Ammonio-nitrate of silver: Crystallized nitrate of silver 1 part, ammonia water 2 parts, distilled water sufficient to make 40 parts; filter.

Nitrate of silver: Nitrate of silver dissolved in 20 parts of distilled water.

Sulphate of silver: Sulphate of silver dissolved in 100 parts of distilled water.

Solution of soda: (See page 850.)

Acetate of sodium: Acetate of sodium dissolved in 10 parts of distilled water.

Carbonate of sodium: Pure carbonate of sodium dissolved in 10 parts of distilled water.

Hypophosphite of sodium: Hypophosphite of sodium dissolved in 10 parts of distilled water.

Phosphate of sodium: Pure phosphate of sodium dissolved in 10 parts of distilled water.

Starch: (See page 168.)

Chloride of tin: Heat moderately granulated tin 2 parts, hydrochloric acid 7 parts, and water 2 parts, until gas ceases to be evolved; then dilute with sufficient distilled water to obtain 12 parts, and preserve the liquid together with the undissolved tin.

Tincture of turmeric: Bruised turmeric 1 part, alcohol 5 parts.

Turmeric paper: Unsized white paper steeped in tincture of turmeric.

Zinc: Chemically pure metallic zinc.

2. *Test Solutions for Volumetric Estimations.*

The British Pharmacopœia recommends volumetric estimations to be made by means of metric weights and measures, but, for the convenience of those who have not the necessary apparatus and weights, expresses the quantities of test solutions employed in testing in *grain measures*, the grain measure being the volume of a grain of distilled water at 15.55° C. (60° F.). Weight and measure of each system bear to each other precisely the same relation; but since the *gram* is more than 15 times greater than the *grain*, it will be found convenient, in employing the metric system, to reduce the values of all the numbers to one-tenth of the values of the grains and grain measures.

In the following we give preference to the metric system, this being the one generally employed in the United States in volumetric analysis, while the British grain measures are almost unknown in this country.

Volumetric solution of bichromate of potassium ($K_2Cr_2O_7 = 295$). Take of bichromate of potassium 14.75 grams, distilled water sufficient for obtaining 1000 cubic centimeters (1 liter) of solution. 100 cubic centimeters of this solution are capable of converting 1.68 grams of iron from the state of protosalt to that of persalt. The solution is used for determining the proportion of protoxide of iron, and the protosalt is known to have been converted into a persalt when a minute drop of the liquid, placed in contact with a drop of the solution of ferridcyanide of potassium on a white plate, ceases to strike with it a blue color.

Or dissolve 147.5 grains of bichromate of potassium in sufficient distilled water to obtain 10,000 grain measures; 1000 grain measures of this solution are capable of converting 16.8 grains of iron from the state of protosalt to that of persalt.

Volumetric solution of hyposulphite of sodium ($Na_2H_2S_2O_4.4H_2O = 248$). Take of hyposulphite of sodium in crystals 28 grams, distilled water sufficient for obtaining 1000 cubic centimeters (1 liter) of solution. Drop this solution from a burette cautiously into 100 cubic centimeters of the volumetric solution of iodine until the brown color is just discharged. Note the number of cubic centimeters (n) required to produce this effect; then put 800 cubic centimeters of the same solution into a graduated jar and augment this quantity by the addition of distilled water until it amounts to $\frac{800 \times 100}{n}$ cubic centimeters. If, for example, $n = 95$, the 800 cubic centimeters of solution should be diluted to $\frac{800 \times 100}{95} = 842.1$ cubic centimeters. 100 cubic centimeters of this solution correspond to 1.27 grams of iodine ($\frac{1}{100}$ of an equivalent).

Grains and grain measures may be employed instead of grams and cubic centimeters, but ten times the numbers should be taken; 1000 grain measures of this solution will correspond to 12.7 grains of iodine (one-tenth of an equivalent).

Volumetric solution of iodine ($I = 127$).—Take of iodine 12.7 grams, iodide of potassium 18.0 grams, distilled water sufficient for obtaining 1000 cubic centimeters (1 liter) of solution. 100 cubic centimeters of this solution correspond to 0.17 gram of sulphuretted hydrogen, 0.32 gram of sulphurous, and 0.495 gram of arsenious acid.

Grains and grain measures may be employed instead of grams and cubic centimeters; but ten times the numbers should be taken; 1000 grain measures of this solution correspond to 1.7 grains of sulphuretted hydrogen, 3.2 grains of sulphurous, and 4.95 grains of arsenious acid.

Volumetric solution of nitrate of silver ($AgNO_3 = 170$).—Take of nitrate of silver 17 grams, distilled water sufficient for obtaining 1000 cubic centimeters (1 liter) of solution. 100 cubic centimeters of this solution contain $\frac{1}{100}$ of an equivalent in grams of nitrate of silver (or 1.7 grams).

Grains and grain measures may be employed instead of grams and cubic centimeters, but ten times the numbers should be taken. 1000 grain measures contain $\frac{1}{10}$ of an equivalent (or 17.0 grains) in nitrate of silver.

Volumetric solution of oxalic acid ($H_2C_2O_4.2H_2O = 126$).—Take of purified oxalic acid in crystals, quite dry but not effloresced, 63 grams, distilled water sufficient for obtaining 1000 cubic centimeters (1 liter) of solution. 100 cubic centimeters of this solution contain $\frac{1}{20}$ of an equivalent in grams of oxalic acid, and will neutralize $\frac{1}{10}$ of an equivalent in grams of an alkali or alkaline carbonate.

Grains and grain measures may be employed instead of grams and cubic centimeters, but ten times the numbers should be taken. 1000 grain measures are capable of neutralizing one equivalent in grains of an alkali or alkaline carbonate.

Volumetric solution of soda ($NaHO = 40$).—Take of solution of caustic soda a sufficiency. Drop it cautiously from a burette into 100 cubic centimeters of volumetric solution of oxalic acid until the acid is exactly neutralized as indicated by litmus. Note the number of cubic centimeters (n) of the solution used, and having introduced

900 cubic centimeters of the soda solution into a graduated jar, augment this quantity by the addition of water until it becomes $\frac{900 \times 100}{n}$ cubic centimeters. If, for example, $n = 93$, the 900 cubic centimeters should be augmented to $\frac{900 \times 100}{93} = 967.7$ cubic centimeters. 100 cubic centimeters of this solution contain $\frac{1}{10}$ of an equivalent in grams (4 grams) of hydrate of sodium, and will neutralize $\frac{1}{10}$ of an equivalent in grams of any monobasic acid.

Grains and grain measures may be employed instead of grams and cubic centimeters, but ten times the numbers should be taken. 1000 grain measures contain one equivalent in grains (40 grains) of hydrate of sodium, and will neutralize one equivalent in grains of any monobasic acid.

GENERAL INDEX.

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